

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------------|---------------------------|------------|
| <i>Euphilotes battoides allyni</i> | El Segundo blue butterfly | 419 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

When the El Segundo blue butterfly was listed as endangered in 1976, there were only two locations known to be occupied by the subspecies. About 86% of the subspecies' historical habitat has been lost to development. The remaining El Segundo blue butterfly habitat suitable for long-term conservation and restoration is limited to about 451 ac (182 ha). Only three disjunct locations (Airport Dunes, Chevron Preserve, and the beach bluffs between Malaga Cove and Redondo Beach) currently support occupied sites.

Although none of the occupied sites are currently threatened by development, their long-term conservation is not assured. El Segundo blue butterfly habitat is easily degraded by competition with non-native vegetation if not actively managed to sustain host plants. Thus, habitat degradation due to the lack of long-term conservation status and management is a major threat precluding the recovery of this subspecies. In consideration of its limited and fragmented distribution, overall small population size, and continued threats as described above, the El Segundo blue butterfly remains at risk of extinction throughout all or a significant portion of its range. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Sources: U.S. Fish and Wildlife Service. 2008. El Segundo Blue Butterfly (*Euphilotes battoides allyni*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, California. 39 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for El Segundo Blue Butterfly (*Euphilotes battoides allyni*) – Amendment. 17 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of El Segundo blue butterflies exposed to malathion at maximum rates varies between use sites, with 1-12% expected to experience mortality in orchards and vineyards, vegetables and ground fruit, open space developed, and developed use sites, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 21% |
| Spray drift areas – mortality | up to 42% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to symbiotic ants | 21% |
| Spray drift areas – effects to symbiotic ants | Up to 42% |
| Plants affected – decline in growth | 17% |
| MOSQUITO CONTROL | |
| Direct mortality | 64% |
| Sublethal | NA |
| Indirect - mortality | 64% arthropods (symbiotic ants) |

Risk modifiers:

The El Segundo blue adult stage typically ranges from four days to two weeks and normally commences in mid-June and lasts until early September. Adults consume coast buckwheat pollen and nectar, and mate and lay eggs on coast buckwheat flowers. Eggs hatch within three to five days, and larvae undergo four instars prior to pupation. During the larval stage, individuals remain concealed within flower heads and upon pupation (change from larval to pupal stage), individuals fall to the ground and remain buried either underground or in the leaf litter at the base of the coast buckwheat for one or more years until they emerge as adult butterflies (US FWS SOS 2016). Some pupae remain in diapause for 2 or more years (USFWS 1998). Because the height of feeding and reproductive activities for this butterfly occurs from mid-June through early September (US FWS 2008), it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle.

The El Segundo blue is myrmecophilous. The larvae develop glands and reversible tubes that produce a sweet secretion by the third instar and are thereafter tended by various species of ants (*Linepithema humile* or *Conomyrmex* species) (US FWS SOS 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 190,886 | 64.0 | 0 | 0 |
| Nurseries | D,I | 1,577 | 0.05 | 156 | 0.05 |
| Vegetables and Ground Fruit | D,I | 6,828 | 2.29 | 6,827 | 2.29 |
| Developed | D,I | 35,679 | 11.99 | 1,784 | 0.6 |
| Open Space Developed | D,I | 12,980 | 4.36 | 649 | 0.22 |
| Orchards and Vineyards | D,I | 3,550 | 1.19 | 0 | 0 |
| Other Crops | D,I | 1,871 | 0.63 | 0 | 0 |
| Other Grains | D,I | 821 | 0.28 | 0 | 0 |
| Pasture | D,I | 602 | 0.2 | 0 | 0 |
| Wheat | D,I | 448 | 0.15 | 0 | 0 |
| Cotton | D,I | 60 | 0.02 | 0 | 0 |
| Corn | D,I | 55 | 0.02 | 0 | 0 |
| Rice | D,I | 8 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 65,053 | 21.2 | 9,416 | 3.16 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 63,053 | 21.2 | 9,416 | 3.16 |
| TOTAL⁴: | | 253,939 | 85.2 | 9,416 | 3.16 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

acres in species range: 297,575 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 102,651 acres, 34.4%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality and sub-lethal effects to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the “other crops” UDLs will prohibit application of malathion within three days prior to bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in these use areas where it occurs in or around the range of the El Segundo blue butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the El Segundo blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to

malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The El Segundo blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 21.0% mortality of individuals, up to 42.0% mortality from spray drift, a loss of about 21.0% to symbiotic ants in use areas, and an additional loss of up to 42.0% of symbiotic ants due to spray drift. In addition, there could be up to 64.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.16% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar usage levels in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the El Segundo butterfly exists mainly in Los Angeles County, thus putting it in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), and to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be adversely affected over the duration of the Action (in the form of the loss of a small number of individuals) as described above, we do not anticipate species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate the proposed action would appreciably reduce survival and recovery of the El Segundo blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------------|-----------------------|------------|
| <i>Lycaeides melissa samuelis</i> | Karner blue butterfly | 420 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: All populations stable, with none known to be increasing or decreasing

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The historical range of the species in the United States has not changed although changes in the distribution of the species within its historic range have occurred since listing (USFWS 2012). The species formerly occurred in a band extending across 12 states from Minnesota to Maine and in the province of Ontario, Canada (USFWS 2003). Karner blue butterflies (KBBs) are likely no longer present in Illinois, Minnesota, Indiana, and Ontario. In New Hampshire, New York, and Ohio, KBB populations are declining and/or are found in very low numbers. Wisconsin populations are the largest and most widespread, and as of the 2019 5-Year Review, Wisconsin populations were reported to be rebounding from a population decrease in 2012 due to widespread drought. Through surveys carried out at Concord Pine Barrens, New Hampshire, within native and restored wild lupine (*Lupinus perennis*) KBB habitat, Pascale and Thiet (2016, p. 633) found that both native and restored wild lupine supported both KBBs and the species' larval-tending ants. Hallfors et al. (2016, p. 1157) performed principal component analyses to explore whether occurrences of KBBs are segregated by climatic variables and to identify potential climatically distinct populations. Their analyses found that KBB showed distinct clustering; two distinct groups were identifiable. The eastern population (KBBEast) consisted of occurrences in Illinois, Indiana, Michigan, Ohio, New York, and New Hampshire and Ontario, Canada and the western population (KBBWest) consisted of occurrences in Minnesota and Wisconsin. Swengel and Swengel (2018) compared survey trends on Wisconsin sites over 17 years for the KBB. Although the authors reported declines for the species, they found higher trends in abundance at "reserve" properties (those "where recovery would be expected to occur") than rights-of-way and forestry land and suggested a higher level of habitat management as the reason for this result.

Major threats have not been ameliorated and the criteria for downlisting to threatened has not been met. Declining populations and loss of habitat in Minnesota, Indiana, and New York are not compensated for by the more numerous populations in Wisconsin. Threats persist for the species in all states including loss of habitat due to natural succession, lack of management, invasive species and commercial, industrial and residential development. In addition, KBB adults react to

potential predators by rapidly flying away from the perceived threat (Bennett et al. 2013). This has negative implications for fecundity and host plant selection, both of which strongly influence population dynamics (Bennett et al. 2013).

The KBB is now thought to be extirpated at the southern edge of its range in Indiana. The population at Indiana Dunes National Park (INDU) declined in conjunction with documented warming conditions, despite habitat management, restoration, and population augmentation efforts (Hellmann et al. 2016, p. 93). Due in part to this discovery, the KBB recovery team recently designated a climate change sub-team tasked with exploring the species' sensitivity to climate change and its adaptive capacity. As discussed in their draft report, KBB likely has low adaptive capacity to tolerate changes associated with climate change, due to the limited capacity to adapt via dispersal, changing behavior (e.g., single larval host plant), or evolving in place. Further, the species' vulnerability to the direct and indirect effects of climate change to it and its host plant, wild lupine, is high.

EB/CE Sources: U.S. Fish and Wildlife Service. 2012. Karner Blue Butterfly (*Lycaeides melissa samuelis*) 5-Year Review: Summary and Evaluation. Ecological Services Field Office, New Franken, Wisconsin. 129 pp.

U.S. Fish and Wildlife Service. 2019. Karner Blue Butterfly (*Lycaeides melissa samuelis*) 5-Year Review: Summary and Evaluation: Minnesota-Wisconsin Field Office, Bloomington, Minnesota. 27 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Karner blue butterflies exposed to malathion at maximum rates varies between use sites, with 4-10% expected to experience mortality in developed, open space developed, pasture, and corn use sites, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|-----------|
| Use areas – mortality | 25% |
| Spray drift areas – mortality | up to 71% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |

| | |
|--|---|
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 8% of use sites could affect plants (decline in growth) |
| MOSQUITO CONTROL | |
| Direct - mortality | 5% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers: The Karner blue butterfly is known to frequent roadsides, military bases, and forests in search of the nectar/pollen from a nectar plant (Recovery Plan 2003) during the adult stage and may be more likely than a larvae to be exposed to pesticide use in these scenarios.

The Karner blue butterfly usually has two generations, and thus two hatches, each year. In April, the first group of caterpillars hatch from eggs that were laid the previous year (overwintered eggs). These individuals mature and lay eggs in June on or near wild lupine plants, which become the second generation of adult butterflies appearing in July. These adults mate and lay eggs that will not hatch until the following spring. April through July is the height of breeding and feeding activity for these butterflies, therefore, the Karner blue may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made from April through July, however it is potentially exposed throughout its entire lifecycle.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 1,028,980 | 5.19 | <0.01 | 0 |
| Corn | D,I | 2,039,044 | 10.28 | 61,180 | 0.31 |
| Pasture | D,I | 893,555 | 4.5 | 96,746 | 0.49 |
| Open Space Developed | D,I | 848,644 | 4.28 | 42,432 | 0.21 |
| Developed | D,I | 751,550 | 3.79 | 37,577 | 0.19 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Vegetables and Ground Fruit | D,I | 182,776 | 0.92 | 22,315 | 0.11 |
| Wheat | D,I | 148,257 | 0.75 | 29,514 | 0.15 |
| Other Grains | D,I | 67,943 | 0.34 | 9,097 | 0.05 |
| Other Crops | D,I | 62,409 | 0.31 | 0 | 0 |
| Orchards and Vineyards | D,I | 46,582 | 0.23 | 2,934 | 0.01 |
| Christmas Trees | D,I | 6,921 | 0.03 | 5,264 | 0.03 |
| Nurseries | D,I | 5,426 | 0.03 | 5,426 | 0.03 |
| Other Row Crops | D,I | 2,240 | 0.01 | 1,542 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 5,055,347 | 25.48 | 314,028 | 1.59 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 5,055,347 | 25.48 | 314,028 | 1.59 |
| TOTAL⁴: | | 6,084,333 | 30.67 | 314,028 | 1.59 |

acres in species range: 19,841,209 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 1,437,062 acres, 7.24%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality and sub-lethal effects to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Karner blue butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Karner blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Karner blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 25.0% mortality of individuals, up to 71.0% mortality from spray drift. In addition, there could be up to 5.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.59% of the non-Federal portion of the species range annually based on standard past usage data. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, blooming alfalfa (alfalfa equates to the pasture UDL) is likely to attract Karner blue butterflies in the immediate vicinity in search of a nectar source. The conservation measure to be implemented prohibits malathion application while alfalfa is in bloom and until petal fall is complete, thus limiting exposure to the individuals of this species living in and around this crop type. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Karner blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------|-----------------------------|------------|
| <i>Apodemia mormo langei</i> | Lange's metalmark butterfly | 421 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

When listed in 1976 and 1978, there were small occurrences of Lange's metalmark butterfly in the Antioch Dunes area of Contra Costa County, occupying the remaining 10% of the original riverine sand dune habitat. The population of Lange's metalmark butterfly has either declined since then or has not been able to produce self-sustainable populations. The Lange's metalmark is a relatively small butterfly (18-27 mm wingspan) and it produces one brood per year. All life stages of Lange's metalmark are closely tied to *Eriogonum nudum* var. *psychicola* (formerly var. *auriculatum*), hereafter referred to as Antioch Dunes buckwheat. This host plant, also endemic to the Antioch Dunes, serves as the primary nectar source for adult butterflies, as sites for oviposition, and as the larval foodplant (Arnold, 1978). However, Antioch Dunes buckwheat may not be utilized by the Lange's metalmark until plants are about three years old, when it is able to produce robust flowers (Arnold, 1983). Antioch Dunes buckwheat is a perennial forb that requires sandy, well-drained soils and some form of disturbance, preferably by natural processes such as wind or erosion, to shift the sand for seedling establishment (Arnold, 1978). Flowering of Antioch Dunes buckwheat begins in July or August, depending on the climate, and just prior to the emergence of Lange's metalmarks. As of the 2020 5-Year Review, Lange's metalmark can only be found within the Antioch Dunes National Wildlife Refuge (ADNWR), which encompasses 67 acres; the 41-acre Stamm Unit, owned by the Service, and the 26-acre Sardis Unit, of which 14 acres are owned by the Service and 12 acres are owned by Pacific Gas and Electric (Service, 2002). Lange's metalmark is associated with Antioch Dunes, a riverbank dune system that historically reached heights of over 100 feet, but specimens collected from Oakley suggest the subspecies may not have been confined to the Antioch Dunes (Howard and Arnold, 1980; Stanford et al., 2011). The Lange's metalmark is now considered entirely restricted to the remaining Antioch Dunes habitat at the NWR (currently only the Sardis Unit). The subspecies has not been observed at the Stamm Unit since 2010. Based on surveys conducted since 1986, peak counts have ranged from as high as 2,342 adult butterflies in 1999, to below 50 adult butterflies in every year since 2009 (Service, 2018c). In 2018, surveys resulted in a total count of nine individuals and group surveys resulted in a total of 20 observations (Service, 2019a). In

2019, surveys resulted in a total count of only five butterflies, and the group surveys resulted in a total of 10 observations (Service, 2019a).

In 2007, a captive breeding program was established for Lange's metalmark. However, breeding in captivity has been generally unsuccessful and the program has shifted to a head starting approach: annually collecting three to five females and rearing their offspring in captivity to later be released back into the wild. Unfortunately, only seven larvae were released in 2018 due to an unexplained die-out in the captive population, and none were released in 2017 due to early eclosion of the captive population, putting them out of sync with the mating period of the wild population. As the wild population continues to decline, captive-reared individuals begin to account for a greater percentage of the population.

Lange's metalmark butterfly will soon become extinct if aggressive and systematic recovery measures are not implemented at the Antioch Dunes National Wildlife Refuge (NWR). Specifically, the proliferation and overgrowth of invasive, non-native grasses and forbs, such as rip-gut brome, star thistle, and vetch, affect nearly every acre of the Antioch Dunes NWR. Endemic plants at the Antioch Dunes NWR depend on sandy dune habitat that is constantly disturbed and replenished by winds, and these endemics cannot compete with invasive plants. Over the last two decades, invasive plants have dominated the remaining natural riverine dune habitat and have successively degraded this habitat by stabilizing the shifting sand dunes with organic sediment and dense vegetation, by eliminating natural seed germination of the rare native plants, and by encumbering native rare plants with competition for space. Aggressive eradication of these invasive plants and followup maintenance to ensure that they do not re-establish will be an ongoing and dedicated effort for many years to come if the recovery of the Lange's metalmark butterfly is to succeed. The threat of non-native, invasive plants is a new threat identified since listing of this species. Other newly identified threats include wildfires, which have continued to destroy the species despite the installation of fencing to exclude trespassers who may inadvertently or purposefully ignite fires.

Since the mid- to late-1800s, the Antioch Dunes habitat has been mostly destroyed and degraded by sand mining for various commercial uses, conversion to other land uses, invasion by nonnative vegetation, and recreational uses (Service 1984). These habitat alterations have also largely eliminated the wind-blown disturbance regime that helps maintain the openness of the dunes in the remaining small and fragmented habitat units. Climate change is an emerging threat to Lange's metalmark, and changes in distribution have already been observed, with substantial evidence of elevation shifts latitudinal shifts, and extended migration distances. The Lange's metalmark as a relatively sedentary subspecies, endemic to a fragmented habitat, surrounded by developed lands, and highly dependent on an endemic plant, will likely be unable to relocate to suitable habitat or conditions elsewhere. The shift in temperature, precipitation, and frequency of extreme conditions anticipated in California as a result of a changing climate may be better tolerated by non-native than native plants, including the Lange's metalmark host plant. Hotter, drier conditions may increase the frequency and severity of wildfires.

Per the 2019 Recovery Plan Amendment, Lange's metalmark is threatened by possible insecticide drift from mosquito abatement spraying on neighboring properties (Richmond et al. 2015). The Mosquito Abatement District allows for spraying of insecticides to reduce the incidence of West Nile Virus at a wetland adjacent to the Stamm Unit of the NWR. The spray could drift on to the refuge and affect pollinators, such as Lange's metalmark. NWR staff have worked with county mosquito control staff to minimize effects from this potential threat.

Because this species is represented by a single small isolated population, it is threatened by the loss of genetic heterozygosity and is susceptible to extinction by a single catastrophic climatic event, from an infectious disease, or from stochastic demographic fluctuations.

EB/CE Sources: U.S. Fish and Wildlife Service. 2008 Lange's metalmark butterfly (*Apodemia mormo langei*), Antioch Dunes evening-primrose (*Oenothera deltoides* subsp. *Howellii*), Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Field Office, California. 42 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for Three Endangered Species Endemic to Antioch Dunes, California: Lange's metalmark butterfly (*Apodemia mormo langei*), *Oenothera deltoides* subsp. *Howellii* (Antioch Dunes evening-primrose), and *Erysimum capitatum* var. *angustatum* (Contra Costa wallflower) – Amendment. San Francisco Bay-Delta Fish and Wildlife Office, Sacramento, California. 64 pp.

U.S. Fish and Wildlife Service. 2020. Lange's Metalmark Butterfly (*Apodemia mormo langei*) 5-Year Review. Sacramento Fish and Wildlife Field Office, California. 30 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Lange's metalmark butterflies exposed to malathion at maximum rates varies between use sites, with 1-15% expected to experience mortality in pasture, other grains, open space developed, wheat, other crops, and developed use sites, and <1% on all other use sites.

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|-----|
| Use areas – mortality | 36% |

| | |
|---|---------------------------------------|
| Spray drift areas – mortality | up to 81% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 19% |
| MOSQUITO CONTROL | |
| Direct - mortality | 78% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers: Lange's metalmark is only found within the bounds of the Antioch Dunes National Wildlife Refuge. Industrial development and a railway line border the southern edge of the wildlife refuge. It is unlikely Lange's would use these areas unless their host plant, naked stemmed buckwheat (*Erigonum nudum*) were found in that area.

Population numbers for Lange's metalmark are the following: 2012 (23 individuals), 2013 (78 individuals), and 2015 (108 individuals).

Lange's metalmark produces one brood in a season when adults will emerge in August and fly until September. Peak populations exist two to three weeks after emergence. Eggs remain attached and are dormant until the rainy season, larvae hatch and overwinter at the base of the plant, feeding on buckwheat from hatching from December-February until pupation approximately 240-270 d later. Larvae appear the following summer, usually occurring in late June and July in the dead foliage at the base of their food plant. Based on the life history of Lange's metalmark, this butterfly is vulnerable to the effects of malathion throughout most of its lifecycle; especially vulnerable are the larval and adult stages if applications are made from March through September.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|------------------|------------------------------|------------------------|------|---------------------------------------|---|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 29,548 | 78.0 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Developed | D,I | 5,446 | 14.5 | 272 | 0.72 |
| Other Crops | D,I | 2,097 | 5.58 | 0 | 0 |
| Wheat | D,I | 2,048 | 5.45 | 1,654 | 4.4 |
| Open Space Developed | D,I | 1,752 | 4.66 | 88 | 0.23 |
| Other Grains | D,I | 1,503 | 3.99 | 1,503 | 3.99 |
| Pasture | D,I | 607 | 1.61 | 607 | 1.61 |
| Corn | D,I | 145 | 0.39 | 145 | 0.39 |
| Orchards and Vineyards | D,I | 39 | 0.10 | 39 | 0.11 |
| Vegetables and Ground Fruit | D,I | 28 | 0.07 | 28 | 0.07 |
| Rice | D,I | 8 | 0.02 | 6 | 0.02 |
| Cotton | D,I | 5 | 0.01 | 0 | 0 |
| Nurseries | D,I | 3 | <0.01 | 3 | <0.01 |
| Other Row Crops | D,I | 2 | <0.01 | 2 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 13,683 | 36.8 | 4,347 | 11.55 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 13,683 | 36.8 | 4,347 | 11.55 |
| TOTAL⁴: | | 43,231 | 100* | 4,347 | 11.55 |

*Use overlaps with range are additive and cannot be greater than 100%.

acres in species range: 4,335 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 67 acres, 0.015%

Overall Usage: ☒ High ☐ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality and sub-lethal effects to the species.

General Conservation Measures

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of the Lange’s metalmark butterfly to malathion in this use area where it occurs in or around the species’ range, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop). This will reduce the amount of malathion used and decrease potential exposure to the Lange’s metalmark butterfly, thus decreasing the risk of mortality to individuals of this species.

Species-specific Measures

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, additional species-specific conservation measures outlined below will be implemented. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

For Agricultural Applications within the range of the species:

A 20-foot minimum vegetated strip (on which pesticides should not be applied) along bodies of water, wetlands, and the downhill side of fields where runoff could occur is required for all agricultural uses. Vegetative strips have been shown to filter surface water runoff and can effectively keep pesticides in the field, reducing risk of exposure to the species.

Allow at least 24 hours between application of malathion and any irrigation that results in surface run-off into natural waters, and do not make aerial applications while irrigation water is on the field unless surface run-off is contained for 72 hours following the application. Given the relatively short half-life of malathion and rapid degradation from hydrolysis and other processes, we anticipate a substantial reduction in malathion concentrations in runoff would result with the implementation of irrigation delays. Restricting application while irrigation water is on the field would also effectively reduce the concentrations of malathion found in runoff. These measures would further reduce malathion concentrations occurring in runoff and would reduce the risk of exposure to the species.

When wind is blowing away from suitable habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When wind is blowing towards habitat, do not make applications within 200 yards by air or 40 yards by ground upwind from occupied habitat (Antioch Dunes National Wildlife Refuge). As spray drift is predominantly controlled by prevailing winds, adjusting the application in response to wind direction would reduce the risk of exposure from spray drift, potentially reducing the risk of exposure via spray drift to zero if the wind is blowing away from suitable habitat. While spray drift may not be fully eliminated when wind is blowing towards suitable habitat, increased buffer distances are expected to substantially reduce the amount of spray drift that the species may encounter, decreasing the likelihood of exposure.

For mosquito control applications within the range of the species:

Where feasible, do not apply within the Antioch Dunes National Wildlife Refuge. Within the range of the species outside of the Refuge, only apply using handheld foggers or truck based application. If applying by truck, must use a 1/4 mile buffer from the Antioch Dunes National Wildlife Refuge. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the Refuge manager and local FWS Ecological Services field offices to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species (FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website <https://ecos.fws.gov/ipac/>). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, including the general and species-specific conservation measures described above, is not likely to jeopardize the continued existence of the Lange's metalmark butterfly.

The Lange's metalmark butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is high based on standard usage data. CalPUR data was not used for this species because data for some uses was unavailable for the areas where the species is found. For the portion of the species mapped range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species mapped range (0.015%) is on Federal lands, and even those areas are surrounded by urbanization and development and are subject to drift from insecticide use nearby.

We estimated that across the non-Federal portion of the species mapped range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 36.0% mortality of individuals, up to 81.0% mortality from spray drift. In addition, there could be up to

78.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species.

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 11.55% of the non-Federal portion of the species mapped range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species. Additionally, plants used for feeding and nectaring are anticipated to experience reduced growth from malathion use, which will likely decrease the survivability and reproduction of individual Lange's metalmark butterflies that are not directly exposed to malathion. Mosquito control use of malathion does not exceed the application threshold for effects to occur to plant species, so no effects to plant growth are expected from this use. Reductions in plant growth and mortality of individual butterflies from other use types (see above Table) are anticipated to be reduced by implementation of the agricultural and residential use measures described above. For example, blooming alfalfa (alfalfa equates to the pasture UDL) is likely to attract Lange's metalmark butterflies in the immediate vicinity in search of a nectar source. The conservation measure to be implemented prohibits malathion application while alfalfa is in bloom and until petal fall is complete, thus limiting exposure to the individuals of this species living in and around this crop type.

Other agricultural uses driving exposure, such as wheat and 'other grains,' will be addressed by the species-specific measure requiring agricultural applicators to use a 200 yard aerial buffer or a 40 yard ground buffer from occupied habitat (currently Antioch Dunes National Wildlife Refuge) when winds are blowing toward the habitat. This measure is anticipated to substantially reduce the amount of spray drift potentially entering the Refuge, thus reducing exposure and the resultant mortality of individual butterflies, and growth of plants used for nectaring and feeding.

The Lange's metalmark butterfly's potential habitat is restricted to about 67 ac at the Antioch Dunes National Wildlife Refuge (Refuge). The Lange's metalmark is now considered entirely restricted to the remaining Antioch Dunes habitat at the Refuge (currently only the 26-ac Sardis Unit). Per the 2019 Recovery Plan Amendment, the species is threatened by possible insecticide drift from mosquito abatement spraying on neighboring properties (Richmond et al. 2015). However, the Refuge undertakes protective management for this species, and malathion usage is anticipated to be low on Federal lands, as described above. Furthermore, the implementation of both general and species-specific conservation measures are expected to further reduce the likelihood of exposure from mosquito control uses of this chemical. The species-specific conservation measure to limit mosquito control applications within the range of this species was designed with input from the Contra Costa Mosquito Abatement District (CCMAD), the entity with jurisdiction over mosquito abatement in the range of the butterfly, and is based on a similar,

pre-existing measure agreed upon by CCMAD and Refuge staff. The measure is anticipated to effectively limit the amount of malathion used during mosquito control operations by reducing the amount and extent of use within the range. Application within the Refuge is prohibited and application within the range outside of the Refuge, must be applied by hand foggers or a ¼ mile buffer around the Refuge is required when applying via truck. Mosquito control applicators who perform operations while following these restrictions will be in compliance with this measure and no coordination will be required with FWS. If applications are needed that do not follow the restrictions, such as to protect the public's health and welfare, the applicator must coordinate with the Refuge manager and the local FWS field office to determine alternative measures to ensure the proposed application is likely to have no more than minor effects on the species. Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as specific timing, species life history, and geographic or habitat factors. Coordination with FWS on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing us to better track this coordination and its outcomes moving forward.

As a result of the above conservation measures, we anticipate mortality from mosquito control, agricultural, and residential uses will be significantly reduced. While we anticipate reduced mortality, small numbers of individuals may be adversely affected over the duration of the action (in the form of the loss of a small number of individuals), however, we do not anticipate malathion usage will result in species-level effects, and do not anticipate that the proposed action would appreciably reduce survival and recovery of the Lange's metalmark butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------------------|----------------------|------------|
| <i>Lycaeides argyrognomon lotis</i> | Lotis blue butterfly | 422 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The lotis blue butterfly appears to be a naturally rare insect with low population densities, and the reasons for its decline are largely speculative (Service 1985). However, changes in vegetation, perhaps exacerbated by drought or vulnerability due to small population sizes, are the prime suspects in the decline (Service 1985). The probable larval food plant is more abundant in open and disturbed areas (Service 1985). Land management practices and fire suppression have likely resulted in reduced disturbance in some areas, allowing succession from more open habitats to dense shrub and trees. At the last known site for the lotis blue butterfly, this succession has certainly occurred. We also know that habitat management at the last known site has changed under PG&E's management since listing, partly at the request and guidance of the Service (Arnold 1991; de Becker, et al. 1991). Subsequent surveys have not detected the lotis blue's presence at the PG&E site since 1983 (Arnold 1991, 2006, 2008; Pratt 2004; R. Arnold, Entomological Consulting Services, pers. comm. 2011). Pratt (2004) conducted extensive surveys for lotis blue under contract from the Arcata Fish and Wildlife Office; however, no butterflies, eggs, or larvae were detected. During at least 6 years between 1990 and 2008, Arnold surveyed the lotis blue's last known remaining site under contract with PG&E, and in 2006, looked for lotis blue where appropriate habitat overlapped with the Behrens' silverspot butterfly (Arnold 2006). No lotis blue butterflies, eggs, or larvae were detected. While these surveys covered a large area of potential habitat over many sites, most survey effort has been limited to State-owned lands where permission to access the sites was more easily obtained. Large areas within the species' historic range are in private ownership, including moist coastal prairie and other potential habitats for the species. The status of the species on private lands is unknown, as most sites on private property where suitable habitat might be found have not been surveyed (Pratt 2004; Arnold 2006). As of the 2020 5-Year Review, the species is still undetected. An additional host plant, *Hosackia rosea* (rose flowered lotus) has been suggested for the species, although its distribution is more limited than the primary host plant, *H. gracilis*.

The most recent literature on climate change includes predictions of hydrological changes, higher temperatures, and expansion of drought areas, resulting in a northward and/or upward

elevation shift in range for many species (IPCC 2007). For the coastal zone that the species inhabits, some studies have predicted increases in coastal upwelling and associated coastal fog frequency in the region (Bakun 1990; Snyder et al. 2003). However, a more recent evaluation of historic climate data from coastal northern California found that summer conditions have become warmer and drier, with less fog, since the early 20th century, suggesting increased drought stress for vegetation (Johnstone and Dawson 2010). While it appears reasonable to assume that the lotis blue butterfly may be affected by such changes, we lack sufficient certainty in knowing the extent to which climate change will affect particular species at this time.

EB/CE Sources: U.S. Fish and Wildlife Service. 2011. Lotis Blue Butterfly (*Lycaeides argyrognomon lotis*) 5-Year Review: Summary and Evaluation. Arcata Fish and Wildlife Office. 14 pp.

U.S. Fish and Wildlife Service. 2020. Lotis Blue Butterfly (*Lycaeides argyrognomon lotis*) 5-Year Review: Summary and Evaluation. Arcata Fish and Wildlife Office. 2 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Lotis blue butterflies exposed to malathion at maximum rates varies between use sites, with 6% expected to experience mortality in open space developed and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 6% |
| Spray drift areas – mortality | up to 6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 6% of use sites could affect plants (decline in growth) |

| MOSQUITO CONTROL | |
|--------------------|------|
| Direct - mortality | 0.07 |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The lotis blue probably has a single generation per year, with a relatively long adult flight period, extending from mid-April to early July. Eggs are likely laid during the adult flight season. Newly hatched larvae begin to feed immediately, overwinter in dormancy as small larvae, then resume feeding the next spring. Lotis blue butterfly larvae are herbivores and probably rely completely on the larval host plant—thought, but not confirmed, to be the coast trefoil (*Lotus formosissimus*)—for feeding. The larvae (caterpillars) probably feed for about 4 to 6 weeks in the spring before pupating. Because the height of feeding and reproductive activities for this butterfly most likely occurs from mid-April through July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time; however it is potentially exposed throughout its entire lifecycle. All information on the life history of the lotis blue is obtained from the closely related species, the northern blue butterfly.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 330 | 0.71 | 0 | 0 |
| Open Space Developed | D,I | 26,738 | 5.51 | 1337 | 0.28 |
| Developed | D,I | 3,445 | 0.71 | 172 | 0.035 |
| Orchards and Vineyards | D,I | 121 | 0.02 | 0 | 0 |
| Other Grains | D,I | 47 | <0.01 | 0 | 0 |
| Nurseries | D,I | 19 | <0.01 | 0 | 0 |
| Other Crops | D,I | 8 | <0.01 | 0 | 0 |
| Pasture | D,I | 7 | <0.01 | 0 | 0 |
| Wheat | D,I | <1 | <0.01 | 0 | 0 |
| Rice | D,I | <1 | <0.01 | 0 | 0 |
| Corn | D,I | <1 | <0.01 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Vegetables and Ground Fruit | D,I | <1 | <0.01 | <1 | <0.01 |
| Other Row Crops | D,I | <1 | <0.01 | 1510 | 0.325 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 30,385 | 6.29 | 1510 | 0.325 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 30,385 | 6.29 | 1510 | 0.325 |
| TOTAL⁴: | | 30,715 | 7.00 | 1510 | 0.325 |

acres in species range: 485,519 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 100,521 acres, 20.7%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

jeopardize the continued existence of the Lotis blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Lotis blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 6.0% mortality of individuals, up to 6.0% mortality from spray drift. In addition, there could be up to 0.07% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where a large proportion of individuals of the population is lost, the area of suitable habitat will not be recolonized.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.325% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Lotis blue butterfly is thought to exist mainly in Mendocino County, and could be in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary) and to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be adversely affected over the duration of the Action (in the form of the loss of a small number of individuals) as described above, we do not anticipate species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Lotis blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---|------------------------|------------|
| <i>Icaricia icarioides missionensis</i> | Mission blue butterfly | 423 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

At the time of its listing in 1976, two populations of mission blue butterfly were known. The number of known locations and the range of the species have substantially increased since its listing. Since then, new colonies have been discovered in the north of its range at the Marin Headlands and in the south of its range at the San Francisco Peninsular Watershed, Sweeney Ridge, Milagra Ridge, and Skyline College. However, it is not clear if the colonies discovered in the north of the range and in the south of the range should each be considered discrete populations or metapopulations. A population at Twin Peaks may have been extirpated due to a reduction in host plant density caused by a fungal pathogen exacerbated by an El Niño event and recreation impacts that directly affected host plants.

As of 2019, threats included permanent and temporary loss of habitat due to public infrastructure development, poaching, small population size, isolation, the effects of reduced host plant density due to exotic invasive plants and a fungal pathogen (*Colletotrichum lupini*), grassland succession to chaparral, recreational impacts that reduce habitat quality and quantity, and the undetermined effects of global climate change. Although the threat of urban and suburban development has been reduced and the number of known colonies has increased, the threats of grassland succession to chaparral, host plant competition with exotic invasive plant species, and small population sizes remain substantial threats to this species. The ability of this species to persist, unaided by human intervention and management, is unlikely. As a result of the 1982 amendment to the Act, allowing for the “incidental take” of listed species by non-federal entities, the first ever Habitat Conservation Plan (HCP) was prepared and approved for San Bruno Mountain. The HCP allows limited development of endangered species habitat in exchange for implementation of a long-term program, funded by development, to protect and enhance the remaining portions of the Mountain as habitat. The HCP allows for the take of mission blue butterfly habitat on San Bruno Mountain. As of June 2009, there were 19.64 ac of mission blue butterfly habitat that had been authorized for, but not yet, developed.

Pesticide use poses a potential threat to mission blues if used in proximity to occupied habitat (e.g. Varela et al. 2008, Service 2009). Vole herbivory threatens the host plants of the mission blue butterfly, with herbivory in some years causing severe declines in available lupine (Arechiga pers. comm. 2018, O'Brien pers. comm. 2018, Wayne pers. comm. 2018).

EB/CE Sources: U.S. Fish and Wildlife Service. 2010. Mission Blue Butterfly (*Icaricia icariodes missionensis*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, California. 39 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for San Bruno Elfin Butterfly (*Callophrys mossii bayensis*) and Mission Blue Butterfly (*Icaricia icariodes missionensis*) – Amendment. Sacramento Fish and Wildlife Office, California. 25 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Mission blue butterflies exposed to malathion at maximum rates varies between use sites, with 13% and 42% expected to experience mortality in open space developed and developed, respectively, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 56% |
| Spray drift areas – mortality | up to 18% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to symbiotic ants | 56% |
| Spray drift areas – effects to symbiotic ants | up to 18% |
| Plants affected – decline in growth | 57% |
| MOSQUITO CONTROL | |
| Direct - mortality | 61% |
| Sublethal | NA |
| Indirect - mortality | 61% arthropods (symbiotic ants) |

Risk modifiers:

The mission blue butterfly is not known to frequent agricultural fields or pastures but may pass through these areas in search of the nectar/pollen from a nectar plant during the adult stage (USFWS Ask to Field Co-occurrence Analysis 2016).

The largest population of mission blue butterflies is found on San Bruno Mountain, in northern San Mateo County, California. San Bruno Mountain is bordered by urbanized areas: South San Francisco, Brisbane, Colma, and Daly City. The removal of nectar-providing flowering plants and larval host plants also limits habitat for the mission blue butterfly (USFWS 2010).

The adult flight period/breeding season is late March to mid-July. All reproductive activities are carried out among patches of the three known larval host plants: silver lupine (*Lupinus albifrons*), many-colored lupine (*L. variicolor*), and summer lupine (*L. formosus*) (USFWS 2010). Larvae emerge after 4-10 days of hatching then go through instar development until they enter diapause after three weeks. The rate of diapause and emergence varies widely, even among sibling larvae. Mission blue butterflies go through three or four instar before pupation (USFWS 2010). March through June is the height of breeding and feeding activity for these butterflies, and may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made during this time period, however the mission blue is potentially exposed throughout its entire lifecycle.

The mission blue is a facultative myrmecophile; it has a symbiotic relationship with ants (USFWS 2010).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 102,230 | 61.0 | 0 | 0 |
| Vegetables and Groundfruit | D,I | 64 | 0.04 | 3.3 | <0.01 |
| Developed | D,I | 71,964 | 43.05 | 3,598 | 2.15 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|------------------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Open Space Developed | D,I | 22,096 | 13.22 | 0 | 0 |
| Nurseries | D,I | 262 | 0.16 | 0 | 0 |
| Orchards and Vineyards | D,I | 56 | 0.03 | 0 | 0 |
| Pasture | D,I | 39 | 0.02 | 0 | 0 |
| Wheat | D,I | 28 | 0.02 | 0 | 0 |
| Other Grains | D,I | 28 | 0.02 | 0 | 0 |
| Other Crops | D,I | 22 | 0.01 | 0 | 0 |
| Rice | D,I | 14 | <0.01 | 0 | 0 |
| Corn | D,I | 2 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | 1.26 | <0.01 | 0 | 0 |
| Cotton | D,I | 0.63 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 94,577 | 56.6 | 3,601.3 | 2.15 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 94,577 | 56.6 | 3,601.3 | 2.15 |
| TOTAL⁴: | | 196,807 | 100 [#] | 3,601.3 | 2.15 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 167,179.22 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 38,023 acres, 22.7%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mission blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measure described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Mission blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 56.0% mortality of individuals, up to 18.0% mortality from spray drift, a loss of about 56.0% of symbiotic ants in use areas, and an additional loss of up to 18.0% of symbiotic ants due to spray drift. In addition, there could be up to 61.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.15% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the

likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measure described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Mission blue butterfly exists mainly in San Francisco and San Mateo Counties in California, thus putting it in close proximity to residential and other developed areas (e.g., portions of San Bruno Mountain). Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

Thus, while we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Mission blue butterfly in the wild

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--|----------------------------|------------|
| <i>Neonympha mitchellii mitchellii</i> | Mitchell's satyr butterfly | 424 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Mitchell's satyr is a rare butterfly and fen habitat specialist (in northern the portion of its range) that is threatened with, among other things, the loss and disruption of suitable fen habitats. Prairie fen is also a rare wetland and vegetation community. New information suggests the status of the species has worsened at some locations since its last status review. While the range and number of known colonies of Mitchell's satyr has expanded significantly with the discovery of the southern populations, the size and status of these populations are not well known.

Known threats have not diminished and new threats to habitat and the species have been documented. An intracellular bacterial parasite, *Wolbachia*, could possibly reduce the already decreasing Mitchell's satyr population by half. Populations are isolated from each other and habitat is extremely fragmented, which leads to increased inbreeding and decreased population viability. These threats, compounded with a warming climate, makes the species even more susceptible to stochastic events that could result in extinction.

EB/CE Source: U.S. Fish and Wildlife Service. 2014. Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) 5-Year Review: Summary and Evaluation. East Lansing Field Office, Michigan. 40 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Mitchells' satyr butterflies exposed to malathion at maximum rates varies between use sites, with 2-10% expected to experience mortality in pasture, developed, open space developed, and corn, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 24% |
| Spray drift areas – mortality | up to 72% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 10 % of overlap could affect plants (decline in growth) |
| MOSQUITO CONTROL | |
| Direct - mortality | 4.6% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Mitchell's satyr butterfly known habitats are all peatlands but range along a continuum from prairie/bog fen to sedge meadow/swamp.

During the flight period, which generally lasts only two weeks, the butterflies mate, lay eggs, and die. McAlpine et al. (1960) noted that under caged conditions, the eggs hatch within 7 to 11 days, and that larvae feed through the summer until reaching the fourth instar. Larvae then diapause in the fourth instar and resume feeding the following spring. However, this has not yet been confirmed under natural conditions. Therefore, Mitchell's satyr butterfly is vulnerable to the effects of malathion throughout its entire lifecycle, especially vulnerable are the larval and adult stages if applications are made in the beginning of Spring through September.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 304,746 | 4.55 | 3 | <0.01 |
| Corn | D,I | 668,355 | 9.9 | 27,797 | 0.42 |
| Open Space Developed | D,I | 337,332 | 5.0 | 16,867 | 0.25 |
| Developed | D,I | 280,440 | 4.19 | 14,022 | 0.21 |
| Pasture | D,I | 141,076 | 2.11 | 34,892 | 0.52 |
| Wheat | D,I | 53,757 | 0.8 | 20,690 | 0.31 |
| Orchards and Vineyards | D,I | 48,358 | 0.72 | 2,838 | 0.04 |
| Vegetables and Ground Fruit | D,I | 34,898 | 0.52 | 17,182 | 0.26 |
| Other Crops | D,I | 25,427 | 0.38 | 0 | 0 |
| Other Grains | D,I | 7,783 | 0.12 | 4,100 | 0.06 |
| Cotton | D,I | 7,525 | 0.11 | 6,597 | 0.1 |
| Nurseries | D,I | 3,866 | 0.06 | 3,866 | 0.06 |
| Other Row Crops | D,I | 1,960 | 0.06 | 846 | 0.06 |
| Christmas Trees | D,I | 3,443 | <0.01 | 245 | <0.01 |
| Rice | D,I | 2.78 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 1,614,223 | 23.99 | 149,941 | 2.84 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 1,614,223 | 23.99 | 149,941 | 2.84 |
| TOTAL⁴: | | 1,918,969 | 28.54 | 149,944 | 2.85 |

acres in species range: 6,694,881 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 187,960 acres, 2.81%

Overall Usage: ☐ High ☐ Medium ☒ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Mitchell’s satyr Butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mitchell's satyr butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Mitchell's satyr butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion

of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 24.0% mortality of individuals, up to 72.0% mortality from spray drift. In addition, there could be up to 4.60% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.85% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the Action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Mitchell's satyr butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------------|-------------------------------|------------|
| <i>Speyeria zerene myrtleae</i> | Myrtle's silverspot butterfly | 425 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: All populations stable, with none known to be increasing or decreasing

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

At the time of listing, four populations of Myrtle's silverspot butterflies were known and described, and included the sighting of a single animal that was assumed to be part of a larger population near Valley Ford. Its distribution and abundance has not changed significantly since listing. It appears that at least three stable populations of Myrtle's silverspot butterfly currently exist. Two populations are protected within the Point Reyes National Seashore at North Beach and at the Tomales Bay headlands, while another relatively dense population remains unprotected on private lands in the area west of the small town of Valley Ford. There may be up to three more separate populations at the Point Reyes National Seashore, but this can not be determined without a mark-recapture study. In addition, populations may occur at Bodega Head and along the coastal terrace southward to Dillon Beach but these areas have not been recently surveyed.

It was believed at the time of listing that cattle grazing significantly decreased the habitat quality of the Myrtle's silverspot butterfly; however, a study revealed that the cattle grazing regime currently used at the Point Reyes National Seashore does not significantly affect the distribution of Myrtle's silverspot butterfly at that site. Current threats to the Myrtle's silverspot butterfly include urban or industrial development of any property with suitable habitat for the butterfly, poaching, small population size, the effects of reduced host and nectar plant density due to invasive plants and forbs, road mortalities during the adult flight season, and the probable constriction of the range and distribution of this butterfly due to global climate change.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Field Office, California. 28 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Myrtle's silverspot butterflies exposed to malathion at maximum rates varies between use sites, with 2-9% expected to experience mortality in pasture, developed, open space developed, and corn, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|--|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 22% |
| Spray drift areas – mortality | up to 17% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 20% of overlap could affect plants (decline in growth) |
| MOSQUITO CONTROL | |
| Direct - mortality | 77% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Myrtle's silverspot females lay eggs solely on the dried leaves and stems of the host plant, *Viola adunca*, during the summer flight season, which lasts about five weeks. Eggs hatch in 23-29 days and become caterpillars. During diapause in fall and winter, there is no feeding and follows a seven to ten month feeding period. The butterfly then makes their pupa out of leaves. Adult Myrtle's silverspot butterflies emerge from their pupae between mid-June and mid-July and live up to five weeks. The total flight period, however, lasts for two to three months since adult emergence is staggered. Because the height of feeding and reproductive activities for this butterfly occurs from mid-June through ~August, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle since adult emergence and larval emergence are staggered (US FWS SOS 2016).

Approximately 10,000 Myrtle's silverspot individuals exist as of 2009 (USFWS 2009).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 398,676 | 76.55 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 170 | 0.03 | 3 | <0.001 |
| Developed | D,I | 64,329 | 12.35 | 3,216 | 0.62 |
| Open Space Developed | D,I | 33,766 | 6.48 | 1,688 | 0.32 |
| Other Grains | D,I | 6,626 | 1.27 | 0 | 0 |
| Orchards and Vineyards | D,I | 6,029 | 1.16 | 0 | 0 |
| Other Crops | D,I | 650 | 0.12 | 0 | 0 |
| Wheat | D,I | 326 | 0.06 | 0 | 0 |
| Nurseries | D,I | 240 | 0.05 | 0 | 0 |
| Pasture | D,I | 62 | 0.01 | 0 | 0 |
| Rice | D,I | 52 | <0.01 | 0 | 0 |
| Corn | D,I | 21 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | 14 | <0.01 | 0 | 0 |
| Cotton | D,I | 2 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 112,285 | 21.57 | 4,907 | 0.94 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 112,285 | 21.57 | 4,907 | 0.94 |
| TOTAL ⁴ | | 510,962 | 98.12 | 4,907 | 0.94 |

acres in species range: 520,834 acres

% of range in California (i.e., where CalPUR data is available): 100%

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Range overlap with Federal lands: 111,203.9 acres, 21.4%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Myrtle's silverspot butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Myrtle's silverspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals, up to 17.0% mortality from spray drift. In addition, there could be up to 77.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in

growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that malathion usage will occur in up to 0.94% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Myrtle's silverspot butterfly exists mainly in Marin and Sonoma Counties in California, and some populations may be in the vicinity of residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the Action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Myrtle's silverspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--------------------------------|-----------------------------|------------|
| <i>Euphydryas editha quino</i> | Quino checkerspot butterfly | 426 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

More than 75% of the Quino checkerspot butterfly's (hereafter, Quino) historical range has been lost (Brown 1991, p. 10), including more than 90% of its coastal mesa and bluff distribution (USFWS 2003a, p. 1; USFWS GIS database). At listing, Quino populations were reduced in number and size from historical conditions by more than 95% range wide. The current range for Quino includes multiple areas in southern Riverside County, south into Mexico. The extinction vulnerability of Quino based on the number of known populations has been greatly reduced since the subspecies was listed, and has improved since the Recovery Plan was published. The listing rule (USFWS 1997, 62 FR 2313) identified "seven or eight" extant Quino populations within the United States. Based on our current analysis, populations described in the listing rule belong to four core and one non-core habitat-based population distributions. Three of the core habitat-based population distributions known at the time of listing are extant, and the status of one is unknown. The status of the non-core habitat-based population distribution known at the time of listing is unknown. Based on our current analysis, six core and 25 non-core habitat-based population distributions were documented post-listing. All six core habitat-based population distributions documented post-listing are extant. Of the 25 non-core habitat-based population distributions documented post-listing, 15 are extant, six are of unknown status, and four were extirpated post-listing.

The population reduction was primarily due to direct and indirect human impacts including habitat loss and fragmentation, invasion of non-native plant species, and catastrophic natural events such as increased frequency of drought and wildfire (USFWS 1997, 62 FR 2313). The habitat conservation status of the subspecies has also improved, because much habitat has been preserved and more is planned for preservation under regional Habitat Conservation Plans. However, the species is still vulnerable to extinction with current habitat destruction, altered habitat suitability due to climate change, non-native species invasions, and population losses. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Sources: U.S. Fish and Wildlife Service. 2009. Quino Checkerspot Butterfly (*Euphydryas editha quino*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, California. 57 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for Quino checkerspot butterfly (*Euphydryas editha quino*) – Amendment. Carlsbad Fish and Wildlife Office, California. 22 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Quino checkerspot butterflies exposed to malathion at maximum rates varies between use sites, with 2-11% expected to experience mortality in wheat, open space developed, and developed, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 22% |
| Spray drift areas – mortality | Up to 14% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 20 % of overlap could affect plants (decline in growth) |
| MOSQUITO CONTROL | |
| Direct - mortality | 65% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Quino life cycle includes four distinct life stages: egg, larva (caterpillar), pupa (chrysalis), and adult, with the larval stage divided into 5 to 7 instars (periods between molts, or shedding

skin). There is usually one generation of adults per year, although larvae may remain in diapause (summer dormancy) for multiple years prior to maturation. Eggs deposited by adults hatch in 10 to 14 days. The flight period occurs from late January to early March and continues as late as early May. Because the height of feeding and reproductive activities for this butterfly occur from January through May (USFWS 2008), it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle. The Quino checkerspot may breed on the periphery of agricultural fields outside of rows. There are also many power line easements in habitats and a number of golf courses adjacent to occupied habitat where the butterflies could be exposed (Alison Anderson, Co-Occurrence ATF, per. comm., 2016).

In 1997, it was predicted that Quino checkerspot butterfly would be the “passenger pigeon butterfly” – a once common, widespread species crashing to extinction over a few decades (USFWS 2009). The more recent population trend of the Quino checkerspot butterfly is stable; however, the species has experienced a long-term decline of 90% (NatureServe 2015). The Quino checkerspot butterfly is a climate-sensitive, “eruptive” species that periodically experiences order-of-magnitude increases in abundance every 5 to 20 years, then drops back to much lower abundance over time (USFWS 2009).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 1,339,528 | 64.5 | 0 | 0 |
| Nurseries | D,I | 778 | 0.04 | 242 | 0.012 |
| Developed | D,I | 244,237 | 11.75 | 12,212 | 0.59 |
| Open Space Developed | D,I | 162,505 | 7.82 | 8,125 | 0.39 |
| Wheat | D,I | 39,035 | 1.88 | 0 | 0 |
| Other Crops | D,I | 11,001 | 0.53 | 0 | 0 |
| Other Grains | D,I | 1,726 | 0.08 | 0 | 0 |
| Pasture | D,I | 1,075 | 0.05 | 89 | 0.004 |
| Orchards and Vineyards | D,I | 935 | 0.04 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 77 | <0.01 | 10 | <0.001 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Cotton | D,I | 2 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 461,370 | 22.22 | 20,678 | 0.997 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 461,370 | 22.22 | 20,678 | 0.997 |
| TOTAL⁴: | | 1,800,898 | 86.72 | 20,678 | 0.997 |

acres in species range: 2,078,513 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 725,127.07 acres, 34.89%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Quino checkerspot butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measure described above is

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Quino checkerspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals, up to 14.0% mortality from spray drift. In addition, there could be up to 65.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.997% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Quino checkerspot butterfly exists mainly in Riverside and San Diego Counties in California, thus putting it in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the Action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Quino checkerspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------------|---------------------------|------------|
| <i>Callophrys mossii bayensis</i> | San Bruno elfin butterfly | 427 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Population size/location(s) unknown

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

This butterfly is endemic to one county in California. Since its listing in 1976, three additional colonies of San Bruno elfin butterfly have been located on the San Francisco Pensular Watershed. The number of known San Bruno elfin butterfly populations has increased since the final listing rule was written and the population on San Bruno Mountain appears to have remained stable. The population at Milagra Ridge is small and fragile and its ability to persist into the future is not known. The current status of the Montara Mountain population and associated colonies is unknown, but according to Arnold (pers. comm. 2009), viable colonies persist.

Current threats include public infrastructure development (except on San Bruno Mountain where take as a result of development is not permitted), poaching, small population size, the effects of reduced host and nectar plant density due to exotic invasive plants and forbs, and the undetermined effects of global climate change. Although the number of known colonies and the known distribution has increased and the threat of suburban and urban development no longer pose as high of a threat, the amount of area occupied by the host plant has not been noted to be increasing and the sustainability of the Milagra Ridge population calls into question the ability of any of the smaller and isolated populations to sustain themselves in perpetuity without reintroduction efforts in the event of extirpation. Therefore, due to an increase in the number of known colonies, the potential loss of the Milagra Ridge population, no noted expansion in habitat, the apparent stability of the San Bruno Mountain colonies, and the relative security of remaining habitat, we believe that overall, the species has remained relatively stable since its listing in 1976.

Additional impacts to the species may occur from other sources. Pesticide use poses a potential threat to San Bruno elfins if used in proximity to occupied habitat (e.g. Varela et al. 2008, Service 2009). In some cases, population monitoring may pose a threat to San Bruno elfin butterflies because of the potential for monitors to inadvertently damage habitat and/or host plants (Bennett and Russo 2016a, Arechiga pers. comm. 2018).

EB/CE Sources: U.S. Fish and Wildlife Service. 2011. Bruno Elfin Butterfly (*Callophrys mossii bayensis*) and Mission Blue Butterfly (*Icaricia icarioides missionensis*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, California. 39 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for San Bruno Elfin Butterfly (*Callophrys mossii bayensis*) and Mission Blue Butterfly (*Icaricia icarioides missionensis*) – Amendment. Sacramento Fish and Wildlife Office, California. 25 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of San Bruno elfin butterflies exposed to malathion at maximum rates varies between use sites, with 1-18% expected to experience mortality in wheat, other crops, other grains, orchards and vineyards, corn, pasture, open space developed, developed, and vegetables and groundfruit, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 37% |
| Spray drift areas – mortality | Up to 46% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to symbiotic ants | 37% |
| Spray drift areas – effects to symbiotic ants | Up to 46% |
| Plants affected – decline in growth | 27 % |
| MOSQUITO CONTROL | |
| Direct - mortality | 84% |
| Sublethal | NA |
| Indirect - mortality | 84% arthropods (symbiotic ants) |

Risk modifiers:

The San Bruno elfin is not known to frequent forests, right of ways, or pastures, but may pass through these areas in search of the nectar/pollen from a nectar plant during the adult stage and may be more likely to be exposed to pesticide use in these scenarios. If vineyards are located nearby, adults could forage on grape inflorescences (no name pers. comm.US FWS ATF Co-Occurrence Analysis 2016).

A thousand or more adults may exist in about fifteen total subpopulations on San Bruno Mountain in a good year. Montara Mountain supports about ten local populations and Milagra Ridge supports four (2010 5-Year Review).

The San Bruno elfin butterfly courtship, mating and reproduction are all carried out in the immediate space around the only known larval host plant, *Sedum spathulifolium* (stonecrop), with which it has an obligate relationship. Females oviposit throughout the flight season, from February to May. Larval development is generally completed by late May or early June, at which time the larvae descend to the ground and enter pupal diapause in loose soil and leaf litter. The larval stage lasts 2 to 4 months; the pupal stage lasts 9 to 10 months. They lie dormant until the following February or March when they emerge as adult butterflies.

Adults feed on nearby flowering plants (nectar) with small inflorescences. Larvae feed on various parts of the stonecrop, depending on their developmental stage, until they mature. Stonecrop is a low-growing succulent associated with rocky outcrops that occur at 274 to 328 m (900 to 1,075 ft) elevation and has a limited distribution in San Bruno elfin habitat.

The San Bruno elfin is a facultative myrmecophile; has a symbiotic relationship with ants (USFWS 2010).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 2,538,641 | 83.59 | 13,374 | 0.53 |
| Corn | D,I | 75,163 | 2.5 | 35 | 0.001 |
| Developed | D,I | 532,207 | 17.5 | 26,610 | 0.88 |
| Open Space Developed | D,I | 216,201 | 7.12 | 10,810 | 0.36 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Pasture | D,I | 75,701 | 2.49 | 3,031 | 0.010 |
| Orchards and Vineyards | D,I | 69,208 | 2.28 | 795 | 0.026 |
| Other Grains | D,I | 47,970 | 1.58 | 0 | 0 |
| Other Crops | D,I | 45,471 | 1.5 | 0 | 0 |
| Wheat | D,I | 36,313 | 1.2 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 27,575 | 0.91 | 1,808 | 0.059 |
| Rice | D,I | 3,318 | 0.11 | 0 | 0 |
| Nurseries | D,I | 1,806 | 0.06 | 37 | 0.001 |
| Other Row Crops | D,I | 344 | 0.01 | 0 | 0 |
| Cotton | D,I | 84 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 1,131,359 | 37.27 | 43,126 | 1.337 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 1,131,359 | 37.27 | 43,126 | 1.337 |
| TOTAL⁴: | | 3,670,000** | 100 [#] | 56,500 | 1.87 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 3,036,885.18 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 188,128 acres, 6.19%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the San Bruno elfin butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the San Bruno elfin butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the San Bruno elfin butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The San Bruno elfin butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 37.0% mortality of individuals, up to 46.0% mortality from spray drift, a loss of about 37.0% of

symbiotic ants in use areas, and an additional loss of up to 46.0% of symbiotic ants due to spray drift. In addition, there could be up to 84.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.87% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps such a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the Action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the San Bruno elfin butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------------------|------------------------|------------|
| <i>Euphilotes enoptes smithi</i> | Smith's blue butterfly | 428 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (9/26/2006): Downlist to Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Smith's blue butterfly is endemic to the central coast of California, within Monterey and northern San Luis Obispo Counties. The Smith's blue butterfly is an annual subspecies that primarily uses two species of buckwheat (*Eriogonum latifolium* and *E. parvifolium*) as host plants that grow in sand dunes and scrub, chaparral habitats. Each of its life stages relies upon the buckwheat, with adults feeding on nectar from the flowers and depositing eggs on the flowerheads, larvae feeding on the flowers and seeds, and pupae either forming in the soil or directly on the plants before dropping to the ground where they overwinter in leaf litter. In order for Smith's blue butterfly populations to maintain viability, they need healthy populations of their buckwheat host plants, coastal habitats with adequate levels of appropriate disturbance regimes to support the buckwheat, and connectivity between occupied spaces to facilitate natural recolonization. The occupied range of the Smith's blue butterfly is larger than was known at the time the subspecies was listed, and numerous new occupied sites have been found throughout the southern part of its range. The best available locality information indicates that the subspecies' range has contracted substantially in the northern portion of its range area, with historic localities from the Salinas River to the city of Monterey (approximately 11.5 mi (18.5 km)) and current localities only from the Salinas River to Sand City (approximately 9 mi (14.5 km)). Most of the occupied sites have been surveyed only once, and we have no substantial information on the persistence of such occurrences in the southern portion of the range. Their host plants are present in Monterey and San Luis Obispo Counties in two metapopulations. These two metapopulations are now likely isolated from one another, with the northern metapopulation inhabiting the dunes along Monterey Bay and the southern metapopulation reaching from the Carmel Valley, south into Big Sur. The two metapopulations are separated by development around the City of Monterey and the Monterey Peninsula. Smith's blue butterfly has never been documented in the gap between the two metapopulations and current habitat conditions indicate that development, tree planting, and fire suppression have likely reduced habitat suitability for Smith's blue butterfly in this area. The most recent survey efforts, described in the 2020 SSA and 2020 5-Year Review, indicate that the gap between metapopulations is expanding.

We remain concerned that threats to the Smith's blue butterfly in the northern portion of its range, along the coast of Monterey Bay from the Salinas River to Sand City, could result in extirpation of the subspecies from this area. This area is highly fragmented due to residential and industrial development, is isolated from the larger southern portion of the subspecies' range, and is threatened by planned future development and by ongoing habitat degradation due to invasive, non-native plants and industrial and recreational use. Further, the northern portion of the range continues to be threatened by urban development activities. The larger, southern portion of the Smith's blue butterfly's range faces different threats than the northern portion. Habitat loss due to residential and commercial development is present but does not appear to be as imminent or large-scale as in the north. Invasive, non-native plants, which are largely unmanaged in the southern range, are widespread, and have been shown to cause local extirpations of suitable butterfly habitat. However, we consider this threat to be less imminent than it was at the time of listing due to the greatly increased number of known butterfly occurrences. A likely benefit to the Smith's blue butterfly population in this area is that it faces a lower level of threat due to the substantial amount of habitat found on public lands, especially the Los Padres National Forest. The coastal habitat formerly encompassed by the Fort Ord Army Base is now owned and managed by California State Parks (Fort Ord Dunes State Park), where we anticipate reduced impacts to the species due to changes in land use and management.

In addition to the threats identified in the 2006 5-year review, we now consider the potential impacts of wildfire and factors related to climate change, especially increasing temperatures, drought, and sea level rise to be additional threats to the species. Since the 2006 5-year review, several large fires have burned many thousands of acres of Smith's blue butterfly habitat in the southern metapopulation, including the 2008 Basin Complex fire, 2016 Soberanes Fire, and 2020 Dolan Fire. According to California's 4th Climate Change Assessment from 2018, average annual maximum temperatures in Monterey County are expected to increase between 3.5 and 5 degrees Fahrenheit based on Representative Concentration Pathway (RCP) 4.5 and 8.5. Climate projections also show an increase in extreme dry events and that drought conditions will increase. Increased drought is expected to lead to an increase in the intensity and size of wildfires, especially in grasslands and shrublands of California's coast and foothills. Warmer and dryer conditions and increased wildfire are also expected to lead to a reduction in shrub dominated habitats in the California Coast Ranges, including the scrub and chaparral habitats of the Smith's blue butterfly, favoring increased spread of invasive, nonnative vegetation.

EB/CE Source: U.S. Fish and Wildlife Service. 2006. Smith's blue butterfly (*Euphilotes enoptes smithi*) 5-Year Review: Summary and Evaluation. 29 pp.

U.S. Fish and Wildlife Service. 2020. Smith's blue butterfly (*Euphilotes enoptes smithi*) 5-Year Review: Summary and Evaluation. 8 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Smith's blue butterflies exposed to malathion at maximum rates varies between use sites, with 4% and 6% expected to experience mortality in developed and open space developed, respectively, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 10% |
| Spray drift areas – mortality | Up to 11% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to symbiotic ants | 10% |
| Spray drift areas – effects to symbiotic ants | Up to 11% |
| Plants affected – decline in growth | 9% |
| MOSQUITO CONTROL | |
| Direct - mortality | 18% |
| Sublethal | NA |
| Indirect - mortality | 18% arthropods (symbiotic ants) |

Risk modifiers:

Smith's blue butterfly is not known to frequent forests or agricultural areas, but may pass through these areas in search of the nectar/pollen from their nectar plant during the adult stage and may be more likely to be exposed to pesticide use in these scenarios as adults. If the host plant is located in developed areas or right of ways, Smith's blue may spend its entire lifecycle in these areas and may be more susceptible to the effects of malathion if used (Jacob Martin, pers. comm. US FWS ATF Co-Occurrence Analysis 2016).

All life stages of Smith's blue are dependent on either coast buckwheat (*Eriogonum latifolium*) or seacliff buckwheat (*E. parvifolium*) (USFWS 2006). The adults feed on the nectar and deposit eggs on the flowers and larvae feeding on the flowers and seeds and pupate on or beneath the plants. Pupae are formed between mid-August and early September. Synchronous with peak flowering of their host buckwheat plants, adult Smith's blue butterflies emerge from their pupal cases for a single flight season extending from mid-June to early September. At a particular location, adults are generally active for about four to ten weeks, but the adult activity period and

duration can vary dramatically from year to year and from one location to another (Arnold 2002). Therefore, Smith's blue is vulnerable to the effects of malathion throughout its entire lifecycle, especially vulnerable are the larval and adult stages if applications are made from mid-June through September.

Smith's blue is a facultative myrmecophile; has a symbiotic relationship with ants (Black and Vaughan 2005).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|---------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 85,601 | 17.5 | NA | NA |
| Other Grains | D,I | 105 | 0.02 | 3.6 | 0.00074 |
| Open Space Developed | D,I | 26,904 | 5.5 | 1,345 | 0.27 |
| Developed | D,I | 18,149 | 3.71 | 907 | 0.19 |
| Other Crops | D,I | 496 | 0.1 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 479 | 0.1 | 479 | 0.1 |
| Orchards and Vineyards | D,I | 210 | 0.04 | 0 | 0 |
| Wheat | D,I | 1,623 | 0.03 | 0 | 0 |
| Other Grains | D,I | 105 | 0.02 | 0 | 0 |
| Pasture | D,I | 50 | 0.01 | 0 | 0 |
| Nurseries | D,I | 45 | <0.01 | 0 | 0 |
| Corn | D,I | 15 | <0.01 | 0 | 0 |
| Rice | D,I | 2 | <0.01 | 0 | 0 |
| Cotton | D,I | 2 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 46,723 | 9.57 | 2,735 | 0.56 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 46,723 | 9.57 | 2,735 | 0.56 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| TOTAL ⁴ : | | 132,324 | 27.07 | 2,735 | 0.56 |

acres in species range: 489,492 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 235,774 acres, 48.2%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Smith’s blue butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Smith's blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Smith's blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 10.0% mortality of individuals, up to 11.0% mortality from spray drift, a loss of about 10.0% of symbiotic ants in use areas, and an additional loss of up to 11.0% of symbiotic ants due to spray drift. In addition, there could be up to 18.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.56% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar usage levels in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and timing restrictions for mosquito control, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species. Thus, while we anticipate that small numbers of individuals may be affected over the duration of the Action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Smith's blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---|------------------------------|------------|
| <i>Heraclides aristodemus ponceanus</i> | Schaus swallowtail butterfly | 429 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: All populations stable, with none known to be increasing or decreasing

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Schaus swallowtail is currently extant on several islands within Biscayne National Park (BNP) and on north Key Largo (Crocodile Lake National Wildlife Refuge [NWR]; Dagny Johnson Key Largo Hammock State Park). However, at the time of listing the historical range was believed to have included the entire Florida Keys and southern tip of Florida (namely all hardwood hammocks from Everglades National Park south to Key West). Subsequent review of Schaus' distribution suggests the subspecies largely occurred within the northern Keys, westward onto coastal areas of Miami (modern day Coral Gables) (Henderson 1945; Kimball 1965). Although there are a few extremely old reports of Schaus' observations from the lower Keys and the Everglades, Kimball (1965) suggested these were rare and in some instances dubious. Schwartz (1987), who conducted the most extensive review of butterflies of the lower Keys, indicated that aside from a single old record of Schaus from Key West, the subspecies is otherwise unknown from south of the Matecumbes (a neighborhood within the village of Islamorada). Lenczewski (1980) did not include Schaus on her comprehensive historical summary of butterflies known to occur in the Everglades. Therefore, the lower Florida Keys and the Everglades are not included within the historical range discussed as part of the delisting criteria for this subspecies.

Although Schaus' populations have been monitored for several decades, it has only been since 2011 that the subspecies' range-wide abundance and distribution have been evaluated in a consistent manner from year-to-year. A total of 4 and 32 individuals were encountered range-wide in 2012 to 2013, respectively (Daniels 2015). However, as a result of captive releases and normal seasonal conditions (rainfall, abundant fresh host plant growth), observations of Schaus' densities increased in subsequent years (Daniels 2015; Tedford, pers. comm. 2017, 2018; Daniels, pers. comm. 2017; Cabrera, pers. comm. 2018). In 2018, naturally occurring Schaus' numbers increased to 438 individuals within the stronghold regions (Elliott Key within BNP and northern Key Largo) (Daniels, pers. comm. 2018a; Tedford, pers. comm. 2017, 2018). Therefore, captive-reared stock has or will be used to augment populations on other islands within BNP, as well as at locations on central Key Largo (i.e., John Pennekamp Coral Reef State Park) (Daniels,

pers. comm. 2018b).

Predominant threats described at the time Schaus swallowtail butterfly (SSB) was listed were habitat destruction, mosquito control practices, and illegal collecting. None of these threats has been eliminated, although each has been reduced. Habitat destruction due to human population growth and associated development has been significantly reduced. However, detrimental habitat effects associated with earlier development, including fragmentation, persist over much of the historic range. Invasive, exotic plants are largely actively controlled and currently do not appear to be an imminent threat. Poaching has the potential to be a significant threat. Predation due to fire ants appears to remain at least a moderate threat, while the threat of predation from twig ants appears to be high. In fact, non-native predators, including Mexican twig ants, fire ants, and other tramp ants, may be among the greatest threats to SSB. Mosquito abatement efforts appear to have contributed significantly to SSB declines and continue to pose a threat to population viability. Currently, regulatory mechanisms provide significant protections to SSB. However, some of the suitable habitat outside of the core remains vulnerable to development pressure and regulatory mechanisms do not provide protection from non-native ants or mosquito control practices at any location. The threat of sea-level rise is potentially high, but these effects have yet to be simulated and projected for the range of the SSB. Hurricanes and tropical storms, depending on location and intensity of catastrophic winds, could result in SSB extirpation or extinction. The SSB appears to be vulnerable to extinction due to limited range, number of populations, and abundances. The SSB has exhibited an overall consistent decline in abundance over the long-term. Additionally, information spanning at least 70 years indicates that the extent of the range has consistently declined without any significant and enduring reversals.

As described in the Recovery Plan Amendment (2019), although mosquito management efforts are believed to have historically contributed to Schaus' declines, ongoing coordination between the Service, its partners, and mosquito control districts have greatly reduced this threat. Mosquito control pesticides are restricted from the islands of BNP, as well as within Crocodile lake NWR on northern Key Largo. However, the Service and Florida Keys Mosquito Control District have coordinated (in order avoid or minimize any impacts to occupied hardwood hammocks and butterfly habitat) to allow limited treatments in these areas during emergency situations (such as post-Irma). That said, occupied and suitable Schaus' habitat on State lands on northern Key Largo and southward in the keys remain subject to pesticide applications.

EB/CE Sources: U.S. Fish and Wildlife Service. 2008. Schaus' swallowtail butterfly (*Heruclides aristodeni ponceanus*) 5-Year Review: Summary and Evaluation. South Florida Ecological Services Office, Vero Beach, Florida. 29 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for the endangered Schaus' swallowtail butterfly (*Heruclides aristodeni ponceanus*). Atlanta Fish and Wildlife Office, Georgia. 9 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Schaus swallowtail butterflies exposed to malathion at maximum rates varies between use sites, with 2% mortality expected for open space developed, 5% mortality expected for developed, and <1% mortality expected on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 3% |
| Spray drift areas – mortality | 0% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 3% |
| MOSQUITO CONTROL | |
| Direct - mortality | 27% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Schaus swallowtail butterfly flight season is ~May-June. New surveys conducted from 2014-2017 found adults in August and September, suggesting this species may be bivoltine (multiple broods) (2021 5-year Status Review). This butterfly uses torchwood and wild lime (*Zanthoxylum fagara*) to deposit its eggs in sub-tropical dry forests (hardwood hammock). Single eggs are laid on the upper surface of the tips of the leaves and take 3 to 5 days to hatch. The chrysalis stage can last either 1 or 2 years. Therefore, the Schaus swallowtail butterfly is vulnerable to the effects of malathion throughout its entire lifecycle. The larval and adult stages are especially vulnerable if applications are made from May through July, and potentially through September given results from recent surveys

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|--------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 62,483 | 27 | 30,368 | 13.1 |
| Developed | D,I | 5,359 | 2.31 | 268 | 0.116 |
| Open Space Developed | D,I | 2,936 | 1.27 | 147 | 0.06 |
| Orchards and Vineyards | D,I | 10 | 0.004 | 10 | 0.004 |
| Vegetables and Ground Fruit | D,I | 2 | 0.0009 | 2 | 0.0009 |
| Other Crops | D,I | 3.6 | 0.002 | 0 | 0 |
| Other Grains | D,I | 1.7 | 0.0007 | 1.7 | 0.0007 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 70,795 | 35 | 30,797 | 13.3 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 8,312 | 3.3 | 429 | 0.18 |
| TOTAL⁴: | | 70,795 | 35 | 30,797 | 13.3 |

acres in species range: 231,573 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 86,250 acres, 37.3%

Overall Usage: ☒ High ☐ Medium ☐ Low**CONSERVATION MEASURES**

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

*General Measures*¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Schaus swallowtail butterfly, are most active (see *Effects of the Action* section for further discussion). This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific measures

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, additional species-specific conservation measures are outlined below. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

Where feasible, do not apply product within Biscayne National Park, Crocodile Lake National Wildlife Refuge, and in tropical hardwood hammock habitat within the species' range. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the Refuge manager or Park superintendent, and the local FWS Ecological Services field office to ensure the proposed application is likely to have no more than minor effects to the species (Refuge and Park staff have experience working with this species and coordinate with the local FWS field office, though the FWS field office should be contacted). FWS points of contact are available through the Information, Planning, and Consultation (IPaC) website <https://ecos.fws.gov/ipac/>. The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, including the general and species-specific conservation measures described above, is not likely to jeopardize the continued existence of the Schaus swallowtail butterfly.

The Schaus swallowtail butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is high based on standard usage data.

For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. The Schaus swallowtail butterfly range occurs on Federal lands (37.3%) and non-Federal lands. Extant populations occur on several islands within Biscayne National Park and on north Key Largo (Crocodile Lake National Wildlife Refuge; Dagny Johnson Key Largo Hammock State Park).

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 3% mortality of individuals, up to 0% mortality from spray drift. In addition, there could be up to 27% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 13.3% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. As noted above, mosquito abatement efforts appear to have contributed significantly to Schaus swallowtail butterfly declines and continue to pose a threat to population viability.

However, implementation of the general and species-specific conservation measures described above are expected to appreciably reduce the likelihood of exposure. The main use driver for this species is mosquito control. As a result, to reduce anticipated exposure and resultant mortality from mosquito uses, a conservation measure will be implemented that restricts this use within the range of the butterfly. More specifically, where feasible, use will be prohibited within the three main areas where this species currently occurs: Biscayne National Park, Crocodile Lake National Wildlife Refuge, and other areas of tropical hardwood hammock within its range (mainly within the Dagny Johnson Key Largo Hammock State Park). If avoidance is not feasible, such as to protect the public's health and welfare, the applicator must coordinate with the Refuge manager or Park superintendent, and the local FWS field office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species.

Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as specific timing, species life history, and geographic or habitat factors. Coordination with FWS on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. In its 2021 Best Practices for Integrated Mosquito Management, the American Mosquito Control Association (AMCA) instructs applicators with listed species in their treatment area to coordinate with FWS prior to application and maintain records of interactions. Discussions with the AMCA and anecdotal reports from FWS field offices indicate that this type of coordination is presently occurring to varying degrees for mosquito control applications in general. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing us to better track this coordination and its outcomes moving forward.

For the Schaus swallowtail butterfly specifically, there is already ongoing coordination between the Service and the Florida Keys Mosquito Control District to ensure avoidance and minimization of impacts to this species and its preferred habitat, particularly within Crocodile Lake National Wildlife Refuge and Biscayne National Park, as discussed in the 2019 Recovery Plan Amendment for this species. The new species-specific conservation measure (as described above) will expand upon that ongoing coordination to other suitable habitats within the range of the Schaus swallowtail butterfly where rediscovered or released populations continue to expand the occupied habitat of this species.

We anticipate that the species-specific conservation measure, in combination with the ongoing coordination, will appreciably reduce exposure of this species to malathion from mosquito control and thus significantly limit mortality of individuals. The general conservation measures would further reduce the likelihood of exposure from mosquito adulticide and other uses. While we anticipate reduced mortality, small numbers of individuals may be affected over the duration of the action (in the form of the loss of a small number of individuals), however we do not anticipate malathion usage within the range of this species will result in species-level effects.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Schaus swallowtail butterfly in the wild.

Conclusion: Not likely to jeopardize

Additional Reference:

AMCA. 2021. Best Practices for Integrated Mosquito Management. American Mosquito Control Association. Sacramento, CA.

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------------|-------------------------------|------------|
| <i>Speyeria callippe callippe</i> | Callippe silverspot butterfly | 430 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: All populations stable, with none known to be increasing or decreasing

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The callippe silverspot butterfly (*Speyeria callippe callippe*) is a single subspecies within a 19 subspecies complex of *Speyeria callippe*. The boundaries of the butterfly's range are not completely described and hybridization is believed to occur with two conspecifics: *S. c. liliana* in the northern portion of the subspecies range and *S. c. comstockii* in the north, east and southern portion of the subspecies range. Of two known extant populations described in the listing rule, only the San Bruno Mountain population is known to be extant, while the second described population once observed at a county park in Alameda County is believed to have been extirpated. An additional population in the Cordelia Hills of Solano County, discovered after listing, is considered to be *S. c. callippe*. Other populations observed at the hills near Pleasanton (Alameda County), at Sears Point (Sonoma County), and at the Calaveras Reservoir (Alameda County) have not been verified. Populations of callippe silverspot butterfly that are presently afforded protection include the population found in the hills between Vallejo and Cordelia that are on a preserve that is managed by the Solano Land Trust and the population at San Bruno Mountain that is protected through the Habitat Conservation Plan. Habitat for this butterfly has been fairly well defined. The following factors have been shown to be necessary components of suitable habitat for the callippe silverspot butterfly: grasslands with proper topography in the San Francisco Bay area, with sufficient larval host plant (*Viola pedunculata*), adequate nectar sources, within the area influenced by coastal fog, and hilltops for mating congregations. As of the 2020 5-Year Review, one population was in moderate condition and the remaining three were in low condition.

Threats to the callippe silverspot butterfly that were identified when the butterfly was listed (1997) and that still persist include the loss of suitable habitat to urbanization and fragmentation in the San Francisco Bay area, grassland conversion, habitat modification through non-native plants (and subsequent elimination of *Viola pedunculata* host plants through competition), pesticide use, fire, small population size, and climate change. Predation, poaching by insect collectors, human recreation, road mortalities, deposition of nitrogen from local traffic that

encourages invasive plants, and dust from the San Bruno Mountain quarry are also considered threats to individuals.

EB/CE Sources: U.S. Fish and Wildlife Service. 2009. Callippe silverspot butterfly (*Speyeria callippe callippe*) 5-Year Review. Sacramento Fish and Wildlife Office, California. 30 pp.

U.S. Fish and Wildlife Service. 2020. Callippe silverspot butterfly (*Speyeria callippe callippe*) 5-Year Review. Sacramento Fish and Wildlife Office, California. 4 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: We anticipate that 2-28% of Callippe silverspot butterflies exposed to malathion for other grains, orchards and vineyards, open space developed, and developed at maximum rates on use sites will die or experience indirect effects, depending on the use site. We anticipate <1% mortality for each other use site. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 42% |
| Spray drift areas – mortality | Up to 27% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 39% |
| MOSQUITO CONTROL | |
| Direct - mortality | 75% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Callippe silverspot lays eggs in the dried remains of their host plant, *Viola pedunculata* (Johnny Jump Up) or on the surrounding debris. Within a week the larvae hatch and eat their egg shells, wander a short distance, and spin a silk pad upon which they pass the summer and winter in diapause (an inactive period). Upon termination of diapause in the spring, the larvae search for food plants, grow through five larval stages or instars, and pupate in a composite leaf and silk chamber. Adults emerge in about 2 weeks and fly for about 3 weeks from about mid-May to about late July. Because the height of feeding and reproductive activities for this butterfly occurs from mid-May through July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle.

Hilltopping behavior is practiced by this butterfly, which allows males and receptive females to congregate on topographic summits to find mates.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 364,229 | 75.0 | 0 | 0 |
| Orchards and Vineyards | D,I | 7,986 | 1.6 | 35 | 0.007 |
| Developed | D,I | 138,516 | 28.4 | 6,926 | 1.42 |
| Open Space Developed | D,I | 45,730 | 9.38 | 2,286 | 0.47 |
| Other Grains | D,I | 7,291 | 1.5 | 0 | 0 |
| Other Crops | D,I | 1,736 | 0.36 | 0 | 0 |
| Pasture | D,I | 631 | 0.13 | 0 | 0 |
| Wheat | D,I | 591 | 0.12 | 0 | 0 |
| Nurseries | D,I | 403 | 0.08 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 190 | 0.04 | 11 | 0.002 |
| Corn | D,I | 66 | 0.01 | 0 | 0 |
| Rice | D,I | 54 | 0.01 | 0 | 0 |
| Other Row Crops | D,I | 49 | <0.01 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Cotton | D,I | 5 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 203,247 | 41.65 | 9,258 | 1.90 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 203,247 | 41.65 | 9,258 | 1.90 |
| TOTAL⁴: | | 567,477** | 100 [#] | 9,258 | 1.90 |

[#]Use overlaps with range are additive and cannot be greater than 100%

**Overlap acreage greater than acres in species range

acres in species range: 487,676 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 19,076 acres, 3.91%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Callippe silverspot butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Callippe silverspot butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Callippe silverspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 42.0% mortality of individuals, up to 27.0% mortality from spray drift. In addition, there could be up to 75.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure and subsequent loss of butterflies occurs during a breeding event, when numerous adults are present in the same location, a larger proportion of individuals would be killed. Where a population is extirpated, recolonization will not occur due to the isolated and fragmented nature of the populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.90% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new

restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Callippe silverspot butterfly exists primarily on San Bruno Mountain near San Francisco, California, thus putting it in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Callippe silverspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------------------|-----------------------------|------------|
| <i>Speyeria zerene hippolyta</i> | Oregon silverspot butterfly | 431 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (11/23/2020): Uplist to Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Oregon silverspot butterflies inhabit three types of early successional grassland habitats. One habitat type consists of marine terrace and coastal headland “salt spray” meadows as exhibited at Cascade Head, Bray Point, Rock Creek-Big Creek, Nestucca Bay NWR, and portions of the Del Norte site. The second consists of stabilized dunes as found at the Long Beach Peninsula, Clatsop Plains, and the remainder of the Del Norte site. Both of these habitats are strongly influenced by proximity to the ocean, with mild temperatures, high rainfall, and persistent fog. The two habitats differ in topography, soils, and exposure to winds. The dune habitat has lower relief, highly porous soils, and less exposure to winds. The third habitat type consists of montane grasslands found on Mount Hebo and Saddle Mountain. Conditions at these sites include colder temperatures, frequent orographic cloud cover, significant snow accumulations, less coastal fog, and no salt spray. Each of these habitat types must provide two essential resources — caterpillar host plants and adult nectar sources — as well as other suitable environmental conditions. Stands of early blue violets sufficient to provide enough food for Oregon silverspot butterfly caterpillars occur only in relatively open and lowgrowing grasslands.

At least two viable Oregon silverspot butterfly populations exist in protected habitat in each of the following areas: Coastal Mountains, Cascade Head, and Central Coast in Oregon; and Del Norte County in California; and at least one viable Oregon silverspot butterfly population exists in protected habitat in each of the following areas: Long Beach Peninsula, Washington, and Clatsop Plains, Oregon. Historically, the Oregon silverspot butterfly was distributed along the Washington and Oregon coasts from Westport in Grays Harbor County, Washington, south to Heceta Head in Lane County, Oregon, with a disjunct population located north of Crescent City in Del Norte County, California. At least 20 separate locations were known to support Oregon silverspot butterfly in the past, discovered 1895-1975 (McCorkle et al. 1980). At the time of listing in 1980, only the Rock Creek-Big Creek population and what was then called the Tenmile Creek population, now called the Bray Pt. population, were considered healthy. One population in Washington and 7 populations in Oregon were mentioned in the 1980 listing document. Currently just 5 populations are known to be extant, located at Rock Creek-Big Creek, Bray Pt,

Cascade Head and Mt. Hebo, OR and the Del Norte County, CA. As of the 2020 5-Year Review, the Mount Hebo and Lake Earl populations have declined and no longer considered stable or self-sustaining, (as previously described in the 2012 5-Year Review). Two non-essential experimental populations were established at Saddle Mountain State Natural Area and Nestucca Bay National Wildlife Refuge.

Central to the life cycle of the Oregon silverspot butterfly is the abundance of the caterpillar host plant, the early blue violet (*Viola adunca*). Field studies have demonstrated that female butterflies select areas with high violet densities for egg-laying (Fish and Wildlife Service 2001, Damiani 2011). Based on laboratory studies 200-300 violets leaves are needed to allow an Oregon silverspot butterfly to develop from caterpillar to pupae. In the wild a caterpillar would require a clump of approximately 16 violet plants for development, assuming each violet could provide about 12 to 20 leaves. Based on studies of other butterflies, nectar abundance and quality are also important to adult survival and particularly fecundity (Schultz and Dlugosch 1999, Boggs and Ross 1993, Mevi-Schutz and Erhard 2005). Plants that provide nectar to adult butterflies include yarrow (*Achillea millefolium*), pearly everlasting (*Anaphalis margaritacea*), Pacific aster (*Aster chilensis*), Canada goldenrod (*Solidago canadensis*), tansy ragwort (*Senecio jacobaeae*) and edible thistle (*Cirsium edule*).

The combined threats of isolated and small populations, lack of population stability, limited availability of suitable habitat (especially lack of high density concentrations of the larval host plant, the early blue violet), habitat degradation from succession and invasive plants, and vulnerability to extreme weather events (i.e., drought, sea-level rise, other climate change effects) continue to endanger the species throughout its range. Genetic diversity that may previously have resided within various populations of the subspecies has likely been reduced by significant population declines as well as the necessity of augmenting populations throughout the range with individuals captured at the one large population at Mount Hebo. The Rock Creek and Lake Earl populations may still contain a limited reservoir of genetic variability, but these populations are extremely small, thus the likelihood that they may still preserve unique genes is greatly reduced.

EB/CE Source: U.S. Fish and Wildlife Service. 2020. Oregon silverspot butterfly (*Speyeria zerene hippolyta*) 5-Year Review: Summary and Evaluation. Newport Field Office, Oregon. 41 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Oregon Silverspot butterflies exposed to malathion at maximum rates will be 1% for pasture and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 3% |
| Spray drift areas – mortality | Up to 5% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 1% |
| MOSQUITO CONTROL | |
| Direct - mortality | 1% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Oregon silverspot deposits eggs during late August-September. The larvae hatch in approximately sixteen days, and the newly hatched larvae wander a short distance to find a suitable place for diapause (i.e., suspension of growth for overwintering). In late spring and early summer, the larvae emerge, feed, and grow for two months going through six instars (i.e., developmental stages). Larvae then pupate for two weeks (in July-September) then the butterfly emerges from its chrysalis as an adult (USFWS SOS 2016). Because the height of feeding and reproductive activities for this butterfly occur from ~May through September, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle

There are only five remaining populations of Oregon silverspot butterfly in existence - four in Oregon and one in northern California. Each small population is at great risk of extirpation. The Oregon silverspot butterfly 5-Year Review (USFWS 2012) concluded that the butterfly “is in danger of extinction throughout its range” and recommended an up-listing to endangered status.

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)***Agricultural usage based on CalPUR data**

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 56,811 | 0.97 | 21,682.54 | 0.37 |
| Pasture | D,I | 67,470 | 1.15 | 106 | 0.002 |
| Open Space Developed | D,I | 39,192 | 0.67 | 1,960 | 0.033 |
| Developed | D,I | 15,927 | 0.27 | 796 | 0.014 |
| Wheat | D,I | 15,428 | 0.26 | 0 | 0 |
| Other Crops | D,I | 9,571 | 0.16 | 0 | 0 |
| Other Grains | D,I | 5,604 | 0.1 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 213 | <0.01 | 92 | 0.002 |
| Nurseries | D,I | 31 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | 9 | <0.01 | 0 | 0 |
| Rice | D,I | 8 | <0.01 | 0 | 0 |
| Orchards and Vineyards | D,I | 8 | <0.01 | 0 | 0 |
| Cotton | D,I | 3 | <0.01 | 0 | 0 |
| Corn | D,I | 2 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 153,466 | 2.68 | 2,954 | 0.05 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 153,466 | 2.68 | 2,954 | 0.05 |
| TOTAL⁴: | | 210,277 | 3.65 | 24,637 | 0.421 |

acres in species range: 5,860,147 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 4,548,610.91 acres, 77.6%

Overall Usage: ☐ High ☐ Medium ☒ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Oregon silverspot butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Oregon silverspot butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Oregon silverspot butterfly. As discussed below, even though the vulnerability is high and risk is medium for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Oregon silverspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is medium. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 3.0% mortality of individuals, up to 5.0% mortality from spray drift. In addition, there could be up to 1.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.421% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability is high and risk is medium for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range and a large proportion (77.6%) of the species range is on federal lands. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Oregon silverspot butterfly may occur in areas where mosquito treatment with malathion is anticipated to occur. The conservation measure described above will prohibit malathion use for mosquito control during most daylight hours, when this butterfly is most active. This is anticipated to further limit the exposure and resultant mortality of this species. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Oregon silverspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---|-----------------------------|------------|
| <i>Glaucopsyche lygdamus palosverdesensis</i> | Palos Verdes blue butterfly | 432 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Historically, Palos Verdes blue butterflies were known to occur throughout the coastal slope of the topographically diverse Palos Verdes peninsula in Los Angeles County, California. The subspecies was subsequently considered extinct, and then rediscovered at a site outside its former known range on the inland, more eastern, slope of the peninsula. When the Palos Verdes blue butterfly was recognized as a distinct subspecies in the 1970s, its range and distribution were already reduced by grazing, agriculture, and residential and urban development (USFWS 1984, p. 4; Mattoni 1994, pp. 183 and 185). The type locality (where the subspecies was first collected and identified) on the Alta Vista Terrace was extirpated in 1978 after the area was developed for residential use (USFWS 1984, p. 4; Arnold 1987, p. 207; Mattoni 1994, p. 183).

At listing there were three known occupied localities, which were designated as critical habitat: Agua Amarga Canyon, Frank Hesse [Memorial] Park, and Palos Verdes Drive [East] (USFWS 1980, p. 44942). Three years after listing, the Recovery Plan (USFWS 1984, p. 4) described seven extant locations: Agua Amarga Canyon, Frank Hesse Memorial Park, Crest Road, Portuguese Canyon, Phantom Drive, Palos Verdes Drive East, and San Pedro Hill. There was one additional historical location near Palos Verdes Drive East that was reported in 1987 (from 1982) not mentioned in the Recovery Plan (Service GIS database from Arnold 1987 data), bringing the total to eight. No individuals could be found within the historical range between 1983 and 1993, leading to the conclusion that the Palos Verdes blue butterfly was likely extinct (Mattoni 1994, p. 185). However, the Palos Verdes blue butterfly was subsequently discovered in 1994 on the Defense Fuel Support Point, San Pedro (DFSP San Pedro; Mattoni 1994, p. 185), located east of the former known range. Palos Verdes blue butterfly is currently presumed extant at two known areas: (1) DFSP San Pedro and adjacent former Palos Verdes Navy housing area (DFSP San Pedro/Navy housing site), and (2) Chandler Preserve. The species may be extant at the Malaga Dune site, but the status is currently unknown. The only area consistently occupied by Palos Verdes blue butterflies since rediscovery is the DFSP San Pedro/Navy housing site. There are several additional sites within the Palos Verdes blue butterfly's historical range that are

recognized habitat for the subspecies, but not currently occupied. These include the former Palos Verdes Drive East Colony location that was occupied in the 1980s (USFWS 1984, pp. 4, 6, 9, 13, and 22), the adjacent Trump National Golf Course (Ocean Trails, L.P, pp. 6 and 7) where Palos Verdes blue butterflies were released in 2009, and Deane Dana Friendship Community Regional County Park (Friendship Park; Sapphos Environmental 2007) where Palos Verdes blue butterflies were released in 2009 and 2010. Palos Verdes Drive East Colony is designated critical habitat (USFWS 1980, p. 44942) and was described in the Recovery Plan as one of the largest colonies in 1982 with 100 hostplants (USFWS 1984, pp. 9 and 22). Introduction was initially successful at Trump National Golf Course, but this site is not believed to be extant (T. Longcore 2012, pers. comm.), and introduction does not appear to have been successful at Friendship Park (Osborne 2013, p. 3).

Since the 2008 5-Year Review, natural succession has become a greater threat, but no loss of Palos Verdes blue butterfly habitat is known to have occurred. Some small habitat patches have been restored and reintroduction efforts have continued and further expanded to additional sites. Management for succession and non-native invasive plants is crucial, because the Palos Verdes blue butterfly populations are still limited to two relatively small, disjunct sites (unknown at the time of listing, only one wild established population). The potentially occupied Malaga Dune site is not conserved through any permanent conservation easements or other perpetual conservation strategies. All occupied habitat requires management to control the spread of non-native plants, and maintaining enough habitat in an early successional state to support hostplants and butterflies. Therefore, habitat modification, including natural succession, poses an ongoing threat to Palos Verdes blue butterfly survival and recovery. Disease is still not known to substantially impact the subspecies. However, the 2008 status review (USFWS 2008, p. 6) noted there is concern that watering of hostplants during habitat restoration may result in larval and egg predation by earwigs (Dermaptera). Although this is a potential threat that should be considered in future research efforts, it is not currently considered significant.

Federal and State actions may provide some discretionary conservation benefit to the Palos Verdes blue butterfly. The Act is the primary regulatory mechanism mandating conservation and ensuring that the subspecies is addressed during planning efforts that may impact the species or its habitat. Because the one established population at Defense Fuel Support Point (DFSP) San Pedro is under the Navy's jurisdiction, Section 7 of the Act is the primary Federal process for addressing Palos Verdes blue butterfly conservation needs at this site. Section 10 of the Act is the primary Federal process for addressing both the economic development needs of the Palos Verdes Peninsula and the conservation needs of the species on private lands. Thus, it is through the Act that we continue to work with our Federal and State partners, local jurisdictions, and private landowners to implement actions to reduce ongoing threats and recover this subspecies. Due to the small size of the Palos Verdes blue butterfly population at the DFSP San Pedro/Navy housing site, and the uncertain status of establishment or persistence at other sites, natural and anthropogenic threats are ongoing and affect the entire range of the subspecies. The subspecies' survival remains insecure because of the combined threats of isolation and vulnerability of small populations from stochastic processes. However, work is being done to develop the Rancho

Palos Verdes Natural Community Conservation Plan/Habitat Conservation Plan and effective reintroduction efforts and successful habitat management practices are being investigated to ensure Palos Verdes blue butterfly persistence in the future.

In the absence of the DFSP survey report for 2018 and in preparation for the 2019 5-Year Review, Service staff asked the lead investigator/expert who has been managing or involved in recovery actions for the species at DFSP since its discovery there, Travis Longcore (Ph.D., Urban Wildlands Group), for his assessment of the species' current status. Longcore (2019, pers. comm., as cited in the 5-Year Review) stated "...I would not consider the species to be extinct in the wild [as some were concerned might be the case]. This past season we observed a few butterflies at DFSP that were not associated with releases from the captive breeding program. There are also other sites on the Palos Verdes Peninsula where butterflies have been observed in the past (e.g., near Malaga Dune) for which recent surveys have not been undertaken. I am also not certain of the status of the population at the Chandler Preserve."

Current threats to survival of the Palos Verdes blue butterfly include habitat conversion through non-native plant invasion and ecological succession, and small population size. Small population size makes this subspecies susceptible to impacts by stochastic events, including events such as potential novel disease epidemics, severe weather, genetic bottlenecks, and wildfire. Non-native plant invasion and ecological succession result in loss of hostplants. The primary measures in place to reduce these threats are vegetative management and captive propagation. Climate change may increase the severity of current threats. While the threats of habitat loss and small population size are cumulative (together they pose a greater threat than either alone), the best available information concerning the butterfly's status does not allow us to assess the magnitude or immediacy of potential combined impacts at this time.

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, California. 31 pp.

U.S. Fish and Wildlife Service. 2019. Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, California. 9 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Palos Verdes blue butterflies exposed to malathion at maximum rates will be 7% for open space developed, 16% for developed, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 23% |
| Spray drift areas – mortality | Up to 9% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 24% |
| MOSQUITO CONTROL | |
| Direct - mortality | 51% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Palos Verdes larva emerge after 7-10 days and only feed on the larva host plants locoweed (*Astragalus trichopodus* var. *lonchus*) or deerweed (*Acmispon glaber*) and depend on the presence of these plants entirely for their survival (USFWS 2014). There are five larval instars. In April and May, the mature larvae exit the seed pods and crawl down to the base of the plant to pupate in the dried leaf litter. The adult flight period and reproductive window is tied to host plant flowering and generally occurs from the second week in February until the end of March. Because of the tight association of the butterfly flight and reproductive timing with the presence of the host plant occurring from February through March, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Palos Verdes blue adults will travel/forage in developed and open space developed areas (no name pers. comm., US FWS co-occurrence ATF 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 360,483 | 51.0 | 0 | 0 |
| Corn | D,I | - | 0 | 43.8 | 0.006 |
| Developed | D,I | 115,859 | 16.37 | 5,793 | 0.82 |
| Open Space Developed | D,I | 50,375 | 7.12 | 2,519 | 0.36 |
| Nurseries | D,I | 353 | 0.05 | 1 | <0.001 |
| Other Crops | D,I | 69 | <0.01 | 0 | 0 |
| Pasture | D,I | 20 | <0.01 | 0 | 0 |
| Orchards and Vineyards | D,I | 20 | <0.01 | 0.2 | <0.001 |
| Vegetables and Ground Fruit | D,I | 10 | <0.01 | 9.9 | <0.001 |
| Other Grains | D,I | 8 | <0.01 | 0 | 0 |
| Wheat | D,I | 6 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | 2 | <0.01 | 0 | 0 |
| Cotton | D,I | 1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 166,724 | 23.62 | 8,367 | 1.19 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 166,724 | 23.62 | 8,367 | 1.19 |
| TOTAL⁴: | | 527,207 | 74.62 | 8,367 | 1.19 |

acres in species range: 707,667 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 349,608 acres, 49.4%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Palos Verdes blue butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Palos Verdes blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Palos Verdes blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 23.0% mortality of individuals, up to 9.0% mortality from spray drift. In addition, there could be up to 51.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable

habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.19% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and timing restrictions for mosquito control uses, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

We anticipate a loss of individuals may occur if malathion is used within the range of the species, and plants used for feeding and nectaring may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Palos Verdes blue butterfly.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------|---------------------------|------------|
| <i>Euproserpinus euterpe</i> | Kern primrose sphinx moth | 433 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Since the Kern primrose sphinx moth was listed in 1980 (45 FR 24088), new findings include: 1) an expansion in the distribution of the Kern primrose sphinx moth to include the area in and around the Carrizo Plain and Cuyama Valley; 2) the species found at the Carrizo Plain and Cuyama Valley is apparently the same species as the Kern primrose sphinx moth found at Walker Basin (based on the results of both morphological and genetic research); and 3) the Kern primrose sphinx moth larvae can travel small distances between plants and may still survive even if adult Kern primrose sphinx moth lay eggs on non-host plants. In 2015, two new occurrence locations were found within the Carrizo Plain population (Bureau of Land Management [BLM] 2016) and the latest survey completed in 2019 found an overall average flight season with moths continuing to be observed in known locations (BLM 2020).

The Kern primrose sphinx moth is a species confronted with a high degree of threats, primarily from habitat loss due to grazing, disking, herbicide and pesticide use, and development; collection of individuals, and non-native plants. New threats identified in the 2019 5-Year Review include succession of alluvial fans, road kill of basking moths, trampling from grazing, and off-road vehicle use. Known populations of Kern primrose sphinx moth are not adequately protected, mainly because the majority of populations at the Carrizo Plain, at the Cuyama Valley, and at Walker Basin exist on private lands. The Kern primrose sphinx moth population at Walker Basin is threatened by residential development, vehicular strikes of basking adult Kern primrose sphinx moths, and agricultural disking practices. The Kern primrose sphinx moth populations at the Carrizo Plain are threatened by habitat degradation due to sheep grazing and by off-road vehicle (ORV) use. The Kern primrose sphinx moth populations in the Cuyama Valley are threatened by habitat degradation due to agricultural use, sheep penning, road maintenance, and ORV traffic.

The Kern primrose sphinx moth is considered to have a high potential for recovery because there exists suitable habitat on public lands at the Carrizo Plain and Cuyama Valley that have yet to be subjected to a concentrated survey and may reveal new populations of the Kern primrose sphinx

moth. Also, owing to the capability of Kern primrose sphinx moth pupae to diapause for several years, this animal has a chance for continued survival under adverse conditions. Thus, if protected from threats, the adaptable characteristics of the Kern primrose sphinx moth appear to make this animal a good candidate for recovery. However, despite the discovery of new populations and suitable habitat, the existing threats listed above and the fact that the majority of the Kern primrose sphinx moth populations exist on private land seriously complicate the recovery of the Kern primrose sphinx moth.

EB/CE Source: U.S. Fish and Wildlife Service. 2020. Kern primrose sphinx moth (*Euproserpinus euterpe*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Field Office. 21 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Kern primrose sphinx moths exposed to malathion at maximum rates will be 1% for vegetables and ground fruit, 2% for open space developed, 4% for other crops, and <1% on all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 8% |
| Spray drift areas – mortality | Up to 24% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 2% |
| MOSQUITO CONTROL | |
| Direct - mortality | 32% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Kern primrose sphinx moth deposit eggs on the underside of the evening primrose and filaree leaves. Eggs will hatch after eleven days and there are five larval instars before pupation occurs in May. Larvae feed on sun cup or evening primrose *Camissonia contorta*. The adults may emerge the following year or may remain in the pupal stage for an undetermined number of years during dry periods (USFWS 1984; USFWS 2015). It is not known how long pupae can survive. The flight period is from late February to early April with the peak period during mid-March. Because the height of feeding and reproductive activities for this moth occur from February through April and May, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Adult Kern primrose sphinx moths will travel through agricultural fields (Timothy Ludwick, per. comm US FWS species co-occurrence ATF 2016). Therefore, adults may be more susceptible than larvae to the effects of malathion if used in these areas.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 71,754 | 31.5 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 3,200 | 1.41 | 55 | 0.024 |
| Other Crops | D,I | 8,654 | 3.8 | 0 | 0 |
| Open Space Developed | D,I | 4,148 | 1.82 | 207 | 0.09 |
| Orchards and Vineyards | D,I | 920 | 0.4 | 0 | 0 |
| Other Grains | D,I | 762 | 0.33 | 0 | 0 |
| Wheat | D,I | 657 | 0.29 | 0 | 0 |
| Cotton | D,I | 484 | 0.21 | 0 | 0 |
| Pasture | D,I | 253 | 0.11 | 0 | 0 |
| Developed | D,I | 198 | 0.09 | 10 | 0.004 |
| Corn | D,I | 66 | 0.03 | 0 | 0 |
| Rice | D,I | 1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): | | 19,343 | 8.5 | 272 | 0.118 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| <i>Other uses with direct effects only</i> ³ | | | | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 19,343 | 8.5 | 272 | 0.118 |
| TOTAL ⁴ : | | 91,097 | 40.0 | 272 | 0.118 |

acres in species range: 227,671 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 132,928 acres, 58.39%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Kern primrose sphinx moth, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Kern primrose sphinx moth. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure.

We do not expect species-level effects to occur.

The Kern primrose sphinx moth has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 8.0% mortality of individuals, up to 24.0% mortality from spray drift. In addition, there could be up to 32.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the moth populations and the limited and limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.118% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as

necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Kern primrose sphinx moth in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------------|------------------------|------------|
| <i>Hesperia leonardus montana</i> | Pawnee montane skipper | 434 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Species/Populations neither constrained nor widespread

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Pawnee montane skipper (skipper) is a small, brownish-yellow butterfly with a wing span slightly over 1 inch. The skipper is dependent on two host plants, namely dotted gayfeather (*Liatris punctata*), previously known as prairie gayfeather, and blue grama grass (*Buteloua gracilis*), within a ponderosa pine (*Pinus ponderosa*) woodland. The dotted gayfeather is the primary nectar plant for adult skippers while the blue grama grass is the primary plant for ovipositing (egg laying), larvae feeding, larvae overwintering, and pupation. The dotted gayfeather generally occurs in small openings in the forest and within more open ponderosa stands. The skipper has a narrow range that is defined by the area of overlap between the northern extension of the ponderosa pine/blue grama grass community and the southern extension of the dotted gayfeather. General characteristics of Pawnee montane skipper habitat include: tree canopy cover 30%, ponderosa pine cover 25%, Douglas-fir cover 5%, tree density less than 120 trees/ac in the smallest size class (0-5ft diameter at breast height), overall tree density less than 200 trees/ac, shrub and grass cover less than 10%, prairie gayfeather flower stem density 50-500/ac, and blue grama cover 5% or less present nearly everywhere. The flight period for adult skippers (August and September) closely corresponds with the main flowering time of the dotted gayfeather, with the primary flight period occurring from late August to early September.

The range of the Pawnee montane skipper is restricted to four Colorado counties (Teller, Park, Jefferson, and Douglas) within an area approximately 23 mi long and 5 mi wide along the South Platte River drainage system (Environmental Research and Technology, Inc. (ERT) 1986a). The total area of skipper habitat is 24,830 ac, of which 70% occurs on the Pike and San Isabel National Forests (Banks 2009, pers. comm.). The skipper has an extremely small range that is inherently restricted by the overlap of the distribution of its primary nectar plant (i.e., prairie gayfeather) and the distribution of its larval host plant, blue grama grass (USFWS 1998). The skipper population was recovering from fires and the severe drought of 2002. Fires burned

approximately 46% of the skipper's habitat since 1996, while the 2002 drought further reduced population numbers in unburned habitat.

The primary threat at the time of listing in 1987 was the construction of the Two Forks Dam and Reservoir, which would have resulted in the inundation and destruction of 22% of the skipper's habitat and the loss of 23 to 42% of the population (USFWS 1998). While this larger dam was not constructed as proposed, the potential remains for a smaller Two Forks Dam to be constructed. A smaller Two Forks Dam (345,000 ac-ft) also would inundate skipper habitat. Denver Water has voluntarily placed a moratorium on applications for development of the Two Forks Right-Of-Way through 2024 (USFS 2004). Other threats identified at the time of listing included residential and commercial development and off-road vehicle (ORV) use. These threats have not resulted in significant impacts to skipper populations or habitat, and are not expected to do so in the near future given the current levels of development. Additional threats have been identified that were not described at the time of listing and are related to forest health conditions. Fire suppression over the past 100 years has created more uniform and denser forest conditions in the lower montane forest, resulting in an increased risk of large-scale, stand-replacing fires and a reduced quality of habitat for the skipper (USFS 2000). Concerns over the risk of such wildfires in the lower montane forests in Colorado were realized in 2002 due to the Hayman Fire, which was the largest recorded wildfire in Colorado's history. The 2002 Hayman/Schoonover Fires burned more than 36% of the skipper's habitat. While skipper populations and habitat are showing recovery on the low-severity burn areas, the future of the skipper is uncertain in the moderate-to-high severity burn areas. The forest canopy has been lost in 30% of the skipper habitat affected by moderate-to-high severity burns. In areas not affected by fires, fuels reduction projects by land management agencies have demonstrated that skipper habitat and skipper densities can be improved by forest thinning treatments (Natural Perspectives 2008). A total of 27% of the skipper habitat has received fuel-reduction treatments, with additional forest thinning planned on 4% of skipper habitat. An additional threat not identified at time of listing is the effect of climate change, which has the potential to result in increased periods of drought and the intensity and frequency of wildfires, both likely to negatively affect the skipper. In conclusion, the Pawnee montane skipper continues to have a high vulnerability to a variety of threats and continues to warrant listing as a threatened species. Fires have severely altered a large amount of its habitat, fire suppression within the skipper's range has reduced the quality of its habitat, skipper population numbers are generally lower than at the time of listing, and the potential remains for a smaller Two Forks Dam and Reservoir to be constructed. Furthermore, the potential impacts of climate change, if realized, could result in additional impacts to the skipper's habitat. In the absence of listing, threats to the skipper would likely be greater than presently experienced.

EB/CE Sources: U.S. Fish and Wildlife Service. 2020. Amendment to the Recovery Plan for Pawnee Montane Skipper (*Hesperia leonardus montana*). Interior Regions 5 & 7 Regional Office, Denver, Colorado. 16 pp.

U.S. Fish and Wildlife Service. 2020. Pawnee Montane Skipper (*Hesperia leonardus montana*) 5-Year Review: Summary and Evaluation. Colorado Field Office, Lakewood, Colorado. 25 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Pawnee montane skippers exposed to malathion at maximum rates will be <1% for all use sites except mosquito control. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|-------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 1% |
| Spray drift areas – mortality | Up to 2% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | A possible source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | < 0.01% |
| MOSQUITO CONTROL | |
| Direct - mortality | 14.5 |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Pawnee montane skippers emerge from their pupae as adult butterflies in late July. The species overwinters as young larvae, and little is known of the larval and pupal stages. The skipper completes its life cycle (egg to larva to pupa to adult butterfly to egg) annually (Keenan et al. 1986). Pawnee montane skippers inhabit dry, open Ponderosa pine woodlands with sparse understory at 6,000 to 7,500 ft. The Pawnee montane skipper hibernates as young (first instar) larvae, almost certainly among dry grass blades near the base of the plant, and possibly also aestivates briefly as a mature larvae (NatureServe, 2015).

Paved parking lots, subdivisions with large lawns, ball fields, cultivated plots, and wide, paved roads do not appear to occur in skipper habitat at this time to any great extent. Habitat impacts from developments in skipper habitat are primarily in the form of rural residential driveways and buildings along the Mainstem and North Fork of the South Platte River. This type of impact from residential and commercial development is anticipated to continue at the current level and, as such, is not considered to be a significant threat to skipper habitat (2011 5-Year Review).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 72,387 | 14.5 | 0 | 0 |
| Open Space Developed | * | 3,201 | 0.64 | 160 | 0.03 |
| Developed | * | 2,012 | 0.4 | 101 | 0.02 |
| Pasture | D,I | 23 | <0.01 | 23 | <0.01 |
| Other Crops | D,I | 6 | <0.01 | 0 | 0 |
| Other Grains | D,I | 3 | <0.01 | 2 | <0.01 |
| Nurseries | D,I | 2 | <0.01 | 2 | <0.01 |
| Wheat | D,I | 2 | <0.01 | 2 | <0.01 |
| Corn | D,I | 2 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 38 | 0.06 | 29 | 0.04 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 38 | 0.06 | 28729 | 0.04 |
| TOTAL⁴: | | 772,425 | 14.6 | 29 | 0.04 |

acres in species range: 499,671 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 396,492 acres, 79.35%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Pawnee montane skipper, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Pawnee montane skipper. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Pawnee montane skipper has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 1.0% mortality of individuals, up to 2.0% mortality from spray drift. In addition, there could be up to 14.5% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the

threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, the ability of this species to recolonize the area is unknown.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.04% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range and a large proportion (79.35%) of the species range is on federal lands. Additionally, the conservation measures described above, new restrictions for residential use and mosquito control measures, will further reduce the risk of exposure to malathion. For example, the Pawnee montane skipper exists in a small area south of Denver, Colorado, thus putting it in proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action , (in the form of the loss of a small number of individuals) we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Pawnee montane skipper in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------|---------------------------|------------|
| <i>Elaphrus viridis</i> | Delta green ground beetle | 435 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

There have been no coordinated systematic annual surveys or population monitoring of the delta green ground beetle to determine population and demographic trends (USFWS 2005). When the beetle was listed in 1980 the population size was not known; however, based on the species' habitat, two critical habitat units were designated (45 FR 52807). These units are located at Olcott Lake and at a smaller playa lake in what is now the Elsie Gridley multi-species conservation bank. When the original recovery plan was published in 1985, delta green ground beetles had been found around Olcott Lake and along the west side of Cook Lane within the Jepson Prairie area; however, one of the original two sites where the delta green beetle was found had been ploughed and disced under and the population was presumed to be extirpated from that site. In 2005 the revised recovery plan, which was included among other vernal pool species, reported that there were 5 extant populations, all in the Jepson Prairie area (USFWS 2005). A recent range wide survey of the delta green ground beetle was conducted in 2007 (Arnold and Kavanaugh 2007). The survey consisted of visits to 71 wetlands that were chosen for their habitat qualities and were inbounded by Creed Road to the South, Hay Road to the North, Travis Air Force Base to the West and the preserved land along Highway 113 to the East. Within the 71 wetlands, adult delta green ground beetles were found at 32 of 81 playa pools. A total of 42 adult delta green ground beetles were counted (Arnold and Kavanaugh 2007). Unfortunately, statistical estimates of population sizes were not possible due to the limited number of individual beetles found at any one location and the population size remains unknown due to the difficulty in surveying for this cryptic beetle, its little-known biology and ecology, and other abiotic and biotic factors.

Since the delta green ground beetle was listed as threatened in 1980, the greatest change that has occurred is the acquisition of key property around the Jepson Prairie Preserve, which holds significant vernal pool and upland habitat for the beetle and for many other listed species. The 2005 Recovery Plan identified six known occurrences at that time. Unfortunately, the population sizes and trends of the beetle populations are not currently known, owing to the difficulty in visually locating these beetles during surveys and the lack of continuous and consistent

monitoring. Since the original Recovery Plan was drafted in 1985, an increase in protected land holdings with suitable habitat for vernal pool species, including the beetle, has been realized. Currently, about 11,047 ac of beetle habitat are protected, or about 54% of the suitable habitat known to be available. Not only has a substantial portion of the Wilcox Ranch, which is inhabited by populations of the beetle, been secured, but several conservation banks for mitigation involving vernal pool species were opened. However, these new acquisitions need to be considered in light of two factors. First, these acquisitions were the result of the loss or degradation of vernal pool habitat at some other location, some of which may have contained suitable beetle habitat, and may not always amount to a net increase in protected habitat for this species. Second, there are still large parcels of private land that may have suitable habitat for the beetle or have recorded occurrences of the species, but remain unprotected. The implementation of adaptive habitat management, restoration, and monitoring of preserved lands is important for the delta green ground beetle. One of the most important aspects of habitat management now is the control of invasive plants, particularly in that they adversely affect the feeding regime of the beetle. There is a draft management plan that incorporates adaptive strategies to maintain and restore the Jepson Prairie Preserve, including the Wilcox Ranch (Witham 2006). All of the local conservation banks are required to have USFWS approved management plans before they can sell credits (LSA Associates 2005).

At the time of listing, the primary threat to the delta green ground beetle was the elimination of vernal pools by agricultural conversion. At this time, the most serious threat to the beetle is habitat degradation caused by the rapid dispersal and overgrowth of invasive plants, as well as the build-up of thatch, which interfere with the beetle's feeding regime (L. Serpa, pers. comm. 2006). Another significant threat to the beetle is the continued encroachment of development projects that impact its habitat, such as: (1) maintenance activities for facilities such as electrical transmission lines located on or crossing suitable beetle habitat; (2) urban and commercial developments, including the proposed Travis Air Force Base runway expansion and the ongoing Highway 12 expansion; and (3) the possible expansion of exploratory drilling for natural gas into the Jepson Prairie Preserve. Additionally, application of wastewater sludge and global climate change threaten the delta green ground beetle. The effects of the threat from wastewater sludge and climate change are not as immediate.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Delta green ground beetle (*Elaphrus viridis*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Field Office, California. 29 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Delta green ground beetles exposed to malathion at maximum rates will be 1-10% for corn, other crops, developed, pasture, other grains, orchards and vineyards, wheat, open space developed, and vegetables and groundfruit, and <1% for all use sites except mosquito control. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 51% |
| Spray drift areas – mortality | Up to 100% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 51% |
| Spray drift areas – effects to dietary items | Up to 100% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 97.6% |
| Sublethal | NA |
| Indirect - mortality | 97.6% arthropods |

Risk modifiers:

The Delta green ground beetle lives in vernal pool systems and surrounding grassland (from water's edge with sightings hundreds of meters from shoreline during wet season). The Delta green ground beetle prefers more open habitats in the grassland-playa pool matrix where the beetle is found, such as edges of pools, trails, roads, and ditches. Adults may also occur in the surrounding grasslands (USFWS 2015).

Currently, these beetles are found only in the greater Jepson Prairie area in south-central Solano County, California (USFWS 2005). As the available habitat becomes dry, delta green ground beetle larvae crawl into cracks in the soil in preparation for pupation (USFWS 2005). There are seven stages in the life cycle: egg, three larval instars, pre-pupa, pupa, and adult.

The delta green ground beetle begins to reproduce at approximately 35 to 45 days. The breeding season lasts from February until mid-May. The clutch size is two to four eggs, and there is one

reproductive event per year. The lifespan of the delta ground green beetle is approximately 9 to 12 months (NatureServe 2015; USFWS 2005).

Goulet (1983) suggested that both larvae and adults of the delta green ground beetle are generalized predators able to eat many different kinds of prey. An important food source for the adults is springtails. These very small, soft-bodied insects are often abundant in moist areas (L. Serpa pers. comm.). Terrestrial larvae of chironomid midges (Diptera: Chironomidae) may also be a food source for both larvae and adults (Goulet 1983, H. Goulet pers. comm.). When springtails are scarce, adult midges are apparently important prey items and the beetles catch ones that happen to crash-land nearby (L. Serpa *in litt.* 1997).

Because the Delta green ground beetle has been found in trails, roads, and ditches, it is confirmed that it will travel through, forage, and reproduce in pasture land and right of ways. It is not known to occur in agricultural areas (No name. pers. comm 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 470,006 | 97.6 | 7,390 | 1.57 |
| Corn | * | 29,025 | 6 | 35 | 0.007 |
| Other Crops | * | 47,012 | 9.76 | 0 | 0 |
| Developed | D,I | 42,453 | 8.81 | 2,123 | 0.44 |
| Pasture | D,I | 35,034 | 7.27 | 514 | 0.107 |
| Other Grains | * | 24,455 | 5.08 | 16 | 0.003 |
| Orchards and Vineyards | * | 24,215 | 5.03 | 174 | 0.036 |
| Wheat | * | 18,606 | 3.86 | 0 | 0 |
| Open Space Developed | D,I | 18,569 | 3.85 | 929 | 0.19 |
| Vegetables and Ground Fruit | * | 5,488 | 1.14 | 18 | 0.004 |
| Other Row Crops | * | 1,225 | 0.25 | 0 | 0 |
| Rice | * | 476 | 0.1 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Nurseries | * | 168 | 0.03 | 0 | 0 |
| Cotton | * | 15 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 96,056 | 19.93 | 3,566 | 0.737 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 96,056 | 19.93 | 3,566 | 0.737 |
| TOTAL⁴: | | 566,062** | 100 [#] | 10,956 | 2.31 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

**Overlap acreage greater than acres in species range.

acres in species range: 481,754 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 12,690 acres, 2.63%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction and aquatic habitat buffers: The Delta green ground beetle is known to rely on aquatic habitat for food resources or is otherwise closely associated with aquatic habitats and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the Delta green ground beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Delta green ground beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Delta green ground beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 51.0% mortality of individuals, up to 100.0% mortality from spray drift, a loss of about 51.0% of dietary items in use areas, and an additional loss of up to 100.0% of dietary items due to spray drift. In addition, there could be up to 97.6% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.31% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps such a small portion of the non-Federal species range, and we anticipate similar levels of usage in the future.

Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and aquatic habitat buffers, will further reduce the risk of exposure to malathion. For example, the Delta green ground beetle exists mainly in vernal pool areas of Solano County, California, thus putting it in proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

We anticipate a loss of individuals may occur if malathion is used within the range of the species, and dietary items may be affected in localized areas over the duration of the action, resulting in a small loss of fitness. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Delta green ground beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--|-----------------------------------|------------|
| <i>Desmocerus californicus dimorphus</i> | Valley elderberry longhorn beetle | 436 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (numerous)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Elderberry (*Sambucus* sp.) is the obligate larval host plant for the Valley elderberry longhorn beetle. After hatching, the larva creates a feeding gallery (set of tunnels) in the pith at the stem center (Burke 1921, Barr 1991). While only one larva is found in each feeding gallery, multiple larvae can occur in one stem if the stem is long enough to accommodate multiple galleries (Talley et al. 2006). Though rarely observed, adults have been described as feeding on the nectar, flowers, and leaves of the elderberry plant (Arnold 1984, Collinge et al. 2001), or flying between trees (Service 1984). Arnold (1984) reported that females lay eggs singly on elderberry leaves and at the junction of leaf stalks and main stems, with all eggs laid on new growth at the outer tips of elderberry branches. Because elderberry is the host plant for the beetle, environmental and habitat conditions that favor a robust elderberry community also benefit the beetle. Elderberry is an important component of riparian ecosystems in California (Vaghti et al. 2009). It can be found as an overstory plant or understory plant within these communities. Elderberry also occurs in upland communities such as oak woodland. Occupancy of elderberry by the Valley elderberry longhorn beetle is generally low but tends to be highest in riparian communities (Barr 1991, Collinge et al. 2001, Talley et al. 2007).

Much of the historically occurring riparian forests were lost in the Central Valley prior to the listing of the valley elderberry longhorn beetle (see summary for the Sacramento Valley by Thompson 1961, pp. 310–315). Katibah (1984, pp. 27–28) estimated approximately 102,000 ac (41,300 ha) of riparian forest remained in the Central Valley in 1984, a reduction of about 89% from an estimated total of 921,600 ac (373,100 ha) of pre-settlement riparian forest area. Adjacent land uses (primarily agriculture), stream channelization, and livestock grazing were reported as important negative influences on riparian systems (Katibah et al. 1981, p. 244). Specifically, artificial levees, river channelization, dams, and water diversions were identified as factors in reducing the original riparian forests to the remnant habitat described at that time for the Central Valley (Katibah 1984, p. 28). The Sacramento River represents one river system in the Central Valley within the northern range of the valley elderberry longhorn beetle that has

been severely degraded through channelization, bank protection (e.g., levees and riprap), and effects related to the construction of the Shasta Dam and other foothill storage reservoirs (Golet et al. 2013, p. 3). Natural, but fragmented, habitats (e.g., riparian, grasslands, sloughs, and valley oak woodlands) remain along the Sacramento River (Golet et al. 2013, p. 5). The middle section of the river (Red Bluff to Colusa) has been the focus of restoration efforts following the passage of State legislation in 1986 (Senate Bill 1086), which mandated the development of a management plan to protect, restore, and enhance riparian vegetation along the river (Sacramento River Conservation Area Forum 2003, p. v). A comprehensive evaluation of the success of these efforts indicated that, while progress has been made in achieving goals related to plant species and communities (including an increase in elderberry shrubs) and some wildlife taxa, progress towards restoring stream flows and natural floodplain and flood processes has been poor (Golet et al. 2013, pp. 19–21). In addition, this evaluation found that the status of natural riverine habitats in this portion of the Sacramento River was, in general, poor and declining, which was attributed to continued human alterations that constrain the river's hydrologic and geomorphic processes (Golet et al. 2013, p. 22). One of the major factors identified as responsible for the continued degradation of riverine habitats was the installation of riprap, which the study indicated has been steadily increasing along the Sacramento River since the 1930s (Golet et al. 2013, p. 22).

Threats to the valley elderberry longhorn beetle's host plant due to effects related to levee vegetation management are likely to continue given the levee vegetation management guidance (U.S. Army Corps of Engineers) and the difficulty in obtaining a variance for this policy. A levee vegetation strategy defined by California Department of Water Resources for some facilities in the Central Valley may, in the short term, result in fewer impacts to elderberry shrubs found on flood control levees. However, we are uncertain if this strategy will be effective in providing protection to elderberry shrubs found within these areas of the Central Valley. Impacts related to road and trail uses, and the effects of dust from roads, trails, or highways adjacent to host plants or beetles are not considered to be threats to the species or its habitat, but loss of habitat at locations adjacent to roads, trails, and associated infrastructure remains a threat. Pruning activities, if conducted appropriately, can result in a temporary loss of the host plant of the valley elderberry longhorn beetle and monitoring of these activities is necessary to ensure that elderberry characteristics important to the life history of the beetle are preserved. Invasive non-native plants may be impacting the species through modification or loss of habitat due to competition for space and resources with its host plant, but additional information is needed to evaluate the magnitude of this threat. Climate models developed for evaluating climate change effects in California, including the Central Valley, indicate increased temperatures and significant changes to hydrologic conditions as a result of the effects of climate change. These changes are expected to affect riparian systems and other habitats where the presence of the valley elderberry longhorn beetle has been observed in the Central Valley and will be compounded by water supply needs for urban and agricultural uses. Drought conditions are also likely to become more common in California and will affect the survival of elderberry. At the time of the last review (2014), the best available data indicated that climate change effects

include the threatened destruction or modification of habitat through at least the 2060s for the valley elderberry longhorn beetle.

Invasive Argentine ants have been confirmed at several locations occupied by the valley elderberry longhorn beetle (Holyoak and Graves 2010, p. 16; Table 2). Projections from climate change modeling indicate suitable conditions will occur for Argentine ants to continue to spread in California during the next several decades (Roura-Pascual et al. 2004, pp. 2531–2532; Hartley et al. 2006, pp. 1073–1077; Roura-Pascual et al. 2011, p. 223). Studies show that Argentine ants will attack and consume exposed insect larvae, including valley elderberry longhorn beetle larvae. The predation threat from Argentine ants is likely to increase in the Central Valley as colonies further expand into the species' range unless additional methods of successful control within natural settings become available (e.g., Choe et al. 2014, entire). Although additional studies are needed to better characterize the level of predation threat to the valley elderberry longhorn beetle from Argentine ants, the best available data indicates that this invasive species is a predation threat to the valley elderberry longhorn beetle, and it is likely to expand to additional areas within the range of the valley elderberry longhorn beetle in the foreseeable future.

Based on the best scientific information available, we do not know whether increased temperature and other projected effects associated with a changing climate in the coming decades (per projections for the 2060s) will exceed lethal levels or influence the survivorship and reproductive success of the valley elderberry longhorn beetle. We also do not know what adaptive capacity the species has, which will influence its response to increased temperature and other physical changes in climate. The best available scientific information indicates potential impacts from pesticides to the valley elderberry longhorn beetle and its habitat; however, further studies are needed to characterize the magnitude or impact of pesticides to the species both in localized areas as well as across the species' range. Pesticide use in the Central Valley remains high and could increase due to climate change effects (e.g., warmer temperatures) that may enhance the pathogenicity of crop pests for agricultural fields that are commonly found adjacent to remnant riparian vegetation. We do not believe that small population size constitutes a threat to the valley elderberry beetle throughout all or a significant portion of its range currently or in the future.

Threats can work in concert with one another to cumulatively create conditions that will impact the valley elderberry longhorn beetle beyond the scope of each individual threat. For some species, vulnerabilities to climate change effects have been found to be dependent on interactions between life-history traits and spatial characteristics (Pearson et al. 2014, p. 218), and it is likely that this is also true for other taxa, including the valley elderberry longhorn beetle. Climate change effects (e.g., warmer temperatures, increase in drought events, and changes in precipitation patterns) are likely to increase the extinction risk of the valley elderberry longhorn beetle and can also affect its host plant, e.g., by creating conditions that favor the expansion of invasive species in the Central Valley, or by outright reduction in host plants if the effects of climate change are more than elderberries can tolerate. An increase in temperature expected before the end of this century will also take place in concert with changes in land use and other

environmental factors such as pesticide use, altered habitat due to invasive plant species, predation threats, and secondary effects of climate change (altered hydrologic conditions). Although distributional shifts of the valley elderberry longhorn beetle (e.g., in both elevation and latitude) might be observed in the future given the alteration of climate, especially with increases in temperature, the limited remaining fragmented habitat and relatively limited dispersal ability of the species may restrict any such range shift. Data from long-term population trends of the beetle and its habitat will be needed to evaluate these types of potential cumulative effects.

Restoration and mitigation sites have contributed to available habitat, with one evaluation indicating a long-term mitigation trend for survival of elderberry plants of 57 to 71 percent and an occupancy rate of the valley elderberry longhorn beetle (based on observations of exit holes only) of 43 to 53 percent. However, comprehensive surveys have not been completed at all conservation areas, including restoration sites and preserves. Colonization rates, where measured, are relatively low at many of these sites.

The California Public Resources Code and Lake and Streambed Alteration Program work synergistically with the Act to provide protections to the species and its habitat. Without the protections provided to the valley elderberry longhorn beetle under the Act (that is, if the species was delisted), these State regulatory mechanisms would not provide an additional level of scrutiny in the evaluation of potential effects to the species or to its habitat from future proposed activities. Under the Natural Community Conservation Planning Program (NCCP), the valley elderberry longhorn beetle receives protections under permitted plans, including obligations to continue to implement the conservation plans in their entirety under the terms of their permits.

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Withdrawal of the Proposed Rule To Remove the Valley Elderberry Longhorn Beetle From the Federal List of Endangered and Threatened Wildlife. Federal Register 79(180):55879-55917.

U.S. Fish and Wildlife Service. 2019. Revised Recovery Plan for Valley Elderberry Longhorn Beetle. Pacific Southwest Region, Sacramento, California. 18 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Valley elderberry longhorn beetles exposed to malathion at maximum rates will be 1-13% for corn, other grains, vegetables and ground fruit, wheat, pasture, open space developed, rice, developed, other crops,

and orchards and vineyards, and <1% for all use sites except mosquito control. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 50% |
| Spray drift areas – mortality | Up to 92% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 24% |
| MOSQUITO CONTROL | |
| Direct - mortality | 95% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Valley elderberry longhorn beetle primarily occurs in riparian areas along rivers in several counties in California such as the Merced River (Merced County), the American River (Sacramento County), and Putah Creek (Yolo County) of the Central Valley of California. Adults are present from March through early June (peak late April to mid-May) (79 FR 55874). During this period, the beetles mate and females lay eggs on living elderberry plants. The first instar larvae bore to the center of elderberry stems where they develop for one to two years feeding on pith. Prior to forming their pupae, the elderberry wood boring larvae chew through the bark (Halstead and Oldham 1990) and then plug the holes with wood shavings. In the pupal chamber, the larvae metamorphose into their pupae and then into adults where upon they emerge between mid-March through June (USFWS 1984).

The Valley elderberry longhorn beetle is an herbivorous specialist that feeds almost exclusively on blue elderberry (*Sambucus cerulea*) throughout all stages of its life. Adults feed on the foliage and perhaps flowers (and nectar) of the host plant, which are present from March through early June. Larva feed on the pith, and emergence of the adult beetle from the pith of the host is synchronized with the host plant bloom period. The species' food resources are limited in distribution. The species is entirely dependent on blue elderberry for feeding and requires the riparian moist woodlands in which the plant grows.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)***Agricultural usage based on CalPUR data**

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|------------------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 8,991,423 | 95.1 | 231,882 | 2.58 |
| Orchards and Vineyards | D,I | 1,266,290 | 13.4 | 13,182 | 0.139 |
| Other Crops | D,I | 638,104 | 6.75 | 41 | <0.001 |
| Developed | D,I | 578,071 | 6.12 | 28,904 | 0.31 |
| Rice | D,I | 502,813 | 5.32 | 747 | 0.008 |
| Open Space Developed | D,I | 414,644 | 4.39 | 20,732 | 0.22 |
| Pasture | D,I | 396,925 | 4.2 | 33,157 | 0.351 |
| Wheat | D,I | 224,110 | 2.37 | 1,620 | 0.017 |
| Vegetables and Ground Fruit | D,I | 213,922 | 2.26 | 4,513 | 0.048 |
| Other Grains | D,I | 191,366 | 2.02 | 519 | 0.006 |
| Corn | D,I | 147,521 | 1.56 | 138 | 0.001 |
| Cotton | D,I | 613,469 | 0.65 | 667 | 0.007 |
| Other Row Crops | D,I | 56,744 | 0.6 | 0 | 0 |
| Nurseries | D,I | 5,828 | 0.06 | 615 | 0.007 |
| Christmas Trees | D,I | 1 | <0.01 | 0 | |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 5,249,809 | 49.71 | 104,835 | 1.18 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 5,249,809 | 49.71 | 104,835 | 1.18 |
| TOTAL⁴: | | 14,241,232 | 100 [#] | 336,717 | 3.76 |

[#]Use overlaps with range are additive and cannot be greater than 100%.^{**}Overlap acreage greater than acres in species range.**# acres in species range:** 9,450,948 acres**% of range in California (i.e., where CalPUR data is available):** 100%**Range overlap with Federal lands:** 197,986 acres, 2.09%¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Valley elderberry longhorn beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Valley elderberry longhorn beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 50.0% mortality of individuals, up to 92.0% mortality from spray drift. In addition, there could be up to 95.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.76% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps such a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops and new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Valley elderberry longhorn beetle often exists in proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Valley elderberry longhorn beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|----------------------------------|------------|
| <i>Boloria acrocynema</i> | Uncompahgre fritillary butterfly | 437 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Increasing population(s)

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Since listing and the completion of the Recovery Plan, the number of confirmed Uncompahgre Fritillary Butterfly (UFB) colonies has increased from two to eleven. Population estimates have increased from about 1,000 to somewhere between 3,400 and 23,000 at the three currently monitored colonies. Similarly, the other eight qualitatively monitored populations have persisted despite four of the colonies apparently having no UFBs during one or two surveys in different years since 2001. Some threats have been addressed.

The primary threat of collecting appears to have been forestalled by maintenance of UFB collecting closures around the two well-known colonies, regular researcher presence, irregular law enforcement visits, and through prohibition of collection by the ESA. However, these protections will need to be extended into the future by some sort of regulatory mechanism before we can find that factor D has been sufficiently addressed. The only observable current impacts are caused by relatively minor habitat degradation from hiking trails on the edge of colonies at Mt. Uncompahgre and Redcloud Peak and short-term impacts from rapid sheep trailing/grazing through Mt. Uncompahgre. Neither of these actions occur at a level to be considered a threat to the species. Climate change has not been an observable threat to either the UFB or its habitat to date, but is a potential future threat that should be monitored. Genetic influences related to population size and isolation are uncertain, but are being researched. Although there is fluctuation in the colony population numbers, it does not appear that the UFB is in danger of extinction. Adequate quality habitat has existed for over 10 years at Mt. Uncompahgre and Redcloud Peak producing what appears (non-statistically) to be stable, albeit fluctuating population numbers, and immediate on-the-ground threats have ceased, moderated, or have been determined to have minor impacts (collecting, recreational impacts, and grazing).

EB/CE Sources: U.S. Fish and Wildlife Service. 2009. Uncompahgre Fritillary Butterfly (*Boloria acrocynema*) 5-Year Review: Summary and Evaluation. Western Colorado Field Office, Grand Junction, Colorado. 19 pp.

U.S. Fish and Wildlife Service. 2018. Uncompahgre Fritillary Butterfly (*Boloria acrocynema*) 5-Year Review: Summary and Evaluation. Western Slope Office, Colorado Field Office, Grand Junction, Colorado. 30 pp.

Overall Vulnerability: ☐ High ☒ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Uncompahgre fritillary butterflies exposed to malathion at maximum rates will be 1% for pasture and <1% for all use sites except mosquito control. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|-------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 4% |
| Spray drift areas – mortality | Up to 7% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | A possible source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 4% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

All known populations of the Uncompahgre fritillary butterfly are associated with large patches of snow willow (*Salix reticulata* spp. *navalis*) above 3,780 m (12,400 ft), which provide food and cover. The species has been found only on northeast-facing slopes, which are the coolest and wettest microhabitat available. Females lay eggs on snow willow (*Salix reticulata* spp. *navalis*), which is the larval food plant. The species requires two years to complete its life cycle. Eggs laid in 2018 would be caterpillars in 2019 and mature into adults the following even-numbered year

(2020). Some caterpillars may take two summers to mature rather than three, and slowly developing caterpillars may take up to four years to mature. The butterflies live as adults for only 1-2 weeks from July into August (NatureServe, 2015).

Because the height of feeding and reproductive activities for this butterfly occurs essentially from March through June, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Because the Uncompahgre fritillary butterfly occurs at such high elevation, it is not known to truly travel through, reproduce, or nectar within agricultural areas, developed areas, or rights of way (no name pers. comm. US FWS ATF co-occurrence analysis 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D,I | 217,298 | 3.85 | 80,888 | 1.43 |
| Pasture | D,I | 81,850 | 1.45 | 27,526 | 0.49 |
| Other Grains | * | 37,868 | 0.67 | 22,080 | 0.39 |
| Vegetables and Groundfruit | * | 30,718 | 0.54 | 2,485 | 0.04 |
| Open Space Developed | * | 25,281 | 0.45 | 1,264 | 0.02 |
| Developed | * | 21,488 | 0.38 | 1,074 | 0.02 |
| Other Crops | * | 13,995 | 0.25 | 0 | 0 |
| Wheat | * | 6,506 | 0.12 | 5,411 | 0.1 |
| Nurseries | * | 31 | <0.01 | 31 | <0.01 |
| Corn | * | 26 | <0.01 | <1 | <0.01 |
| Orchards and Vineyards | * | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 81,850 | 1.45 | 27,526 | 0.49 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 81,850 | 1.45 | 27,526 | 0.49 |
| TOTAL⁴: | | 299,148 | 5.30 | 108,414 | 1.92 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

acres in species range: 5,647,706 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 3,990,562 acres, 70.66%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Uncompahgre fritillary butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Uncompahgre fritillary butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Uncompahgre fritillary butterfly. As discussed below, even though the vulnerability is medium and risk is high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Uncompahgre fritillary butterfly has a medium vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated

usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 4.0% mortality of individuals, up to 7.0% mortality from spray drift. In addition, there could be up to 4.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.92% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability is medium and risk is high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range and a large proportion (70.66%) of the species range is on federal lands. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Uncompahgre fritillary butterfly may occur in areas where mosquito treatment with malathion is anticipated to occur. The conservation measure described above will prohibit malathion use for mosquito control during most daylight hours, when this butterfly is most active. This is anticipated to further limit the exposure and resultant mortality of this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Uncompahgre fritillary butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------------|---------------------------|------------|
| <i>Euphydryas editha bayensis</i> | Bay checkerspot butterfly | 438 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened, Five-Year Review Recommendation (8/17/2009): Uplist to Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The status of *Euphydryas editha bayensis*, which historically occurred in five San Francisco Bay Counties, has declined dramatically since it was listed as threatened in 1987. At the time the Recovery Plan was finalized in 1998, the butterfly was restricted to San Mateo and Santa Clara Counties, with each county having one core population and a few satellite populations. Since 1998, populations of the butterfly have continued to be lost, including the core population and all satellite populations in San Mateo County. Loss of all populations in Alameda, Contra Costa, and San Mateo Counties, despite most being largely protected from development in City, County, and State Parks, and inclusion of some of the areas within existing or proposed Habitat Conservation Plans, indicates that habitat protection alone is not sufficient to protect the subspecies. The Bay checkerspot butterfly is now restricted to one core population (Coyote Ridge) and a few satellite populations within an approximate 9-mi radius of Coyote Ridge. None of the threats identified in the listing rule or the Recovery Plan have been reduced or eliminated.

The butterfly is still at great risk from invasion of non-native vegetation, exacerbated by nitrogen deposition from air pollution. Despite the use of prescribed burns to control non-native vegetation, wildfires may pose a greater threat now than at the time of listing due to the extremely narrow distribution of the butterfly; a single wildfire across Coyote Ridge could eliminate a large percentage of the remaining individuals. Given the butterfly's much reduced distribution and a life history closely tied to timing of annual rainfall, the butterfly may not be capable of withstanding natural fluctuations in annual weather patterns (periodic droughts) let alone larger variations due to climate change. Finally, the majority of habitat in Santa Clara County is in private ownership and ongoing development pressure will result in additional fragmentation, including fragmentation of the only remaining core population.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Bay checkerspot butterfly (*Euphydryas editha bayensis*) 5-Year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, California. 41 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for bay checkerspot butterflies exposed to malathion at maximum use rates is 2-10% for other crops, orchards and vineyards, open space developed, and developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 22% |
| Spray drift areas – mortality | Up to 35% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 19% |
| MOSQUITO CONTROL | |
| Direct - mortality | 38% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The bay checkerspot is exclusively a serpentine grassland species. While the adults may travel through/over other areas (including developed areas, orchards, field crops, etc.) and the adults will opportunistically feed on most any flowering plant, their predominant land use should be grasslands, including pasture (Mike Thomas, pers. comm US FWS Co-Occurrence Analysis Ask to Field 2016).

According to the delisting criteria, populations of 8,000 adult butterflies or populations of at least 20,000 post-diapause larvae are considered to be healthy; however, no minimum population size has been presented (US FWS 1998; US FWS 2009).

The primary larval host plant of the bay checkerspot butterfly is the dwarf plantain (*Plantago erecta*), and the secondary larval host plants are the purple owl's-clover (*Castilleja densiflora*) and the exserted paintbrush (*Castilleja exserta*); they are considered to be necessary food sources for completion of juvenile development for the species (66 FR 21450; NatureServe 2015).

Eggs hatch into larvae approximately 2 weeks after they are laid (between March and May); the larvae feed for another 2 weeks until they reach their fourth instar (larval development stage/molting), at which time they are able to enter summer diapause. Larvae break diapause and resume feeding with the onset of the rainy season and host plant germination, generally between November through January. Post-diapause larvae then feed until reaching sufficient mass to pupate. Pupation occurs from late January to early April (USFWS 2009). Therefore, the bay checkerspot butterfly is vulnerable to the effects of malathion throughout most of its lifecycle, except when entering diapause when the larvae shelter under rocks or in crevices.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 1,199,375 | 38.3 | 98 | <0.01 |
| Christmas trees | D,I | 0 | 0 | 1 | <0.001 |
| Developed | D,I | 314,589 | 10.09 | 15,729 | 0.50 |
| Open Space Developed | D,I | 197,497 | 6.31 | 9,875 | 0.32 |
| Orchards and Vineyards | D,I | 76,738 | 2.45 | 373 | 0.012 |
| Other Crops | D,I | 57,271 | 1.83 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 17,981 | 0.57 | 31,558 | 1.008 |
| Other Grains | D,I | 10,440 | 0.33 | 4 | <0.001 |
| Wheat | D,I | 8,384 | 0.37 | 0 | 0 |
| Pasture | D,I | 5,818 | 0.19 | 30 | 0.001 |
| Corn | D,I | 2,103 | 0.07 | 612 | 0.020 |
| Nurseries | D,I | 1,794 | 0.06 | 22 | 0.001 |
| Cotton | D,I | 655 | 0.02 | 0 | 0 |
| Rice | D,I | 384 | 0.01 | 0 | 0 |
| Other Row Crops | D,I | 81 | <0.01 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 693,734.8 | 22.31 | 58,204 | 1.87 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 693,735 | 22.31 | 58,204 | 1.87 |
| TOTAL⁴: | | 1,893,110 | 60.4 | 58,302 | 1.87 |

acres in species range: 3,129,689 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 563,691 acres, 18.01%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Bay checkerspot butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Bay checkerspot butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Bay checkerspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals, up to 35.0% mortality from spray drift. In addition, there could be up to 38.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where a large proportion of individuals of the population is lost, the area of suitable habitat will not be recolonized.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.87% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Bay checkerspot butterfly exists only in Santa Clara County, California, putting it in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Bay checkerspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|----------------------|------------|
| <i>Ambrysus amargosus</i> | Ash Meadows naucorid | 439 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Population size/location(s) unknown

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Ash Meadows naucorid is a small aquatic insect endemic to the flowing waters of the Point of Rocks springs within Ash Meadows National Wildlife Refuge in Nevada. Its remaining habitat is greatly reduced from that known to have existed historically because of channelization of the springs' outflow for agricultural diversion, and because of large-scale alteration of the Point of Rocks Springs area when 90% of flowing water was impounded. This species is now restricted to several stream channels less than 0.3 m wide and 10 m long. The life history of the Ash Meadows naucorid shows populations fluctuate seasonally with a peak in summer and a low in winter (Parker et al. 2000, pp. i, 21-24). As reported in the 2020 5-Year Review, multiple formal surveys have been conducted, but the results are presented as density estimates, not population estimates (Service 2009a, 2009b, 2010a, 2010b, 2010c, 2010d,). Also per the review, the Service is not able to produce a population trend because habitat enhancement and reintroduction projects were being conducted between surveys (Service 2005a, 2005b, 2006a, 2007b, 2009c, 2010a, 2010a, 2010d). The best surrogate for estimating population size and trend is based on habitat quality size. Typically, declines in the population are strongly tied to habitat loss by shading from overgrowth of vegetation and loss of suitable substrate (Service 2005b, 2008b, 2009b,). All of the remaining habitat of this species occurs within land purchased to established the Ash Meadows National Wildlife Refuge. As of the 2020 5-Year Review, the Ash Meadow naucorid only occupied five low-flow spring brooks and was likely absent in the location from which it was originally described.

Threats to the species include ground water depletion decreasing spring discharge and extremely limited range making it susceptible to decline because of a single event disturbing its habitat or causing mortality. Other threats include scientific overcollection, which has reduced since listing, and predation by introduced fish and crayfish.

EB/CE Source: U.S. Fish and Wildlife Service. 2020. Ash Meadows Naucorid (*Ambrysus amargosus*) 5-Year Review. Southern Nevada Ecological Services Field Office, Las Vegas, Nevada. 6 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Ash Meadows naucorid beetles exposed to malathion at maximum use rates is <1% for all use types.

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | <1% |
| Spray drift areas – mortality | NA |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | <1% |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | <0.01% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Ash Meadows naucorid has a narrow environmental specificity and is restricted to gravel bottoms of swift-flowing hot springs at Point of Rocks Springs in Ash Meadows. Populations are restricted to several stream channels less than 0.3 m (11 in) wide and 10 m (32.8 ft) long. Remaining habitat is greatly reduced from historic conditions because of modification. Channelization of the springs' outflow for agricultural diversion and large-scale alteration of the Point of Rocks Springs area has degraded habitat (USFWS: 50 FR 20777, 1985).

Recall from the “Approach to the Effects Analysis” section of the main body of the Opinion that specific considerations were made for species that occur in Bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Ash Meadows naucorid does

occupy other aquatic habitats that accumulate potentially high levels of malathion, they can mitigate their potential exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

The Ash Meadows naucorid consumes aquatic insects and crustaceans in warm spring outflows of Ash Meadows, and it uses modified fang-like front legs to capture prey (USFWS 2014).

Little is known about the reproduction of this species. Eggs are probably attached to pebbles at the bottom of swift-flowing hot springs in a few inches of water (USFWS 1990).

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|------------------|------------------------------|------------------------|-------|---------------------------------------|-------|--|--|
| | | Acres | % | Acres | % | | |
| Mosquito Control | D | 881 | <0.01 | 0 | 0 | 2,3 | 2H 3 |
| Pasture | D | 2,642 | 0.03 | 2,150 | 0.02 | 2,3 | 2H 3 |
| Developed | D | 2,510 | 0.03 | 126 | <0.01 | 2,3 | 2H 3 |
| Other Crops | D | 830 | <0.01 | 0 | 0 | 2,3 | 2H 3 |
| Wheat | D | 182 | <0.01 | 22 | <0.01 | 2,3 | 2H 3 |
| Other Grains | D | 107 | <0.01 | 89 | <0.01 | 2,3 | 2H 3 |
| Corn | D | 67 | <0.01 | 11 | <0.01 | 2,3 | 2H 3 |
| Vegetables and | D | <1 | <0.01 | <1 | <0.01 | 2,3 | 2H 3 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|--|------------------------------|------------------------|------|---------------------------------------|------|--|--|
| | | Acres | % | Acres | % | | |
| Ground Fruit | | | | | | | |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 6,337 | 0.11 | 2,398 | 0.08 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 0 | 0 | 0 | 0 | | |
| TOTAL⁴: | | 7,219 | 0.11 | 2,398 | 0.08 | | |

[^]We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

*For all aquatic insects, additional bins may be shown on the R-plots, but only the bins in this table were relevant and used in the analysis.

acres in species range: 9,952,763 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 9,755,657 acres, 98.0%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers substantially reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Ash Meadows naucorid. As discussed below, even though the vulnerability is high, risk and the likelihood of exposure to malathion are low for this species, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Ash Meadows naucorid has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is low. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about <1% mortality of individuals and a loss of <1% of dietary items in use areas. There could be <0.01% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the Ash Meadows naucorid (bin 2, specifically) would maintain a high concentration of toxins, including malathion, if exposed due to their small size and low water flow.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.08% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. We anticipate a loss of a small number of individuals may

occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action, resulting in a small reductions in fitness for a small number of individuals. Because 98.0% of the species range is on the Ash Meadows National Wildlife Refuge, we anticipate the likelihood of exposure is relatively low. Additionally, the conservation measures described above, including the rain restriction and aquatic habitat buffers, will further reduce the risk of exposure to malathion. These measures are anticipated to address the concerns related to surface run-off contamination and reduce the run-off potential into the smaller water bodies where these naucorid beetles reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is made and when it can potentially reach the habitat by taking into account the half-lives of malathion in soils and water.

Furthermore, the Refuge's 2009 Comprehensive Conservation Plan indicates the area is managed for the protection of this species. Thus, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Ash Meadows naucorid in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------------|-------------------------|------------|
| <i>Nicrophorus americanus</i> | American burying beetle | 440 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered; Proposal to reclassify as Threatened (also supported by Five-Year Review Recommendation (5/3/2019))

Distribution: Species/Populations widespread or wide-ranging

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The American burying beetle (*Nicrophorus americanus*) is a member of the beetle family Silphidae (subfamily Nicrophorinae); these beetles bury vertebrate carcasses for reproductive purposes and exhibit parental care of young. Once widely distributed throughout eastern North America, the American Burying beetle (ABB) has disappeared from most of its historic range. The American burying beetle is native to at least 35 States in the United States, covering most of temperate eastern North America, and the southern borders of three eastern Canadian provinces. The species is believed to be extirpated from all but nine States in the United States and is likely extirpated from Canada. At the time of listing, the only two highly disjunct populations of this formerly widespread species were known to be extant, one on a New England island and the other in eastern Oklahoma. Based on the last 15 years of surveys, the American burying beetle is known to occur in portions of Arkansas, Kansas, Oklahoma, Nebraska, South Dakota, and Texas; on Block Island off the coast of Rhode Island; and in reintroduced populations on Nantucket Island off the coast of Massachusetts and in southwest Missouri, where a nonessential experimental population (NEP) was established in 2012 under section 10(j) of the Act (77 FR 16712; March 22, 2012). Reintroduction efforts are also underway in Ohio, but survival of reintroduced American burying beetles into the next year (successful overwintering) has not yet been documented. The species is now known to occur in five of the nine eco-regions where it was once found west of the Mississippi and in one of the seven eco-regions east of the Mississippi; about four eco-regions support ABB populations estimated at >1,000 individuals. Based on extinction modeling by K. Holzer, Amaral et al. (eds) (2005) surmised that populations of this size have the potential to remain demographically viable over the long-term in the absence of severe catastrophic events or reductions in carrying capacity through reduced carcass availability, habitat loss, or fragmentation.

Although several ABB populations occur on public lands or private conservation organization properties, most of the protected lands supporting ABB require ongoing management to ensure the species' continued presence. Elsewhere in the range (Nebraska, South Dakota, and Kansas),

the species occurs almost exclusively on private land. The species thus receives varying levels of habitat protection across its current range. Given the ephemeral availability of carrion for ABB reproduction, it is unlikely that populations isolated by habitat fragmentation will be self-sustaining over the long-term. Habitat fragmentation remains a risk across much of the species' current range, particularly because habitat conservation at the landscape level has not been initiated. In addition, little is known about ABB population size and trends in much of the species' current range, making it difficult to design appropriate conservation strategies.

In addition to ongoing concerns about habitat fragmentation, reductions in carrion availability, and increasing competition for carcasses, newly identified threats of invasive species (red cedar) and animals (red-imported fire ants) are growing problems in the portion of the range where all except one of the natural populations occur. Further, effects of disease and climate change on the species have not been ruled out as concerns. These types of factors pose risks irrespective of land conservation measures. Threats to extant populations are a heightened concern because, although husbandry and captive rearing methods for the species are now reasonably well-established (A. Kozol in litt. 1990, Perrotti 2005), efforts to reintroduce populations through the release of captive-reared or wild translocated beetles have met with mixed results.

EB/CE Sources: U.S. Fish and Wildlife Service. 2008. American Burying Beetle (*Nicrophorus americanus*) 5-Year Review: Summary and Evaluation. New England Field Office, Concord, New Hampshire. 53 pp.

U.S. Fish and Wildlife Service. 2019. Endangered and Threatened Wildlife and Plants; Reclassifying the American Burying Beetle From Endangered to Threatened on the Federal List of Endangered and Threatened Wildlife With a 4(d) Rule. Federal Register 84(86):19013-19029.

Overall Vulnerability: ☐ High ☒ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for American burying beetle exposed to malathion at maximum use rates is 1-5% for developed, open space developed, and corn and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|----------|
| Use areas – mortality | 12% |
| Spray drift areas – mortality | Up to 1% |

| | |
|---|---------------------------------------|
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 12% |
| Spray drift areas – effects to dietary items | Up to 1% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 10% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The American burying beetle (ABB) is an opportunistic scavenger that is only active between February and October. They overwinter underground as adults at all other times. Reproduction occurs from late April through mid-August. Block Island populations are reproductively active in June and July, but Oklahoma beetles breed as early as April, or as late as August. Reproductive activity includes the burial of a carcass, building of a chamber, and laying eggs. ABB eggs are laid in soil adjacent to buried carcasses and after molting, adults overwinter in soil (Raithel 1991; Creighton et al, 1992; NatureServe, 2015). Adults bury vertebrate carcasses, upon which larvae feed, ideally between 80 and 100 grams of weight (USFWS 2008).

The number of eggs produced is not known, but anywhere from 1 to 36 larvae have been observed on a carcass (Kozol, pers. comm.; US FWS SOS 2016). One or both parents feed, tend, and guard larvae throughout this stage (48-60 days). The beetle generally raises only one brood per year, but in Oklahoma it is possible that 2 broods are raised during the year (Raithel 1991; US FWS SOS 2016). It is doubtful that adults remain reproductively viable for more than one season; they apparently die off after reproduction or during the subsequent winter (NatureServe 2015).

The Block Island populations utilize abundant carrion resources of Ring-necked Pheasant chicks and American Woodcock. Oklahoma beetles feeding on small mammals such as Hispid Cotton Rat (Kozol, pers. comm.). Carrion is shaved, rolled into a ball, and treated with secretions by adults. Both parents may remain with the carcass and larvae, feeding their offspring with regurgitated meat until the larvae are capable of feeding themselves on the carrion (USFWS 2008). Larvae feed continuously throughout the 24 hour day, emerging as teneral (after molting) adults in July and August. Newly emerged adults are dormant throughout the winter, reproducing the following spring (NatureServe 2015).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 4,791,086 | 9.8 | 10,709 | 0.22 |
| Corn | D,I | 2,447,535 | 5.0 | 54,292 | 0.11 |
| Open Space Developed | D,I | 1,589,899 | 3.25 | 79,495 | 0.16 |
| Developed | D,I | 541,301 | 1.11 | 27,065 | 0.06 |
| Wheat | D,I | 386,317 | 0.79 | 241,949 | 0.49 |
| Pasture | D,I | 371,797 | 0.76 | 71,830 | 0.15 |
| Other Grains | D,I | 239,411 | 0.49 | 49,641 | 0.1 |
| Other Crops | D,I | 139,771 | 0.29 | 9 | <0.01 |
| Other Row Crops | D,I | 26,056 | 0.05 | 15,445 | 0.03 |
| Vegetables and Ground Fruit | D,I | 17,803 | 0.04 | 8,832 | 0.02 |
| Cotton | D,I | 10,305 | 0.02 | 6,076 | 0.01 |
| Orchards and Vineyards | D,I | 5,062 | 0.01 | 1,206 | <0.01 |
| Rice | D,I | 1,884 | <0.01 | 266 | <0.01 |
| Nurseries | D,I | 1,864 | <0.01 | 1,863 | <0.01 |
| Christmas Trees | D,I | 177 | <0.01 | 61 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 5,779,182 | 11.84 | 558,031 | 1.17 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 5,779,182 | 11.84 | 558,031 | 1.17 |
| TOTAL⁴: | | 10,570,268 | 21.6 | 568,740 | 1.39 |

acres in species range: 48,885,009 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 1,914,469 acres, 3.92%

Overall Usage: ☐ High ☐ Medium ☒ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications (previously ranging from 3-13 applications per year, depending on the specific crop) to 2-4 per year, as described in the Description of the Action of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the American burying beetle. As discussed below, even though the vulnerability is medium and risk is high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The American burying beetle has a medium vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 12.0% mortality of individuals, up to 1.0% mortality from spray drift, a loss of about 12.0% of dietary items in use areas, and an additional loss of up to 1.0% of dietary items due to spray drift. In

addition, there could be up to 10.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.39% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability is medium and the risk is high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops and new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the American burying beetle exists in proximity to residential and other developed areas in portions of its range. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs. We expect only minor impacts to dietary items, and do not anticipate such impacts would result in appreciable impacts to beetle individuals. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the American burying beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------|------------------------------------|------------|
| <i>Brychius hungerfordi</i> | Hungerford's crawling water beetle | 441 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Although the dietary requirements for Hungerford's crawling water beetle (HCWB) are not fully understood, Spirogyra, lithophilic diatoms or Cocconeis are the most likely food sources for HCWB adults (Grant and Vande Kopple 2003). There are eleven streams range-wide with known populations of HCWB. Throughout the recognized range, we have very limited information on the abundance, population trends, and demographic features of this species. Observations of HCWB in the East Branch of Maple River suggest that they may have two generations per year, with adults emerging in early spring (May) and a second brood of adults emerging late in the season (August) (Grant et al. 2000; Bert Ebberts, Great Lakes Ecosystems, pers. comm. 2004). The emergence of adults in the spring from overwintering larvae is likely not synchronous, occurring over a period of weeks, dictated somewhat by local temperature conditions (Michael Grant, University of Michigan Biological Station, pers. Comm 2010). In addition, some adult beetles survive over the winter, even beneath ice cover (Grant et al. 2000). Thus, the timing and magnitude of peak population numbers undoubtedly changes from year to year, with the magnitude controlled somewhat by local climatic conditions and survivability of old adults (Grant, pers. comm. 2010).

Threats to this species include stream modification, road work, and certain types of fish management activities. Recent road culvert projects and sea lamprey control actions appear to indicate that conservation measures can be implemented to reduce adverse effects to HCWB, with little impact to HCWB populations. Monitoring at some of these project sites is on-going and may provide additional insight on the magnitude and management of these threats. No information is available at this time to assess the threat of logging to HCWB. Climate change represents an unknown threat to HCWB. Due to its apparent dependence on various stream characteristics, such as water temperature and flow rate, substrate composition of gravel and cobble, and the presence of Dichotomosiphon algae, alteration of stream habitat from climate change may significantly change the distribution and persistence of HCWB in certain streams. Climate change may cause some streams to become unsuitable for HCWB while others develop suitable habitat; however, the geographic isolation of HCWB populations and its uncertain

dispersal capabilities (as discussed in 2.3.1.7) may affect its ability to find and colonize new streams. At this time, the greatest challenge to ensuring recovery of this species remains the lack of information on ecology and natural history.

Stream modification is thought to be the primary threat to the species and may include physical destruction of the stream habitat and degradation of water quality. Specific threats may include beaver control, beaver activity, stream pollution, stream-side logging, channelization, bank stabilization, dredging, and impoundment (Wilsmann and Strand 1990, USFWS 1994, Hyde and Smar 2000). Road work and culvert removal or bridge construction may impact *B. hungerfordi*. In-stream projects, such as culvert removal projects, may result in considerable disturbance downstream. In some cases, these projects may have short-term adverse effects but may have overall benefits through reduction of erosion and sedimentation in the stream. Logging in the riparian zone represents another possible threat to habitat; it can cause significant modification of habitat and increase erosion and the sediment load into the stream (Strand 1989). Other alterations of stream habitat that may result in destruction of suitable *B. hungerfordi* habitat include dredging for stream bed modification and channelization.

Other threats are also assumed to have varying degrees of impact to the species. For example, the use of lampricides for the control of sea lamprey is a potential concern for *B. hungerfordi*. Sea lamprey larvae live in certain Great Lakes tributaries before transforming into parasitic adults that migrate to the Great Lakes. Lampricides are chemicals used to reduce populations of sea lamprey to levels that lessen the impact to Great Lakes fish (Great Lakes Fishery Commission 2000). The Carp Lake River and unoccupied portions of the Maple River have been treated with the lampricides 3- trifluoromethyl-4-nitrophenol (TFM) and 2'5-dichloro-4'-nitrosalicylanilide (niclosamide) (J. Weisser, U.S. Fish and Wildlife Service, pers. comm., 2004). Human disturbance within the stream may be a threat to *B. hungerfordi*. Areas of a stream where there are high levels of disturbance caused by fishing and recreation are not likely to be suitable for *B. hungerfordi*. Human activity could result in habitat disturbance as one walks through the stream or inadvertent crushing of individuals by stepping on them. Although this is a potential threat, there are no known occupied sites with excessive human disturbance due to fishing or recreation. Certain types of fish management activities also may pose a threat to the species (USFWS 1994), although other forms of fish management may be beneficial. Specifically, fish management activities that result in creation, maintenance, or enhancement of suitable *B. hungerfordi* habitat may be beneficial to the species. Conversely, activities that result in the elimination of suitable *B. hungerfordi* habitat may pose a threat. For example, removal of a dam or culvert (e.g., to allow fish passage) immediately upstream of a known site may, in some cases, eliminate suitable *B. hungerfordi* habitat (as discussed above). Some actions may have contemporaneous positive and negative impacts that must be weighed carefully.

EB/CE Sources: U.S. Fish and Wildlife Service. 2006. Hungerford's Crawling Water Beetle (*Brychius hungerfordi*) Recovery Plan. Great Lakes-Big Rivers Region, Fort Snelling, Minnesota. 91 pp.

U.S. Fish and Wildlife Service. 2012. Hungerford's Crawling Water Beetle (*Brychius hungerfordi*) 5-Year Review: Summary and Evaluation. East Lansing Field Office, Michigan. 19 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Hungerford's crawling water beetle exposed to malathion at maximum use rates is 2% each for pasture and developed and less than 1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 10% |
| Spray drift areas – mortality | NA |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 10% |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 0% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Hungerford's crawling water beetle was discovered in 1952. The species has a limited geographic range, being known only from a few populations in northern Michigan and across the border in Canada. Whether the species may have historically been more widespread is unknown.

Recall from the "Approach to the Effects Analysis" section of the main body of the Opinion that specific considerations were made for species that occur in Bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental

concentrations, thus overestimating potential exposure. While the Hungerford's crawling water Beetle does occupy other aquatic habitats that accumulate potentially high levels of malathion, they can mitigate their potential exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Reproduction in haliplids usually occurs in the spring and early summer. Mating has been observed in June for *B. hungerfordi* (Scholtens 2002) and *B. hornii* (Mousseau and Roughley 2003), but optimal breeding activity for *B. hungerfordi* may begin in early to mid-July and continue into early August (Grant et al. 2009b).

Populations of *B. hungerfordi* are found downstream from culverts, beaver and natural debris dams, and anthropogenic impoundments. They are found in plunge pools created below these structures and in riffles and other well-aerated sections of the stream. In general, *B. hungerfordi* is found in areas of streams characterized by moderate to fast stream flow, good stream aeration, inorganic substrate, and alkaline water conditions (Wilsmann and Strand 1990).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use ^ | Effect associated with bin H >50% M 1-50% L <1% |
|----------------------|------------------------------|------------------------|------|---------------------------------------|------|------------------------------|--|
| | | Acres | % | Acres | % | | |
| Mosquito Control | * | 0 | 0 | 0 | 0 | - | - |
| Developed | D,I | 75,741 | 1.88 | 3,787 | 0.09 | 2,3 | 2H |
| Open Space Developed | D,I | 178,989 | 4.44 | 8,949 | 0.22 | 2,3 | 2H |
| Pasture | D,I | 73,345 | 1.82 | 25,392 | 0.63 | 2,3 | 2 H |
| Corn | D,I | 22,831 | 0.57 | 5,638 | 0.14 | 2,3 | 2 H |
| Wheat | D,I | 15,007 | 0.37 | 15,007 | 0.37 | 2,3 | 2 H 3 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use ^ | Effect associated with bin H >50% M 1-50% L <1% |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|------------------------------|--|
| | | Acres | % | Acres | % | | |
| Other Grains | D,I | 12,186 | 0.3 | 3,563 | 0.09 | 2,3 | 2 H 3 |
| Other Crops | D,I | 9,423 | 0.23 | 0 | 0 | 2,3 | 2 H 3 |
| Vegetables and Ground Fruit | D,I | 8,283 | 0.21 | 8,578 | 0.21 | 2,3 | 2 H 3 |
| Orchards and Vineyards | D,I | 7,055 | 0.18 | 2,247 | 0.06 | 2,3 | 2 H 3 |
| Christmas Trees | D,I | 1,692 | 0.04 | 1,100 | 0.03 | 2,3 | 2 H 3 |
| Other Row Crops | D,I | 398 | <0.01 | 411 | 0.01 | 2,3 | 2 H 3 |
| Nurseries | D,I | 231 | <0.01 | 231 | <0.01 | 2,3 | 2 H 3 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 405,181 | 0.10 | 74,903 | 2.13 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 405,181 | 0.10 | 74,903 | 2.13 | | |
| TOTAL⁴: | | 405,181 | 0.10 | 74,903 | 2.15 | | |

^We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

acres in species range: 4,026,785 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 536,993 acres, 13.3%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers substantially reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Hungerford's crawling water beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Hungerford's crawling water beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 10.0% mortality of individuals and a loss of about 10.0% of dietary items in use areas. We do not anticipate any mortality of individuals from spray drift or malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the Hungerford's crawling water beetle (bin 2, specifically) would maintain a high concentration of toxins, including malathion, if exposed due to their small size and low water flow. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.15% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability for this species is high, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, rain restrictions, aquatic habitat buffers, and new restrictions for residential use, will further reduce the risk of exposure to malathion. These measures are anticipated to address the concerns related to surface run-off contamination and reduce the run-off potential into the aquatic habitat areas where these beetles reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is made and the species' habitat by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the water body.

Developed and open space developed uses (described as residential uses) make up the majority of overlap in the range of this species that are anticipated to cause mortality. New residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied to, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to further reduce the contribution of malathion from residential uses into the Hungerford's crawling water beetle's range. For other agricultural use applications, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific crop) which are also anticipated to significantly reduce the amount of malathion that could enter the aquatic environment. We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Hungerford's crawling water beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------------|---------------------------------|------------|
| <i>Cicindela dorsalis dorsalis</i> | Northeastern beach tiger beetle | 442 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The northeastern beach tiger beetle's historic range was from Massachusetts to Virginia. It is now found only in the Chesapeake Bay of Maryland and Virginia, and on two sites in Massachusetts. The beetle is restricted to sandy beaches in areas subject to stochastic storm events, high shoreline development pressure, and human use. Surveys have documented a decline in beetle numbers over most of the beetle's range. The western shoreline of the Chesapeake Bay (both Maryland and Virginia) shows a large decline in numbers and amount of available habitat.

The continued increase in threats from human development, the specificity of its habitat requirements, and the length of time spent as larvae occupying the intertidal zone of a beach make the beetle highly susceptible to changes in beach habitat and vulnerable to extirpation. Originally the beetle was proposed for listing as endangered, but it was listed as a threatened species in the final rule. Since that time, more occupied sites have been identified, but the Service has also documented a decline in numbers of beetles and occupied habitat rangewide. Overall, the northeastern beach tiger beetle is facing serious and growing threats to its continued existence throughout its range.

EB/CE Source:

U.S. Fish and Wildlife Service. 2009. Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) 5-Year Review: Summary and Evaluation. Virginia Field Office, Gloucester, Virginia. 21 pp.

U.S. Fish and Wildlife Service. 2019. Northeastern Beach Tiger Beetle (*Cicindela dorsalis dorsalis*) 5-Year Review: Summary and Evaluation. Virginia Field Office, Gloucester, Virginia. 27 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Northeastern beach tiger beetles exposed to malathion at maximum use rates is 3% for developed, 2% for open space developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 6% |
| Spray drift areas – mortality | Up to 1% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 6% |
| Spray drift areas – effects to dietary items | Up to 1% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 45% |
| Sublethal | NA |
| Indirect - mortality | 45% arthropods |

Risk modifiers:

The Northeastern beach tiger beetle occurs in open sand flats, dunes, water edges, beaches, woodland paths, and sparse grassy areas. Adults are primarily active from June to September, and over winter as larvae. The adults mate and lay eggs from late June through August. The eggs hatch in 10-14 days, depending on soil moisture. Adequate moisture may allow a shorter hatch period (C.B. Knisley, pers. comm. 2008). Larvae pass through three instar stages, pupate, and emerge as adults two years following hatching (Knisley et al. 1987, Service 1994).

Larvae occur over a relatively narrow band (8-12 m) of the upper intertidal to high drift zone, but the zone may be wider in areas of washover or where the upper beach is flat and gets periodically wet from high tides. While this intertidal location poses hazards of flooding and increased energy expenditure to maintain burrows, it is the zone where prey is most abundant. Larvae nearer to the water's edge tend to develop faster than those farther back where it is drier and prey items are less numerous (C.B. Knisley pers. obs.).

Adult and larval beetles are typically found on highly dynamic beaches with back beach vegetation, and they prefer long, wide beaches that have low human and vehicular activity, fine

sand particle size, and a high degree of exposure. The Northeastern beach tiger beetle makes use of open sand flats, dunes, water edges, beaches, woodland paths, and sparse grassy areas where beetles live, breed, and forage. If pesticide applications are made, it would be in these areas where these beetles would be impacted the most (no name pers. comm. 2016 co-occurrence information, USFWS field office request).

Larvae are sedentary ambush predators that live in well-formed burrows from which they extend to capture passing prey. Adults are active predators that forage on small invertebrates or scavenge on dead fish, crabs, and amphipods.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 16,238 | 44.79 | 0 | 0 |
| Open Space Developed | D,I | 1,044 | 2.88 | 52 | 0.14 |
| Developed | D,I | 893 | 2.46 | 45 | 0.12 |
| Corn | D,I | 162 | 0.45 | 76 | 0.21 |
| Other Crops | D,I | 99 | 0.27 | 2 | <0.01 |
| Pasture | D,I | 23 | 0.06 | 22 | 0.06 |
| Wheat | D,I | 10 | 0.03 | 10 | 0.03 |
| Other Grains | D,I | 7 | 0.02 | 7 | 0.02 |
| Vegetables and Groundfruit | D,I | 7 | 0.02 | 7 | 0.02 |
| Orchards and Vineyards | D,I | <1 | <0.01 | <1 | <0.01 |
| Cotton | D,I | <1 | <0.01 | <1 | <0.01 |
| Other Row Crops | D,I | <1 | <0.01 | <1 | <0.01 |
| Christmas Trees | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 2,245 | 6.23 | 221 | 0.65 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 2,245 | 6.23 | 221 | 0.65 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| TOTAL ⁴ : | | 18,483 | 51.02 | 221 | 0.65 |

acres in species range: 36,251 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 4,576 acres, 12.6%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Northeastern beach tiger beetle, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Northeastern beach tiger beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

The Northeastern beach tiger beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 6.0% mortality of individuals, up to 1.0% mortality from spray drift, a loss of about 6.0% of dietary items in use areas, and an additional loss of up to 1.0% of dietary items due to spray drift. In addition, there could be up to 45.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.65% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use and timing restrictions for mosquito control use, will further reduce the risk of exposure to malathion.

For example, the Northeastern tiger beetle exists in coastal areas of the Chesapeake Bay and in Massachusetts, thus putting it in proximity to residential and other developed areas in some areas of its range. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Northeastern beach tiger beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|----------------------|------------|
| <i>Cicindela Puritana</i> | Puritan tiger beetle | 443 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Species/Populations neither constrained nor widespread

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Puritan tiger beetle is found in shoreline habitat along the Connecticut River in New England and the Chesapeake Bay in Maryland. The species has disappeared from a large part of its range in New England, and the Chesapeake Bay populations appear to be highly susceptible to habitat loss and degradation. Due to its declining range and vulnerability to natural and human-related threats, this species was listed as threatened in August 1990 (U.S. Fish and Wildlife Service 1990). Information evaluated for the 2007 5-Year Review provides a clear indication that the Puritan tiger beetle is not recovering. It has not met any of the four recovery criteria and, in fact, is further from these goals today than at the time the recovery plan was written: there are fewer large populations, none of the required new metapopulations in New England have been established, there is no site-specific management at most tiger beetle sites, and there are few protected populations or corridors.

Residential development and recreational use activities continue to threaten the species' habitat rangewide, as do storm and flooding events that could increase in frequency and/or intensity due to changing climate conditions. New information indicates that there is a declining trend in population numbers and a substantial decline in suitable habitat for the Chesapeake Bay populations of the Puritan tiger beetle. This is significant because, rangewide, the majority of Puritan tiger beetles and Puritan tiger beetle habitat occurs along the Chesapeake Bay. The decline in suitable habitat results partly from construction of shore erosion control projects (the number one threat for the species according to the recovery plan) and partly from a newly recognized threat: significant vegetative encroachment on the cliffs along the Chesapeake Bay that support the species. In addition, the population viability analysis for the Chesapeake Bay Puritan tiger beetle populations (Gowan and Knisley 2005) provides evidence that both Chesapeake Bay metapopulations are vulnerable to extinction; this is particularly true for the Sassafras River metapopulation. In New England, the Massachusetts population remains extremely small and vulnerable, while the Connecticut population has shown a small increase. However, there is a marked trend toward increasing degradation of habitat by intensive recreational usage at sites supporting both of these populations. In summary, information

indicates that the species has declined substantially since listing and recovery plan approval, that the species is highly vulnerable to extinction, and that threats to the species have markedly increased.

However, a new 5-year Status Review was completed in 2019, and describes some positive trends for the Puritan tiger beetle. The Review indicates there are two strong metapopulations in the Chesapeake Bay, with the highest numbers ever counted in the Sassafrass River metapopulation in 2018. In addition, two new areas of beetles were discovered in Maryland in 2014 and 2015. Also in Maryland, three large subpopulations are currently protected from development by State ownership, and a fourth and fifth subpopulation are now protected by conservation easements, thus achieving protection of five of the six large populations as required for Recovery Criterion 1 in the Status Review (2019).

EB/CE Source: U.S. Fish and Wildlife Service. 1993. Puritan Tiger Beetle (*Cicindela Puritana* G. Horn) Recovery Plan. Hadley, Massachusetts. 45 pp.

U.S. Fish and Wildlife Service. 2007. Puritan Tiger Beetle (*Cicindela Puritana*) Draft 5-Year Review: Summary and Evaluation. Chesapeake Bay Field Office, Annapolis, Maryland. 21 pp.

U.S. Fish and Wildlife Service. 2019. Puritan Tiger Beetle (*Cicindela Puritana*) 5-Year Review: Summary and Evaluation. Chesapeake Bay Field Office, Annapolis, Maryland. 38 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Puritan tiger beetles exposed to malathion at maximum use rates is 3-6% for developed, corn, and open space developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 9.5% |
| Spray drift areas – mortality | Up to 5% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |

| | |
|--|----------------|
| Use areas – effects to dietary items | 9.5% |
| Spray drift areas – effects to dietary items | Up to 5% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 88% |
| Sublethal | NA |
| Indirect - mortality | 88% arthropods |

Risk modifiers:

The Puritan tiger beetle occurs in Massachusetts, Maryland, Connecticut and Rhode Island. The Maryland population: lives in deep burrows, which they dig in sandy deposits on non-vegetated portions of the bluff face; Connecticut population: burrows are found among scattered herbaceous vegetation at the upper portions of sandy beaches and occasionally near the water's edge. Adults and larvae position themselves in the rack along the shoreline and probably also to some extent on the bluff face on sandy beaches. The Puritan tiger beetle makes use of sandy areas where beetles live, breed, and forage. If pesticide applications are made, it would be in these areas where these beetles would be impacted the most (pers. comm 2016 co-occurrence information, USFWS field office request).

Only two small Connecticut River populations remain, one in Massachusetts and one in Connecticut. Approximately six localities with more than 500 adults, and approximately 13 smaller populations, occur along the Chesapeake Bay in Calvert County and near the mouth of the Sassafra River in Kent and Cecil Counties, Maryland.

Puritan tiger beetles typically undergo a two-year larval period before emergence. Larvae hatch in late July or August as first instars. Larvae generally over-winter as second instars and become active again (as evidenced by open burrows) the following spring, when they molt to the third instar. Larvae tend to be most active (as evidenced by open burrows) in the fall, with lesser numbers appearing in the spring and summer. Pupation occurs in late spring, and in Maryland, adults emerge during mid- to late-June (Hill and Knisley 1991). The timing of adult emergence is 2-3 weeks later in the Connecticut River populations (P. Nothnagle pers. obs.).

The adult populations peak in late June to early July and begin to decline in late July. Population size then decreases rapidly until the middle of August, when only a few adults remain.

Young beetles develop in tiny burrows in sandy soils of the cliff face and adults inhabit the beach below the cliffs. The larvae firmly position themselves at the mouths of their burrows by means of abdominal hooks and wait for small invertebrates to pass by. Adults feed actively on smaller invertebrates which probably comprise the bulk of their diet.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 10,490 | 88 | 795 | 6.7 |
| Open Space Developed | D,I | 647 | 5.43 | 32 | 0.28 |
| Corn | D,I | 271 | 2.28 | 245 | 2 |
| Developed | D,I | 296 | 2.48 | 14.8 | 0.12 |
| Other Crops | D,I | 93 | 0.79 | 0 | 0 |
| Other Grains | D,I | 46 | 0.38 | 46 | 0.38 |
| Wheat | D,I | 22 | 0.18 | 18 | 0.15 |
| Pasture | D,I | 26 | 0.22 | 26 | 0.22 |
| Vegetables and Ground Fruit | D,I | 20 | 0.17 | 20 | 0.17 |
| Orchards and Vineyards | D,I | 0.4 | 0.003 | 0.4 | 0.003 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 11,911 | 99.9 | 1,197 | 10 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 1,421 | 9.45 | 402 | 3.3 |
| TOTAL⁴: | | 11,911 | 99.9 | 1,197 | 10 |

acres in species range: 11,924 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 45acres, 0.38%

Overall Usage: ☒ High ☐ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

General Conservation Measures
Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific measures

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, additional species-specific conservation measures outlined below will be implemented. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

Agricultural measure:

For all agricultural uses in the months of June – September, applicators in Massachusetts and Connecticut within the range of the species (plus 200 feet to account for spray drift from applicators adjacent to the range) must apply by ground application only and use a 50-foot buffer from cliffs and sandy beaches when winds are blowing towards these habitat features.

For all agricultural uses in the months of June – August, applicators in Maryland within the range of the species (plus 200 feet to account for spray drift from applicators adjacent to the range) must apply by ground application only and use a 50-foot buffer from cliffs and sandy beaches when winds are blowing towards these habitat features.

Application buffers are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to species. While the exact amount of spray drift reduction will vary depending on environmental conditions and application method, AgDRIFT modeling indicates that spray drift can be reduced from 82-90% for ground applications with a 25-50 foot buffer. This measure coincides with the period of adult puritan tiger beetle emergence and activity, ensuring that this protection measure will be in place when adults are most vulnerable to spray drift, substantially reducing the risk of exposure. Larvae typically spend most of their time burrowed underground, where they are more likely protected from malathion exposure. Larvae are active at the soil surface during the fall, when malathion application does not typically occur, thus do not require additional protection like adults which are more active on the beach surface during the above mentioned time frames.

Mosquito control measure:

For mosquito control applications, where feasible, do not apply product within the range of the species, plus 200 feet, from June to September. If avoidance is not feasible, or impairs the ability

of the mosquito control district or agency to protect the public's health and welfare, the applicator must coordinate with the local FWS Ecological Services field office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species (FWS points of contact and maps of designated critical habitat are available through the Information, Planning, and Consultation (IPaC) website <https://ecos.fws.gov/ipac/>). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

The specific period of application restriction, again, coincides with the period of peak adult beetle activity, and the additional 200 feet around the species range ensures substantial reduction of any potential spray drift that might enter the species' range, decreasing the risk of exposure and subsequent adverse effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, including the general and species-specific conservation measures described above, is not likely to jeopardize the continued existence of the Puritan tiger beetle.

The Puritan tiger beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is high based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (0.38%

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 9.5% mortality of individuals, up to 5.0% mortality from spray drift, a loss of about 9.5% of dietary items in use areas, and an additional loss of up to 5.0% of dietary items due to spray drift. In addition, there could be up to 88% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 10% of the non-Federal portion of the species range annually based on standard past usage data. As stated by the local Field Office (see Risk Modifier above), if pesticide applications are made, bluff faces and sandy beaches would be where these beetles would be impacted the most (pers. comm 2016 co-occurrence information, USFWS field office request).

However, implementation of the general and species-specific measures described above are anticipated to appreciably reduce the likelihood of exposure and resultant mortality of the species and its prey items. The main use driver for this species is mosquito control, and to a lesser extent, agricultural use on corn and other crops (see Table, above). To reduce anticipated exposure from these use types, conservation measures will be implemented that restrict use within and adjacent to the range of the Puritan tiger beetle. These conservation measures were designed to decrease use and off-site transport in close proximity to the cliffs and sandy beaches where this species is known to exist.

More specifically, for agricultural applications, within the range plus 200 feet, applicators must apply malathion by ground application, and must use a 50 foot buffer from beaches and cliffs if the wind is blowing towards those features. The 200 foot buffer around the range is anticipated to limit spray drift exposure by up to 90%, thus appreciably diminishing the anticipated effects to individual beetles and their prey items from use on agricultural crops within and adjacent to the range of the beetle. These measures will be implemented during the time of year (June to September) when the species is active at the surface and most likely to be exposed to malathion.

To address exposure from mosquito control, applicators are prohibited from spraying in or within 200 feet of the range of the beetle from June through September in the Maryland, Massachusetts, and Connecticut populations. If avoidance of these areas is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, the applicator must coordinate with the local FWS Ecological Services field office to ensure the proposed application is likely to have no more than minor effects on the species. Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as specific timing, species life history, and geographic or habitat factors. Coordination with the Service on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. In its 2021 Best Practices for Integrated Mosquito Management, the American Mosquito Control Association (AMCA) instructs applicators with listed species in their treatment area to coordinate with the Service prior to application and maintain records of interactions. Discussions with the AMCA and anecdotal reports from FWS field offices indicate that this type of coordination is presently occurring to varying degrees for mosquito control applications in general. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing us to better track this coordination and its outcomes moving forward.

For the state of Maryland, some on the ground conservation measures related to mosquito control are already in place under the Maryland mosquito control program. Mosquito adulticide ground and aerial spraying is mostly done outside of areas where the Puritan tiger beetle is found (the southern end of the Eastern Shore of the Chesapeake Bay) due to the qualification that mosquito populations must reach a specific loading amount (12 mosquitoes per minute landing rate count and/or 100 mosquitoes per light trap) before any spraying can be done. Malathion is not on the list of insecticides for use in mosquito adulticide spraying. Additionally, in order to be as precise as possible when spraying, night vision technology is used on aircraft so that the insecticide can be applied at night, specifically when mosquitoes are active (Maryland Mosquito Control Program).

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). However, we do not anticipate this level of malathion usage will result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Puritan tiger beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------------------|-------------------------------|------------|
| <i>Speyeria zerene behrensii</i> | Behren's silverspot butterfly | 444 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Behren's silverspot butterfly is a medium-sized butterfly with a wingspan of approximately 2.2 in (5.5 cm). This species was historically recorded from several coastal locations from central Sonoma County north to near the City of Mendocino, Mendocino County, California. In the decade before the 2020 5-Year Review, the species has been observed at only three areas: two highly localized sites in Sonoma County, and a cluster of observations, perhaps representing a metapopulation, in southern Mendocino County in the vicinity of Point Arena. The butterfly is associated with grasslands on coastal terraces and stabilized dunes, where its larval host plant, the early blue violet (*Viola adunca*) occurs. Disturbance is probably important in maintaining suitable habitat for the species; in the absence of disturbance, shrubs and coastal pines can colonize coastal prairies and degrade or eliminate habitat. Key resources for the species include sufficient violets to support larval development for a population, as well as nectar sources for the adult butterflies. In other *Speyeria*, the amount and quality of available nectar affect fecundity (Boggs and Ross 1993; Boggs 1997), and has been implicated in the decline and loss of populations (Dunford 2009).

We have no new information to suggest that threats to the species have substantially changed since the time of listing and of our previous 5-Year Review in 2008. The primary threats continue to be potential destruction and modification of habitat. Regulatory mechanisms do not prevent development of coastal grassland areas. Conversion of potential habitat by development and succession due to altered disturbance regimes continue to result in the loss of habitat. Development likely increases the modification of habitat caused by vegetation succession, by reducing fire frequency through increased suppression, and perhaps by reducing grazing, which can help maintain coastal grasslands. The threat posed by destruction of habitat has diminished since the time of listing, where occupied sites have been conserved through land purchases, including two large purchases of occupied areas since the last review. We anticipate that future management of these areas will reduce and perhaps eventually reverse the negative effects from succession and other threats that could reduce the suitability of butterfly habitat. While no known occupied sites are being managed primarily for Behren's silverspot butterfly conservation,

management actions at Stornetta Public Lands and Manchester State Park have helped to maintain habitat for the species, and will likely occur on 126 ac (51 ha) near Point Arena, which was transferred in January 2012 to Bureau of Land Management (BLM). Some aspects of BLM's management of the Stornetta Public Lands, such as cattle grazing, may result in incidental take of butterflies, but may also benefit the species by limiting succession. Other BLM management actions have helped restore habitat, notably removal of conifers encroaching into butterfly habitat. Service-funded surveys conducted between 2004 and 2011 observed Behren's silverspot butterflies at historical sites in Sonoma County and, in one case, at a new location near Point Arena, Mendocino County. However, the extent and viability of those populations remain unknown. Extant populations remain at historical sites located at Salt Point, Stewarts Point, and Point Arena/Manchester, which were documented at the time of listing. Populations of the species are likely sensitive to the effects of climatic variation on important vegetation resources and on thermal regime and other climatic characteristics, which can affect survival and reproduction. While climate change has the potential to affect the species, the nature of any effects could not be predicted at the time of the 2012 review. A captive rearing program is considered in the 2020 5-Year Review.

EB/CE Sources: U.S. Fish and Wildlife Service. 2012. Behren's silverspot butterfly (*Speyeria zerene behrensii*) 5-Year Review: Summary and Evaluation. Arcata Fish and Wildlife Office, California. 26 pp.

U.S. Fish and Wildlife Service. 2020. Behren's silverspot butterfly (*Speyeria zerene behrensii*) 5-Year Review. Arcata Fish and Wildlife Office, California. 3 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Behren's silverspot butterflies exposed to malathion at maximum use rates is 1% for developed, 4% for open space developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|----------|
| Use areas – mortality | 6% |
| Spray drift areas – mortality | Up to 8% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |

| | |
|--|---------------------------------------|
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 6% |
| MOSQUITO CONTROL | |
| Direct - mortality | 84% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Behren's silverspot is a coastal terrace prairie species that occurs in habitat west of the Coast Range in southern Mendocino and Northern Sonoma Counties, California. This habitat is strongly influenced by proximity to the ocean with mild temperatures, moderate rainfall, and frequent summer fog. An occupied site must have two key resources: 1) caterpillar host plants; and 2) adult nectar sources. Coastal terrace prairie is a dense grassland dominated by perennial grasses, on sandy loam soils on marine terraces below about 1,000 ft elevation, and in the zone of coastal fog.

The Behren's silverspot has five instar stages and a pupa stage before becoming an adult. Eggs are laid in mid to late summer, and hatch soon after. The larvae then pass the fall and winter in diapause (a period of physical dormancy). Upon termination of diapause in the spring, the larvae immediately seek out the violet host plant. During the spring and early summer they grow, before forming a pupa within a chamber of leaves that they draw together with silk. The adults emerge in about two weeks and live for approximately three weeks from July to late August/September (US FWS 2001). Because the height of feeding and reproductive activities for this butterfly occurs from April through September, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time, however it is potentially exposed throughout its entire lifecycle.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 250,128 | 84.0 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | <1 | <0.01 | 0.11 | 0.003 |
| Open Space Developed | D,I | 14,177 | 4.78 | 709 | 0.24 |
| Developed | D,I | 3,911 | 1.32 | 196 | 0.066 |
| Orchards and Vineyards | D,I | 246 | 0.08 | 0 | 0 |
| Other Grains | D,I | 48 | 0.02 | 0 | 0 |
| Other Crops | D,I | 14 | <0.01 | 0 | 0 |
| Nurseries | D,I | 11 | <0.01 | 0 | 0 |
| Pasture | D,I | 9 | <0.01 | 0 | 0 |
| Wheat | D,I | <1 | <0.01 | 0 | 0 |
| Rice | D,I | <1 | <0.01 | | |
| Corn | D,I | <1 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 18,416 | 6.27 | 905 | 0.309 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 18,416 | 6.27 | 905 | 0.309 |
| TOTAL⁴: | | 268,545 | 90.27 | 905 | 0.309 |

acres in species range: 296,395 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 2,395 acres, 0.81%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7–10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Behren’s silverspot butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Behren’s silverspot butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Behren’s silverspot butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 6.0% mortality of individuals, up to 8.0% mortality from spray drift. In addition, there could be up to 84.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those

populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.309% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use and timing restrictions for mosquito control use, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Behren's silverspot butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------|--------------------------|-------------------|
| <i>Somatochlora hineana</i> | Hine's emerald dragonfly | 445 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Species/Populations widespread or wide-ranging

Number of Populations: Multiple populations (numerous)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Since the 2013 5-Year Review, seven new sites were confirmed, although population numbers do not appear to have changed in that time. Two of these recently confirmed sites have verified breeding habitat that have geological characteristics that are different than what is typical for Hine's emerald dragonfly habitat, specifically the soil depth to bedrock. Previously, the species was believed to be restricted to wetland habitats characterized by thin soils over dolomite bedrock with marshes, seeps, and sedge meadows. Of the 16 subpopulations within the Northern Wisconsin Population and Northern Michigan Population, the habitat of five of those subpopulations are entirely managed and protected by Federal or State agencies, while others have a mixture of ownership and are not completely protected and managed. Hine's emerald dragonfly breeding sites currently known or verified in the future within the Hiawatha National Forest will be protected under the Federal Threatened and Endangered Species and Regional Forest Sensitive Species Plan (USFS 2006). The majority of the habitat within the three Illinois subpopulations is protected and managed by County and State agencies and State laws (K. Lah, USFWS, pers. comm. 2012). Private land exists within Illinois Subpopulation 1, but it is currently being managed to benefit Hine's emerald dragonfly. The habitat within the Ozaukee County, Wisconsin Population is protected and managed by the Wisconsin Department of Natural Resources and the University of Wisconsin (W. Smith, Wisconsin Department of Natural Resources, pers. comm. 2012). The entire Hine's emerald dragonfly habitat area that has been identified within the Southwest Wisconsin Population is managed and protected by the Wisconsin Department of Natural Resources (W. Smith, pers. comm. 2012). In Missouri, the majority of the habitat in two of the five subpopulations are completely protected and managed by either the U.S Forest Service or Missouri Department of Conservation (P. McKenzie, USFWS, pers. comm. 2012). The Forest Plan for the Mark Twain National Forest identifies a number of actions supporting management of Hine's emerald dragonfly habitat (USFS 2005). Management actions identified include control of non-native and/or undesirable (e.g., woody) plant species, restoration of local hydrology, and methods to minimize unauthorized vehicle and heavy equipment access near fens with known or suspected Hine's emerald dragonfly. There is

an ongoing captive rearing project, though success of this project was not discussed in the 2019 5-Year Review.

Fragmentation and destruction of suitable habitat are believed to be the main reasons for this species' endangered status and continue to be the primary threats to its recovery. The known breeding sites in Illinois occur along the Des Plaines River floodplain, which has been fragmented by industrial and urban development (Cashatt 1991). In Wisconsin, land development for agriculture, light industry, and tourism are principal threats (Vogt and Cashatt 1990). Off-road vehicle use and possibly logging, creation of water impoundments, real estate development, road development and maintenance, pipeline construction, and changes in hydrology are potential threats in Michigan (Steffens 1997). In addition, the species is vulnerable to loss of habitat caused by off-site hydrology alterations and groundwater development affecting the groundwater-fed seeps and springs. Many of the threats to habitat vary across the range of the species but also vary in magnitude and ability to be mitigated. Direct loss of habitat is the most severe of all of the threats but occurs infrequently due to laws protecting wetlands and measures taken to preserve habitat. Other threats to hydrology or from fragmentation and contamination can also have a permanent impact on habitat and even entire populations of the species but our ability to manage or prevent these threats is limited. Invasive plant species are the most widespread of the threats; however, the magnitude of this threat and our ability to manage it depends on the invasive species and the degree that it has encroached upon Hine's emerald dragonfly habitat. Management of impacts from invasive plants and animals will be an ongoing effort.

EB/CE Sources: U.S. Fish and Wildlife Service. 2001. Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) Recovery Plan. Great Lakes-Big Rivers Region, Fort Snelling, Minnesota. 133 pp.

U.S. Fish and Wildlife Service. 2013. Hine's Emerald Dragonfly, *Somatochlora hineana* (Odonata: Corduliidae) 5-Year Review: Summary and Evaluation. Chicago Ecological Services Field Office, Barrington, Illinois. 52 pp.

U.S. Fish and Wildlife Service. 2019. Hine's Emerald Dragonfly (*Somatochlora hineana*) 5-Year Review. Chicago Ecological Services Field Office, Barrington, Illinois. 10 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bin 2 waters and in the terrestrial phase would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

Terrestrial Phase: Mortality for Hine's emerald dragonfly adults exposed to malathion at maximum use rates is 2-8% for pasture, open space developed, corn, developed, and <1% for all other use types.

Aquatic Phase: Mortality for Hine's emerald dragonfly nymphs exposed to malathion at maximum use rates is 2-8% for pasture, corn, developed, and <1% for all other use types.

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | Terr: 22% Aquatic: 22% |
| Spray drift areas – mortality | Terr: up to 38% Aquatic: NA |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | Terr: 22% Aquatic: 22% |
| Spray drift areas – effects to dietary items | Terr: up to 38% Aquatic: NA |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 21% |
| Sublethal | NA |
| Indirect | 21% |

Risk modifiers:

The HED lifecycle encompasses both terrestrial and aquatic environments. The following analysis looks at both the adult stage of the lifecycle when the dragonfly is capable of flight and is terrestrial as well as the nymph stage which was assessed using the Aquatic R plot.

Currently known from 42 locations (not all viable): 9 in Illinois (Will, Cook, DuPage Cos.; most not viable), 20 in Wisconsin (Door, Kewaunee, Ozaukee Cos.), 10 in Michigan (Mackinac, Presque Isle, Alpena Cos.), and at least 3 sites in Missouri (Reynolds, Iron Cos.) (USFWS 2001). The first Canadian occurrence was documented in 2007 in Simcoe County, Ontario (Colin Jones, ON CDC, pers. comm., July 2007) (NatureServe 2015).

AQUATIC LIFE STAGE

Nymphs live in water for 2 to 4 years then crawl out and shed for a final time, emerging as a flying adult (Soluk et al. 1996; Vogt and Cashatt 1994). Females most likely lay more than 500 eggs during their lives. Larvae begin to emerge as adults possibly as early as late May in Illinois and late June in Wisconsin and continue to emerge throughout the summer. Hine's emerald dragonfly (HED) larvae may become less active and/or crawl into tight spaces during cooler

water temperatures in the late fall to early spring (Soluk et al. 1998). Similarly, larvae can withstand drought during these times by crawling under objects for protection in small streamlets when they dry up; enabling them to survive short-term drought conditions (Soluk et al. 1998). Larvae are sit and wait predators and are more active at night. Larvae feed on oligochaetes and larval mayflies and caddisflies (USFWS 2001). As the larva grows, it feeds on prey items of increasingly larger size (NatureServe 2015).

TERRESTRIAL LIFE STAGE

Known flight season lasts up to early October in Illinois and to late August in Wisconsin. Females oviposit by repeatedly dipping their abdomens up to 200 times in shallow water from June to late August in Illinois and early to late July in Wisconsin; usually in seepage marshes, seepage sedge meadows, sedge hummocks, muck along sluggish water, and in small muck-bottomed pools (see Vogt and Cashatt 1994; Soluk et al. 1996; USFWS 2001). Reproductive adults establish breeding sites and territories, using these areas to mate and oviposit. Fully adult Hine's emerald dragonflies can live at least 14 days (Soluk et al. 1996) and may live 4 to 6 weeks (Mierzwa et al. 1995b).

The HED as an adults are general predators, feeding on insects they can capture while flying (NatureServe 2015).

The HED will use right of ways and golf courses as flight corridors (Louise Clemency, pers. comm. 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|----------------------|------------------------------|------------------------|------|---------------------------------------|------|--|--|
| | | Acres | % | Acres | % | | |
| Mosquito Control | D | 3,641,760 | 21 | 47,255 | 0.27 | 2 | 2H |
| Developed | D,I | 1,436,353 | 8.09 | 71,818 | 0.4 | 2 | 2H |
| Corn | D,I | 1,266,481 | 7.13 | 60,822 | 0.34 | 2 | 2H |
| Open Space Developed | D,I | 784,610 | 4.42 | 39,231 | 0.22 | 2 | 2H |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|--|--|
| | | Acres | % | Acres | % | | |
| Pasture | D,I | 326,415 | 1.84 | 75,893 | 0.43 | 2 | 2H |
| Wheat | D,I | 92,309 | 0.52 | 32,054 | 0.18 | 2 | 2H |
| Other Grains | D,I | 38,373 | 0.22 | 10,637 | 0.06 | 2 | 2H |
| Rice | D,I | 28,890 | 0.16 | 15,149 | 0.09 | 2 | 2H |
| Other Crops | D,I | 28,861 | 0.16 | 7 | <0.01 | 2 | 2H |
| Vegetables and Ground Fruit | D,I | 17,437 | 0.1 | 13,286 | 0.1 | 2 | 2H |
| Nurseries | D,I | 4,789 | 0.03 | 4,789 | 0.03 | 2 | 2H |
| Orchards and Vineyards | D,I | 3,406 | 0.02 | 2,049 | 0.02 | 2 | 2H |
| Other Row Crops | D,I | 1,379 | <0.01 | 549 | <0.01 | 2 | 2H |
| Cotton | D,I | 990 | <0.01 | 902 | <0.01 | 2 | 2H |
| Christmas Trees | D,I | 393 | <0.01 | 0 | <0.01 | 2 | 2H |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 4,030,687 | 23 | 327,184 | 1.84 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 4,030,687 | 23 | 327,184 | 1.84 | | |
| TOTAL⁴: | | 7,672,447 | 44 | 374,439 | 2.11 | | |

[^]We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

acres in species range: 17,758,964 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 2,458,656 acres, 13.8%

Overall Usage: ☐ High ☐ Medium ☒ Low

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk to the Hine's emerald dragonfly during its aquatic phase.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. These buffers will substantially reduce exposure to the aquatic phases of the Hine's emerald dragonfly.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from "repeat as necessary" to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Hine's emerald dragonfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion..

This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Hine's emerald dragonfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Hine's emerald dragonfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals (both terrestrial and aquatic), up to 38.0% mortality from spray drift in terrestrial areas, a loss of about 22.0% of dietary items in use areas (both terrestrial and aquatic), and an additional loss of up to 38.0% of dietary items due to spray drift in terrestrial areas. In addition, there could be up to 21.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the Hine's emerald dragonfly (bin 2) would maintain a high concentration of toxins, including malathion, if exposed due to their small size and low water flow. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the dragonfly populations and low dispersal ability of this species.

However, the rain restriction and aquatic habitat buffer conservation measures described above are anticipated to address the concerns related to surface run-off contamination, and reduce the run-off potential into the aquatic habitat areas where these dragonfly reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is

made and the species' habitat by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the water body.

Developed and open space developed uses (described as residential uses) make up the majority of overlap in the range of this species that are anticipated to cause mortality. New residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied to, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to further reduce the contribution of malathion from residential uses into the Hine's emerald dragonfly's range. For other agricultural use applications, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific crop) which are also anticipated to significantly reduce the amount of malathion that could enter the aquatic environment. The conservation measure restricting malathion use as a mosquito adulticide to times when the Hine's emerald dragonfly is not active, is anticipated to further reduce exposure of this species to malathion.

In addition, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.11% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range, and conservation measures will be implemented as described above, further reducing the risk of exposure to malathion. We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Hine's emerald dragonfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|-------------------------|------------|
| <i>Batrisodes texanus</i> | Coffin Cave mold beetle | 447 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Coffin Cave mold beetle is very small, less than 3mm (1/8 inch) in length. It is eyeless and dark colored, with short wings and long legs. The beetle is a troglobite, which is a species restricted to the subterranean environment that typically exhibits morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Troglobitic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Williamson County, Texas. Karst areas commonly have few surface streams; most water moves through cavities underground. Within this habitat this species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses. It is imperative to consider that while these species spend their entire lives underground; their ecosystem is very dependent on the overlying surface habitat. As of the 2018 review, the Coffin Cave mold beetle occurred in two of eight karst fauna regions demarcated for Travis and Williamson counties. As of the last review, *B. texanus* was found in 23 caves in Williamson County, and faced the same threats it did at the time it was listed.

Batrisodes texanus was listed as endangered in 1988, based on the threats of: 1) habitat loss to development; 2) cave collapse or filling; 3) alteration of drainage patterns; 4) alteration of surface plant and animal communities, including the invasion of exotic plants and predators (i.e., the red-imported fire ant (RIFA), *Solenopsis invicta*), changes in competition for limited resources and resulting nutrient depletion, and the loss of native vegetative cover leading to changes in surface microclimates and erosion; 5) contamination of the habitat, including groundwater, from nearby agricultural disturbance, pesticides, and fertilizers; 6) leakages and spills of hazardous materials from vehicles, tanks, pipelines, and other urban or industrial runoff; and 7) human visitation, vandalism, and dumping; mining, quarrying (limestone), or blasting above or in caves. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Sources: U.S. Fish and Wildlife Service. 2009. Coffin Cave Mold Beetle (*Batrisodes texanus*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Texas. 37 pp.

U.S. Fish and Wildlife Service. 2018. Coffin Cave Mold Beetle (*Batrisodes texanus*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Texas. 15 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for 20 Southwest Species. Southwest Region, Albuquerque, New Mexico. 45 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Coffin cave mold beetles exposed to malathion at maximum use rates is 2-14% for cotton, wheat, other grains, developed, open space developed, and corn, and <1% for all other use types.

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 38% |
| Spray drift areas – mortality | Up to 77% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 38% |
| Spray drift areas – effects to dietary items | Up to 77% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 99.9% |
| Sublethal | NA |
| Indirect - mortality | 99.9% arthropods |

Risk modifiers:

The Coffin cave mold beetle (CCMB) occurs in 23 caves in Williamson County, Texas, that have been confirmed. Nineteen caves are in the North Williamson County Karst Faunal Region (KFR) and four caves are in the Georgetown KFR (USFWS 2009). The habitat for the CCMB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

Very little is known about the reproductive strategy of the CCMB.

Specific information on *B. texanus* is not available. Most of the endangered karst invertebrates are believed to be predators of microarthropods, such as collembolans. Many troglobites also feed on well decomposed organic matter. Others, such as the ground beetle, may consume cave cricket eggs or dead cave cricket parts. The limited data available suggest that most troglobites are food generalists (Barr 1968), although this does not preclude the development of food specialization in some species. Examples of nutrient sources include leaf litter fallen or washed in, animal droppings, and animal carcasses (USFWS 1994; USFWS 2009).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 725,587 | 99.9 | 63 | <0.01 |
| Corn | D,I | 101,640 | 13.99 | 4,101 | 0.56 |
| Open Space Developed | D,I | 65,383 | 9 | 3,269 | 0.45 |
| Developed | D,I | 49,453 | 6.81 | 2,473 | 0.34 |
| Other Grains | D,I | 24,620 | 3.39 | 24,620 | 3.39 |
| Wheat | D,I | 18,658 | 2.57 | 17,234 | 2.37 |
| Cotton | D,I | 14,317 | 1.97 | 13,184 | 1.82 |
| Other Crops | D,I | 3,030 | 0.42 | 0 | 0 |
| Orchards and Vineyards | D,I | 233 | 0.03 | 39 | <0.01 |
| Nurseries | D,I | 43 | <0.01 | 43 | <0.01 |
| Vegetables and Ground Fruit | D,I | 16 | <0.01 | 16 | <0.01 |
| Pasture | D,I | 6 | <0.01 | 6 | <0.01 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Other Row Crops | D,I | 5 | <0.01 | 5 | <0.01 |
| Rice | D,I | 4 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 277,407 | 38.23 | 65,053 | 8.98 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 277,407 | 38.23 | 65,053 | 9.01 |
| TOTAL⁴: | | 1,002,994** | 100 [#] | 65,116 | 9.02 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 726,264 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 825 acres, 0.11%

Overall Usage: ☐ High ☒ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

General Conservation Measures

Rain restriction and aquatic habitat buffers: The Coffin Cave mold beetle is closely associated with the subterranean streams that create the cave systems they live in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the Coffin Cave mold beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Conservation Measures:

In addition to the above general label changes that would apply to all uses specified on the label, an additional species-specific conservation measure will be implemented. This measure is now part of the Action and will be included in *BulletinsLive! Two*.

Do not spray within 444 feet of confirmed locations. This buffer distance mimics protections for similar central Texas karst invertebrate species, which includes a 344 foot no spray buffer to protect the foraging area of cave crickets (which are an important food source for the Coffin Cave mold beetle) and an additional 100-foot spray drift buffer. If applicators are enrolled in the Balcones Canyonlands Conservation Plan, they will already be following equivalent restrictions and thus will not need to implement the above. While this extended buffer may not fully eliminate spray drift from entering the species' habitat, we expect that this measure will substantially reduce spray drift entering the species' habitat and decrease the risk of malathion from entering the cave systems the species occupies.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Coffin Cave mold beetle.

The Coffin Cave mold beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is medium based on standard usage data, and the implementation of the general and species-specific conservation measures described above is expected to further reduce the likelihood of exposure. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (0.11%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 9.01% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will not be recolonized due to the isolated and fragmented nature of the beetle populations. Additionally, dietary items will be lost from malathion use, which will affect the survivability and reproduction of individual Coffin Cave mold beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species include developed and open space developed (residential uses), 'other grains,' corn, wheat, and cotton (agricultural uses).

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

To further prevent exposure from agricultural uses listed above, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific crop) which is anticipated to substantially reduce the contribution of malathion from use on corn that could enter the karst environment.

In order to further address exposure and the resultant effects from all uses of malathion within the range of the Coffin Cave mold beetle, a species-specific measure will be implemented. This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. These conservation measures prohibit malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This

effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items.

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Coffin Cave mold beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------|------------------------------|------------|
| <i>Texamaurops reddelli</i> | Kretschmarr Cave mold beetle | 448 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Kretschmarr Cave mold beetle is endemic to a restricted range in the Balcones Canyonlands ecoregion of Texas, specifically western Travis County (Chandler 1992; Chandler and Reddell 1999; Chandler et al. 2009). The Balcones Canyonlands form the eastern to southeastern boundary of the Edwards Plateau, where the activity of rivers, springs, and streams has resulted in the formation of an extensive karst landscape of canyons, caves, and sinkholes (Griffith et al. 2007). The term “karst” refers to a type of terrain that is formed by the slow dissolution of calcium carbonate from surface and subsurface limestone, and other soluble rock types (e.g., carbonites and evaporates), by mildly acidic groundwater (Holsinger 1988; Culver and Pipan 2009; Stafford et al. 2014). Flow of groundwater through conduits leads to the formation of an interconnected system of subterranean voids that become larger as bedrock is dissolved (Culver and Pipan 2009; Stafford et al. 2014). The Kretschmarr Cave mold beetle is one of 14 troglobitic (i.e., species adapted to subterranean habitats that must complete their life-cycle underground) Pselaphinae occurring in Texas (Chandler et al. 2009). These species occur primarily in the dark zone of caves, often in humid microhabitats (e.g., under rocks), and exhibit such troglomorphic traits (i.e., adaptations to subterranean environments) as absent or reduced eyes, elongated antennae and legs, and elongated sensory setae (i.e., hair-like structures) (Chandler 1992; Chandler and Reddell 2001; Chandler et al. 2009). Research indicates that cave-dwelling arthropods often display preferences for higher relative humidity and/or relatively narrow temperature regimes underscoring a dependence on subterranean conditions.

One of the main threats to the species is loss of habitat due to urban development activities (53 FR 36029). The species occurs in an area that is undergoing continued urban expansion at a rapid rate and few caves are adequately protected. Most of the species’ localities occur adjacent to or near developed areas (i.e., residential subdivisions, schools, golf courses, roads, commercial and industrial facilities, etc.) or in areas that are proposed for development. Unless proper protective measures can be devised, urban development may lead to the filling in or collapse of caves, alteration of drainage patterns, alteration of surface plant and animal communities, as well as increased contamination and human visitation. One cave cluster in the Jollyville Plateau karst

fauna region occurs in an area that presently supports some residential and industrial development and where additional development has been proposed. Another cave to the north of this cave cluster occurs in an area that is undergoing expansion of a residential community. These two areas include the entire range of the species.

Because karst is highly susceptible to groundwater contamination, urbanization (including industrial, residential, road, and commercial development) may result in the contamination of karst ecosystems. Types of contaminants associated with urbanization may include chemical, sewage, and oil pollution. These pollutants are derived from urban runoff; broadcasting, spraying, and fogging pesticides and fertilizers; hazardous materials spills; pipeline and storage tank leaks; power transformer and industrial accidents; leakage from septic systems, landfills, and sewer lines; and other sources. Primary routes of contaminant entry into karst ecosystems include the surface and subsurface drainage basin of a karst ecosystem; air (for air-borne contaminants); and dumping of household garbage, construction debris, motor oil, alkaline batteries (which contain mercury), pesticides, and other materials directly into cave entrances. Many caves are currently subject to disposal of refuse, urban runoff, and contamination from pesticides and fertilizers. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Sources: U.S. Fish and Wildlife Service. 1994. Endangered Karst Invertebrates (Travis and Williamson Counties, Texas) Recovery Plan. Region 2, Albuquerque, New Mexico. 162 pp.

U.S. Fish and Wildlife Service. 2018. Kretschmarr Cave Mold Beetle (*Texamaurops reddelli*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Texas. 33 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for 20 Southwest Species. Southwest Region, Albuquerque, New Mexico. 45 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Kretschmarr Cave mold beetle exposed to malathion at maximum use rates is 1-16% for other grains, corn, open space developed, and developed and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 27% |
| Spray drift areas – mortality | Up to 48% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 27% |
| Spray drift areas – effects to dietary items | Up to 48% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 100% |
| Sublethal | NA |
| Indirect - mortality | 100% arthropods |

Risk modifiers:

The Kretschmarr Cave mold beetle (KCMB) is known to occur in four caves within a 2-km radius in the Jollyville Plateau karst fauna region, Travis County, Texas. Eight caves support the Kretschmarr Cave mold beetle: Amber Cave, Gallifer Cave, Tardus Hole, Tooth Cave, Kretschmarr Double Pit Cave, Stovepipe Cave, Japygid Cave, MWA Cave. The habitat for the KCMB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

There is currently no information about the reproductive strategy of the KCMB.

Texamaurops reddelli can only be distinguished from other pselaphid beetles by a qualified systematist upon microscopic study. The species is “superficially similar to *Batrisodes texanus* by the greatly elongated antennae and legs, as well as body size” (Chandler 1992), but can be definitively separated from *Batrisodes texanus* by its ocular knobs and its lack of the pencil of setae on the metatibia.

All members of the family are believed to be predators.

This species is a troglobite, which describes species restricted to the subterranean environment that typically exhibit morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Their habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Travis County. It is imperative to consider that while these species spend their entire lives underground, their ecosystem is dependent on the overlying surface habitat. Pselaphids are found in soil, moldy wood, moss, under stones and logs, in caves, or in termite nests. *Texamaurops reddelli* is

found in total darkness under and among rocks and buried in silt (Barr and Steeves 1963, Reddell 1966).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|------------------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 9,999 | 106 | 0 | 0 |
| Developed | D,I | 1,738 | 18.4 | 87 | 0.92 |
| Open Space Developed | D,I | 823 | 8.7 | 41 | 0.4 |
| Corn | D,I | 0.04 | 0.0004 | 0.04 | 0.0004 |
| Other Grains | D,I | 0.34 | 0.004 | 0.34 | 0.004 |
| Wheat | D,I | 0.04 | 0.0005 | | 0.0006 |
| Cotton | D,I | 0.07 | 0.0008 | 0.07 | 0.0008 |
| Other Crops | D,I | 0.7 | 0.008 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 12,561 | 133 | 0.07 | 1.32 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 2,562 | 27 | 0.07 | 1.32 |
| TOTAL⁴: | | 12,561** | 133 [#] | 0.07 | 1.32 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 9,445 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 0 acres, 0%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

General Conservation Measures

Rain restriction and aquatic habitat buffers: The Kretschmarr Cave mold beetle is closely associated with the subterranean streams that create the cave systems they live in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the Kretschmarr Cave mold beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Measures:

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, an additional species-specific conservation measure will be implemented as outlined below. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

All agricultural uses are prohibited within 100 feet of confirmed locations (cave openings) of this species. As the Balcones Canyonland Conservation Plan already includes a 344-foot buffer where pesticides cannot be applied to protect the foraging area of cave crickets (which are an important food source for the species), this additional measure extends the area where malathion cannot be applied to 444 feet around cave entrances. This extended buffer would substantially decrease the fraction of spray drift entering critical habitat and reduce the risk of exposure.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Kretschmarr Cave mold beetle.

The Kretschmarr Cave mold beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the species range is medium based on standard usage data, however, the implementation of the general and species-specific conservation measures described above is expected to substantially reduce the likelihood of exposure. While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 1.32% of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. We anticipate a loss of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will not likely be recolonized due to the isolated and fragmented nature of the beetle populations. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of some individual Kretschmarr Cave mold beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species are developed and open space developed (residential uses), and various agricultural use site, though at a low level.

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

In order to further address exposure and the resultant effects from all uses of malathion within the range of the Kretschmarr Cave mold beetle, a species-specific measure will be implemented. This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. This conservation measure prohibits malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items.

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate this level of malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Kretschmarr Cave mold beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|--------------------------|------------|
| <i>Rhadine persephone</i> | Tooth Cave ground beetle | 449 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Tooth Cave ground beetle, *Rhadine persephone* (family Carabidae), was first described by Barr (1974) from specimens collected in the Tooth Cave by W.M. Andrews, R.W. Mitchell, and T.C. Barr in 1965. It is troglobitic and has only rudimentary eyes. It probably feeds on cave cricket eggs, which have been determined to be a major food of another troglobite species of *Rhadine* (Mitchell 1968). The Tooth Cave ground beetle is known only from 16 cave clusters and individual caves in Travis and Williamson counties, Texas. One known site is destroyed and five others have low resiliency for the species, therefore they may not support viable populations of the Tooth Cave ground beetle over the long-term. Nine cave clusters and individual caves have high to moderate resiliency with potential to support viable Tooth Cave ground beetle populations.

Urban, industrial, and highway expansion are planned or ongoing in the area containing the cave habitat of these species. This development could result in filling or collapse of these shallow caves, disturbances of water drainage patterns that affect cave habitat, introduction of exotic competitive and predatory insects and other organisms, and pollution of the cave systems with pesticides, fertilizers, oils, and other harmful substances. *Rhadine persephone* occurs in ten caves (eight positive, two tentative identifications) in the Jollyville Plateau karst fauna region (Travis County) and 17 localities (16 positive, one tentative identifications) in the Cedar Park karst fauna region (Travis and Williamson counties), with a total distance of about 14 km between the northern and southernmost locations. One of the main threats to the listed species is loss of habitat due to urban development activities (53 FR 36029). The species occur in an area that is undergoing continued urban expansion at a rapid rate and few caves are adequately protected. Most of the species' localities occur adjacent to or near developed areas (residential subdivisions, schools, golf courses, roads, commercial and industrial facilities, etc.) or in areas that are proposed for development. Unless proper protective measures can be devised, urban development may lead to the filling in or collapse of caves, alteration of drainage patterns, alteration of surface plant and animal communities, as well as increased contamination and human visitation. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Sources: U.S. Fish and Wildlife Service. 1988. Endangered and Threatened Wildlife and Plants; Final Rule To Determine Five Texas Cave Invertebrates To Be Endangered Species. Federal Register 53(180):36029-36033

U.S. Fish and Wildlife Service. 1994. Endangered Karst Invertebrates (Travis and Williamson Counties, Texas) Recovery Plan. Region 2, Albuquerque, New Mexico. 162 pp.

U.S. Fish and Wildlife Service. 2018. Tooth Cave Ground Beetle (*Rhadine persephone*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Texas. 38 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan Amendments for 20 Southwest Species. Southwest Region, Albuquerque, New Mexico. 45 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Tooth Cave ground beetle exposed to malathion at maximum use rates is 1-11% for cotton, wheat, other grains, corn, open space developed, and developed and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 36% |
| Spray drift areas – mortality | Up to 63% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 36% |
| Spray drift areas – effects to dietary items | Up to 63% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 97% |
| Sublethal | NA |

| | |
|----------------------|----------------|
| Indirect - mortality | 97% arthropods |
|----------------------|----------------|

Risk modifiers:

The Tooth Cave ground beetle (TCGB) occurs in ten caves (eight positive, two tentative identifications) in the Jollyville Plateau karst fauna region (Travis County) and 17 localities (16 positive, one tentative identifications) in the Cedar Park karst fauna region (Travis and Williamson counties) with a total distance of about 14 km between the northern and southernmost locations. The habitat for the TCGB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

Very little is known about the reproductive strategy of the TCGB.

Due to the paucity of light and limited capability for photosynthesis, karst ecosystems are almost entirely dependent upon surface plant and animal communities for nutrient and energy input. Karst ecosystems receive nutrients from the surface in the form of leaf litter and other organic debris that have washed or fallen into the caves, from tree and other vascular plant roots, or through the feces, eggs, or dead bodies of troglophiles and trogoxenes (i.e., cave crickets, raccoons). Presumably it is a predator on small or immature arthropods, and possibly cave cricket eggs. The beetle runs rapidly and patrols the floor area in search of prey.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 1,342,285 | 97.2 | 64 | <0.01 |
| Developed | D,I | 154,757 | 11.2 | 7,738 | 0.56 |
| Open Space Developed | D,I | 143,869 | 10.43 | 7,193 | 0.52 |
| Corn | D,I | 119,889 | 8.68 | 4,101 | 0.30 |
| Other Grains | D,I | 37,563 | 2.72 | 37,563 | 2.72 |
| Wheat | D,I | 24,441 | 1.77 | 22,784 | 1.65 |
| Cotton | D,I | 16,370 | 1.19 | 14,687 | 1.06 |
| Other Crops | D,I | 5,080 | 0.37 | 0 | 0 |
| Nurseries | D,I | 613 | 0.04 | 613 | 0.04 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Orchards and Vineyards | D,I | 580 | 0.04 | 249 | 0.02 |
| Vegetables and Ground Fruit | D,I | 20 | <0.01 | 19 | <0.01 |
| Other Row Crops | D,I | 10 | <0.01 | 12 | <0.01 |
| Pasture | D,I | 7 | <0.01 | 7 | <0.01 |
| Rice | D,I | 5 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 503,205 | 36.48 | 94,966 | 6.90 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 503,205 | 36.48 | 94,966 | 6.90 |
| TOTAL⁴: | | 1,845,490** | 100 [#] | 95,030 | 6.90 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

**Overlap acreage greater than acres in species range.

acres in species range: 1,381,225 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 38,859 acres, 2.81%

Overall Usage: ☐ High ☒ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

General Conservation Measures

Rain restriction and aquatic habitat buffers: The Tooth Cave ground beetle is closely associated with the subterranean streams that create the cave systems they live in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the Tooth Cave ground beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Conservation Measures

In addition to the above general label changes that would apply to all uses specified on the label, an additional species-specific conservation measure will be implemented as outlined below. This measure is now part of the Action and will be included in *BulletinsLive! Two*.

For agricultural uses, do not spray within 444-foot of confirmed locations. This buffer distance mimics protections for similar central Texas karst invertebrate species, which includes a 344 foot no spray buffer to protect the foraging area of cave crickets (which are an important food source for the Tooth Cave ground beetle) and an additional 100-foot spray drift buffer. If applicators are enrolled in the Balcones Canyonlands Conservation Plan, they will already be following equivalent restrictions and thus will not need to implement the above. We expect this measure will substantially reduce spray drift entering the species’ habitat and decrease the risk of malathion from entering the cave systems the species occupies.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Tooth Cave ground beetle.

The Tooth Cave ground beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is medium based on standard usage data, however, the implementation of the general and species-specific conservation measures described above is expected to substantially reduce the likelihood of exposure. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we

assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (2.81%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 6.90% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. We anticipate a loss of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of individual Tooth Cave ground beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species include developed and open space developed (residential uses), 'other grains,' wheat, cotton, and corn (agricultural uses).

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

To further prevent exposure from agricultural uses, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific crop) which is anticipated to substantially reduce the contribution of malathion from use on corn that could enter the karst environment.

In order to further address exposure and the resultant effects from all uses of malathion within the range of the Tooth Cave ground beetle, a species-specific measure will be implemented. This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. These conservation measures prohibit malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items. However, conservation measures to be implemented, such as aquatic buffers, rain restriction, and no spray zones around confirmed species locations, are anticipated to appreciably reduce the exposure of this species and its dietary items to malathion, therefore reducing the effects to this species.

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Tooth Cave ground beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------------|-------------------------|-------------------|
| <i>Icaricia icarioides fenderi</i> | Fender's blue butterfly | 450 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered, Five-Year Review Recommendation (3/6/2019): Downlist to Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: All populations stable, with none known to be increasing or decreasing; most recent 5-Year Review indicates abundance has increased (see below)

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The historic distribution of Fender's blue butterfly is not precisely known due to the limited information collected on this species prior to its description in 1931. Although the type specimen for this butterfly was collected in 1929, few collections were made between the time of the subspecies' discovery and Macy's last observation of the butterfly on May 23, 1937, in Benton County, Oregon (Hammond and Wilson 1992). Fender's blue butterfly was rediscovered in 1989 at the McDonald Research Forest, Benton County, Oregon. Past survey efforts determined that Fender's blue butterfly is endemic to the Willamette Valley and persisted at about thirty sites on remnant prairies in Linn, Yamhill, Polk, Benton, and Lane counties (Hammond and Wilson 1993, Schultz 1996, Schultz et al. 2003). Extensive survey efforts resulted in the discovery of several subpopulations and populations that were not known when Fender's blue butterfly was listed as endangered. Most significantly, in 2011, a large Fender's blue butterfly population was found at Hagg Lake in Washington County, Oregon (Hammond 2011). In 2014, the Service introduced Fender's blue butterfly to the William Finley National Wildlife Refuge and intend to augment the population in 2015-2016 (Severns and Fitzpatrick 2015). Fender's blue butterfly populations also occur on public lands or lands that are managed by a conservation organization at the Service's Baskett Slough National Wildlife Refuge, the U.S. Army Corps of Engineer's Fern Ridge Reservoir, the Bureau of Land Management's West Eugene Wetlands, The Nature Conservancy's Willow Creek Preserve and Coburg Ridge easement, and on a small portion of Oregon State University's Butterfly Meadows in the McDonald State Forest. All of these parcels have some level of management for native prairie habitat values. Most populations occur on private lands which are not managed to maintain native prairie habitats and are at high risk of loss to development or continuing habitat degradation (USFWS 2000). However, the Service's Partners for Fish and Wildlife Program works with private landowners to restore Fender's blue butterfly habitats. Habitat requirements for Fender's blue butterfly include lupine host plants (Kincaid's lupine, longspur lupine, and sickle-keeled lupine) for larval food and oviposition sites and wildflowers for adult nectar food sources. The status of Fender's blue butterfly has improved since the species was listed as endangered, primarily due to the number of sites that are now

actively managed to improve habitat conditions and the discovery of several subpopulations and populations that were not previously known. As of 2014, Fender's blue butterfly was found at an estimated 67 sites in Oregon with a total species abundance estimate of approximately 16,664 adults (Fitzpatrick 2014). As discussed in the 2019 5-Year Review, Fender's blue butterfly abundance has significantly increased, but the Service interprets butterfly numbers with caution due to changes and uncertainties in survey methodologies over time. We are most confident in survey information from 2012 forward, but population estimates are not comparable to those collected in earlier years. More important is the substantial increase in the number of sites occupied by Fender's blue butterfly and its greater distribution relative to the time of listing.

Habitat loss, encroachment of shrubs and trees into prairie habitats due to fire suppression, fragmentation, invasion by non-native plants, and elimination of natural disturbance regimes all threaten the survival of Fender's blue butterfly. Some substantial threats to the long-term persistence of the species remain. For example, we have yet to develop an effective method for eradicating tall oatgrass, which is rapidly expanding into prime prairie habitats and a growing management concern. The highly restricted availability of lupine host plants, and inadequate supply of appropriate lupine seed for restoration efforts, is also a serious limiting factor for the species at this time. In addition, Fender's blue butterfly remains highly vulnerable to loss of its prairie habitat should active management cease for any reason; we have observed instances where habitat quality has rapidly degraded within a matter of years if not maintained. Finally, one of the largest and most robust networks of Fender's blue butterfly at Hagg Lake in Washington County may potentially be impacted by a dam raise that is now under consideration at that site.

EB/CE Source: U.S. Fish and Wildlife Service. 2015. Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (PROJECTS) program, "PROJECTS Biological Opinion." Oregon Fish and Wildlife Office, Portland, Oregon.

U.S. Fish and Wildlife Service. 2019. Fender's blue butterfly (*Icaricia icarioides fenderi*) 5-Year Review. Oregon Fish and Wildlife Office, Portland. 5 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Fender's blue butterfly exposed to malathion at maximum use rates is 1-5% for vegetables and ground fruit, orchards and vineyards, other crops, open space developed, and developed and <1% for all other use

types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 13.9% |
| Spray drift areas – mortality | Up to 56% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 10% |
| MOSQUITO CONTROL | |
| Direct - mortality | 43.4% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Fender's blue butterfly lays their eggs on Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), longspur lupine, (*Lupinus arbustus*) or sickle-keeled lupine (*Lupinus albicaulis*), which are the larval food plants, during May and June (Ballmer and Pratt 1988). Newly hatched larvae feed for a short time, reaching their second instar in the early summer, at which point they enter an extended diapause. Diapausing larvae remain in the leaf litter at or near the base of the host plant through the fall and winter when the lupine plant senesces. Larvae become active again in March or April of the following year. Some larvae may be able to extend diapause for more than one season depending upon the individual and environmental conditions. Once diapause is broken, the larvae feed and grow through three to four additional instars, enter their pupa stage, and after about two weeks emerge as adult butterflies in May and June (Schultz *et al.* 2003). Because the height of feeding and reproductive activities for this butterfly occur essentially from March through June, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

The endangered Fender's blue depends on the endangered plant, Kincaid's lupine as a food source during the larval stage.

Fender's blue butterfly is known to travel through, reproduce, and nectar within right of way, agricultural areas, managed forested areas and pasture (no name pers. comm. US FWS ATF co-occurrence analysis 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 2,116,280 | 43.4 | 0 | 0 |
| Developed | D,I | 256,178 | 5.26 | 12,809 | 0.26 |
| Open Space Developed | D,I | 140,545 | 2.88 | 7,027 | 0.14 |
| Other Crops | D,I | 68,789 | 1.41 | 23,834 | 0.49 |
| Orchards and Vineyards | D,I | 61,356 | 1.26 | 32,201 | 0.66 |
| Vegetables and Ground Fruit | D,I | 50,886 | 1.04 | 37,247 | 0.76 |
| Wheat | D,I | 44,514 | 0.91 | 24,757 | 0.51 |
| Corn | D,I | 18,918 | 0.39 | 181 | <0.01 |
| Christmas Trees | D,I | 11,174 | 0.23 | 9,043 | 0.19 |
| Other Grains | D,I | 9,717 | 0.20 | 2,956 | 0.06 |
| Other Row Crops | D,I | 9,265 | 0.19 | 486 | <0.01 |
| Nurseries | D,I | 3,605 | 0.07 | 3,605 | 0.07 |
| Pasture | D,I | 2,464 | 0.05 | 2,270 | 0.05 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 677,411 | 13.89 | 156,417 | 3.21 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 677,411 | 13.89 | 156,417 | 3.21 |
| TOTAL⁴: | | 2,793,690 | 57.29 | 156,417 | 3.21 |

acres in species range: 4,874,898 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 832,649 acres, 17.1%

Overall Usage: ☐ High ☐ Medium ☒ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Fender’s blue butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Fender’s blue butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Fender’s blue butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above

is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Fender's blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 13.9% mortality of individuals, up to 56.0% mortality from spray drift. In addition, there could be up to 43.4% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations, the limited flight capability of this species, and its specific host plant requirements.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.21% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, Fender's blue butterfly is endemic to the Willamette Valley in Oregon, where agricultural crops are prevalent. The conservation measure reducing application number and rate on various crops, including some of those occurring within the species' range, such as orchards and vineyards and 'other crops,' is anticipated to decrease exposure and the resultant mortality of individuals.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Fender's blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------------|--------------------------|------------|
| <i>Pyrgus ruralis lagunae</i> | Laguna Mountains skipper | 451 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Laguna Mountains skipper is currently restricted to Palomar Mountain where there are four extant occurrences. They inhabit large wet mountain meadows and associated forest openings at elevations above 3,900 feet (ft) (1,189 meters (m)) in elevation. Adult occupancy is associated with surface water such as streams and wet seeps, and population growth appears positively correlated with rainfall levels. Laguna Mountains skipper's primary host plant is *Horkelia clevelandii* (Cleveland's horkelia). *Horkelia clevelandii* is a rare species restricted to the Peninsular Range, specifically Palomar Mountain and the Cuyamaca, Laguna, and San Jacinto mountains of southwestern California (Osborne 2003, pp. 12 and 13; Baldwin et al. 2012, pp. 46 and 1182; Calflora 2014; San Diego Natural History Museum 2014), and the Sierra de San Pedro Mártir in northwestern Baja California, Mexico (Thorne et al. 2010, p. 30; Encyclopedia of Life 2014). Eggs are typically deposited on the underside of mature or moderately mature leaves (Osborne 2008, p. 5). It is likely Laguna Mountains skipper populations specifically require *H. clevelandii* for persistence, but the presence of alternate host plants increases habitat quality and allows for some additional development.

The best available scientific information indicates primary current threats to survival of the Laguna Mountains skipper are habitat modification through succession, climate change, cattle grazing, and small isolated populations susceptible to catastrophic events such as drought and fire. Habitat fragmentation and degradation continue to affect the remaining occurrences of Laguna Mountains skipper. Additional stressors including increase in average temperature, adverse weather effects (storm intensity and timing), localized drought, increase in human recreation that affects fire frequency by increasing potential for fire-starts/spread in fire prone habitat, threat of collection, threat of rangewide conflagration by natural or anthropogenic causes, and Allee effect (depensation) continue to adversely affect the subspecies. These factors in addition to its extremely localized distribution and small population size makes the Laguna Mountains skipper highly vulnerable to extinction through a single cataclysmic event or synergistic factors of multiple threats. The Laguna Mountains skipper may be the most

endangered species in southern California during the next decade; without concentrated recovery efforts, its population may further progress on a path to extinction or may be unrecoverable.

EB/CE Sources: U.S. Fish and Wildlife Service. 2019. Laguna Mountains Skipper (*Pyrgus ruralis lagunae*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, California. 85 pp.

U.S. Fish and Wildlife Service. 2019. Recovery Plan for Laguna Mountains Skipper (*Pyrgus ruralis lagunae*). Region 8, Sacramento, California. 69 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Laguna mountains skipper butterflies is <1% for all uses except mosquito control. Mosquito control mortality is 16%. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 0.3% |
| Spray drift areas – mortality | Up to 0.73% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | <1% |
| MOSQUITO CONTROL | |
| Direct - mortality | 16% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Laguna Mountains skipper development from egg to pupa takes approximately seven weeks. Eggs take 12 to 14 days to hatch (NatureServe 2015). Reproduction occurs more than once per

year, but not all first generation offspring complete development and reproduce during the second reproductive cycle of the year (two overlapping generations) (USFWS 2015). This species has an obligatory relationship with its host plant, not only for obtaining food during both larval and adult stages but also for laying eggs. Adults have two flight seasons each year. During these times, the butterflies mate and die soon after eggs are laid; one flight season occurs in mid-spring (April and May) and the other in late summer (June and July) (USFWS 2015). Because the height of feeding and reproductive activities for this butterfly occur from April through July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

The Laguna Mountains skipper is known to breed, travel through, and nectar in agricultural areas, right of ways, developed, and pasture use sites (Alison Anderson, per. comm., US FWS ATF co-occurrence analysis 2016) and may be more likely than a larvae to be exposed to pesticide use in these scenarios.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 14,450.61 | 16.0 | 0 | 0 |
| Open Space Developed | D,I | 298.5 | 0.33 | 15 | 0.017 |
| Wheat | D,I | 5.4 | <0.01 | 0 | 0 |
| Developed | D,I | 4.7 | <0.01 | 0.24 | 0.0003 |
| Orchards and Vineyards | D,I | 1.19 | <0.01 | 0 | 0 |
| Pasture | D,I | 0.8 | <0.01 | 0 | 0 |
| Other Crops | D,I | 0.4 | <0.01 | 0 | 0 |
| Other Grains | D,I | 0.2 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 311.19 | 0.39 | 15.24 | 0.0173 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 311.19 | 0.39 | 15.24 | 0.0173 |
| TOTAL⁴: | | 14,761.8 | 16.39 | 15.24 | 0.0173 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

acres in species range: 89,950 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 75,981 acres, 84.5%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Laguna Mountains skipper. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low. We do not expect species-level effects to occur.

The Laguna Mountains skipper has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 0.3% mortality of individuals, up to 0.73% mortality from spray drift. In addition, there could be up to 16.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.0173% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range and a large proportion (84.5%) of the species range is on federal lands. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Laguna Mountains skipper in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--|-------------------------------|------------|
| <i>Rhaphiomidas terminatus abdominalis</i> | Delhi Sands flower-loving fly | 452 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Delhi Sands flower-loving fly is only known from Riverside and San Bernardino Counties, with most occupied Delhi Sands flower-loving fly habitat located within a limited area of southwestern San Bernardino County (Carlsbad Fish and Wildlife Office, GIS database, 2007). At the time the Delhi Sands flower-loving fly was listed in 1993, the Service estimated that between 140 and 285 ha (350 and 700 ac) of known occupied Delhi Sands flower-loving fly habitat existed at five locations (58 FR 49884). By 1997, we estimated that 485 ha (1,200 ac) of suitable Delhi Sands flower-loving fly habitat (both occupied and unoccupied) and several hundred acres of restorable habitat remained. The recovery plan stated that 12 known occupied sites encompassing about 180 ha (450 ac) of suitable habitat were known as of the spring of 1997 (Service 1997). Based on observations, we expanded current acreage estimates of remaining suitable Delhi Sands flower-loving fly habitat to include moderately disturbed areas such as abandoned vineyards or grazing lands. We note that all populations discovered in these disturbed areas appear small and are unlikely to persist without substantial habitat restoration and management; thus, although the area of potentially suitable habitat has expanded, no newly discovered occupied site supports a major population of the Delhi Sands flower-loving fly that was not known at the time of the listing. We now estimate that approximately 1,144 ha (2,826 ac) of potential Delhi Sands flower-loving fly habitat remain (Carlsbad Fish and Wildlife Office Geographic Information Systems mapping 2006). Of the 1,144 ha (2,826 ac) of potential Delhi Sands flower-loving fly habitat, 365 ha (900 ac) are known to be occupied in 12 sites. We define occupied sites to be sites known to be occupied at the time of listing or where Delhi Sands flower-loving fly were subsequently observed by biologists holding 10(a)(1)(A) recovery permits issued by the Service. Accurate population size estimates of historical viable populations are unknown for the Delhi Sands flower-loving fly.

The final rule listing the Delhi Sands flower-loving fly identified habitat loss and degradation as major threats (58 FR 49884). Some progress has been made at reducing these threats as a result of the listing, and a small percentage (about 10%) of the limited remaining Delhi Sands flower-

flower-loving fly habitat has been conserved, though most of this habitat is not yet actively managed. While significant efforts have been made to conserve occupied Delhi Sands flower-loving fly habitat, only the Jurupa Hills conservation area is likely of sufficient size and quality to potentially sustain a stable population through time. We anticipate that the Conservation Bank will be effectively managed to protect a relatively large block of Delhi Sands flower-loving fly habitat once all of the conservation credits are sold, but additional lands surrounding the Conservation Bank are still needed to ensure the long term conservation of the largest remaining block of Delhi Sands flower-loving fly habitat. Other conserved areas are likely too small and isolated to provide adequate protection to existing populations without protection of additional surrounding lands and adequate land management. Despite the progress that has been made to protect lands occupied by the Delhi Sands flower-loving fly, habitat destruction in association with residential and commercial development continues to be the primary threat to the subspecies. Secondary threats include habitat degradation from weed abatement activities for fire control, trash dumping, off-road vehicle use, small population size, and isolation due to habitat fragmentation. Isolation due to habitat fragmentation is likely to increase in the future as a consequence of continued habitat loss. The 2019 Recovery Plan Amendment clarified recovery criteria.

EB/CE Source: U.S. Fish and Wildlife Service. 2008. Delhi Sands Flower-loving Fly (*Rhaphiomidas terminatus abdominalis*) 5-Year Review: Summary and Evaluation. Carlsbad Fish and Wildlife Office, Carlsbad, California. 29 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Delhi Sands flower-loving fly is 17% for open space developed, 59% for developed, and <1% for all other uses. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 77% |
| Spray drift areas – mortality | Up to 21% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |

| | |
|--|-------|
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 76% |
| MOSQUITO CONTROL | |
| Direct - mortality | 94.5% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Delhi Sands flower-loving fly (DSFLF) prefers arid, sandy areas and is restricted to Delhi sands soil type; however, studies have found individuals in moderately disturbed areas such as abandoned vineyards or grazing lands (USFWS 2008).

Currently, this species occurs in southwestern San Bernardino and northwestern Riverside Counties in California within an 8-mile radius. The distribution straddles Interstate 10 in the vicinity of Colton and Rialto, Riverside and San Bernardino Counties, California. The Delhi Sands flower-loving fly now occupies less than 2.5% of the total area of Delhi fine sands (NatureServe 2015; USFWS 1997; USFWS 2008).

Oviposition (egg-laying) occurs within loose, sandy soils in early July through September, adult flies emerge from larval burrows to feed, mate, and lay eggs in the sandy soil and may primarily occur near telegraph weed (Rogers and Mattoni 1993; Kingsley 1996). Larval stages develop completely underground and emerge as adults from July through September (USFWS 1997; USFWS 2008).

The life span of this animal is unknown, but the larval stage may last two years or longer, depending on availability of food, temperature, rainfall, and other environmental conditions.

This animal is a strong fast flier, and, like a hummingbird, is capable of stationary, hovering flight.

The DSFLF feeds on nectar from California buckwheat (*Eriogonum fasciculatum*) and other plants. The only other flowers available during the flight time are croton (*Croton californicus*) and telegraph weed (*Heterotheca grandiflora*), but visitations to these plants have not been noted. The nectaring events have been brief, on the order of 2 to 10 seconds (USFWS 1997). It is not clear whether nectar is essential for adults to survive through to breeding and reproduction (USFWS 2008). Its larval food source is unknown, but observations suggest that the larvae are opportunistic subterranean predators that may feed in ant nests; however, this has neither been confirmed nor refuted from observations (USFWS 2008).

The species is diurnal, being most active during the warmest and sunniest parts of the day. Delhi series soil type is the key resource the species requires for feeding. The species is thought to develop slowly, requiring 3 or more years to reach pupation and become an adult (USFWS 2008).

The DSFLF is known to travel through agricultural areas, developed and pasture lands as well as utilize right of way for feeding, and traveling (Geary Hund, pers. comm. 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 187,102 | 94.5 | 0 | 0 |
| Developed | D,I | 117,333 | 59 | 5,867 | 2.97 |
| Open Space Developed | D,I | 35,256 | 17 | 1,763 | 0.89 |
| Nurseries | D,I | 259 | 0.13 | 242 | <1 |
| Orchards and Vineyards | D,I | 92 | 0.05 | 0 | 0 |
| Pasture | D,I | 29 | 0.01 | 0 | 0 |
| Other Crops | D,I | 24 | 0.01 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 7 | <0.01 | 6 | <0.01 |
| Wheat | D,I | 5 | <0.01 | 0 | 0 |
| Other Grains | D,I | 3 | <0.01 | 0 | |
| Cotton | D,I | 1 | <0.01 | 0 | 0 |
| Corn | D,I | <1 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 153,009 | 76.26 | 7,878 | 3.87 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 153,009 | 76.26 | 7,878 | 3.87 |
| TOTAL⁴: | | 340,111** | 100 [#] | 7,878 | 3.87 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

**Overlap acreage greater than acres in species range.

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

acres in species range: 197,844 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 0.17 acres, 0.00008%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Delhi Sands flower-loving fly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measure described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Delhi Sands flower-loving fly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 77.0% mortality of individuals, up to 21.0% mortality from spray drift. In addition, there could be up to 94.5% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in

growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the fly populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.87% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Delhi Sands flower-loving fly exists mainly in San Bernardino and Riverside Counties, California, thus putting it in proximity to residential and other developed areas in portion of its range. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Delhi Sands flower-loving fly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------|-----------------------------|------------|
| <i>Heterelmis comalensis</i> | Comal Springs riffle beetle | 453 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The main threat to the habitat of these aquatic invertebrates is a reduction or loss of water of adequate quantity and quality, due primarily to human withdrawal of water from the San Antonio segment of the Edwards Aquifer (Balcones Fault Zone) and other activities. Total withdrawal from the San Antonio region of the Edwards Aquifer has been increasing since at least 1934, when the total well discharge was 101,900 ac-ft (Edwards Underground Water District 1989). The human population in the region is expected to increase (Technical Advisory Panel 1990, Edwards Underground Water District 1993), which will result in increased demand for water from the aquifer. There is an integral connection between the water in the aquifer west of the springs and the water serving as habitat for this species. Water in the Edwards Aquifer flows from west to east or northeast and withdrawal or contamination of water in the western part of the aquifer can have a direct effect on the quantity and quality of water flowing toward the springs and at the spring openings. Prior to wells being drilled into the aquifer, almost all of the water entering the aquifer eventually exited at springs (Guadalupe-Blanco River Authority 1988).

In addition to a loss of water, a decrease in the water level in the aquifer could lead to decreased water quality at the springs. The Balcones Fault Zone— San Antonio Region is bounded on the south and east by a “bad water” interface across which the groundwater quality abruptly deteriorates to greater than 1000 mg/L total dissolved solids. Crossing the bad water interface, groundwater goes from fresh to saline or brackish. Lowered water levels resulting from groundwater pumpage and/or decreased recharge may result in deterioration of water quality in the fresh water section of the aquifer through movement of the bad water interface. The Comal and San Marcos Springs are less than 305 and 62 m (1,000 and 200 ft), respectively, from the bad water interface (TWC 1989, Edwards Underground Water District 1992b). Although the data are inconclusive at present, even a small movement of the water may negatively impact the species. Other possible effects of reduced spring flow exist. These include changes in the chemical composition of the water in the aquifer and at the springs, a decrease in current velocity

and corresponding increase in siltation, and an increase in temperature and temperature fluctuations in the aquatic habitat (McKinney and Watkins 1993).

Another threat to the habitat of this species is the potential for groundwater contamination. Pollutants of concern include, but are not limited to, those associated with human sewage (particularly septic tanks), leaking underground storage tanks, animal/feedlot waste, agricultural chemicals (especially insecticides, herbicides, and fertilizers) and urban runoff (including pesticides, fertilizers, and detergents). Pipeline, highway, and railway transportation of hydrocarbons and other potentially harmful materials in the Edwards Aquifer recharge zone and its watershed, with the attendant possibility of accidents, present a particular risk to water quality in Comal and San Marcos Springs. Comal and San Marcos Springs are both located in urbanized areas. Hueco Springs is located alongside River Road, which is heavily traveled for recreation on the Guadalupe River, and may be susceptible to road runoff and spills related to traffic. Fern Bank Springs is in a relatively remote, rural location and its principal vulnerability is probably to contaminants associated with leaking septic tanks, animal/feedlot wastes, and agricultural chemicals. Of the counties containing portions of the San Antonio segment of the Edwards Aquifer, the potential for acute, catastrophic contamination of the aquifer is greatest in Bexar, Hays, and Comal Counties because of the greater level of urbanization compared to the western counties. Although spill or contamination events that could affect water quality do happen to the west of Bexar County, dilution and the time required for the water to reach the springs may lessen the threat from that area. As aquifer levels decrease, dilution of contaminants moving through the aquifer may also decrease. The Texas Water Commission reported that in 1988 within the San Antonio segment of the Edwards Aquifer, Bexar, Hays, and Comal Counties had the greatest number of land-based oil and chemical spills in central Texas that affected surface and/or groundwater with 28, 6, and 4 spills, respectively (TWC 1989). The Texas Water Commission (1989), using the assessment tool DRASTIC (Aller, et al. 1987), classified aquifers statewide according to their pollution potential. The Edwards Aquifer (Balcones Fault Zone—Austin and San Antonio Region) was ranked among the highest in pollution potential of all major Texas aquifers. The project's objective was to identify areas sensitive to groundwater pollution from a contaminated land surface based on the hydrogeologic setting. The area of particular concern was the Edwards Aquifer recharge zone and its watershed.

The effect of natural droughts in south central Texas will increase in severity due to the large increase in human groundwater withdrawals (Wanakule 1990). The species' limited habitat is likely to be lost through flow during minor or severe drought. At present, competition is not known to be a significant threat to these species. However, two exotic snail species, *Thiara granifera* and *Thiara tuberculata*, are common in the spring runs and, as grazers, may compete for food. Another exotic species, the giant ramshorn snail (*Marisa cornuarietis*), is present in two of the spring runs and may colonize the other runs at low flow levels. *Marisa* can have a tremendous impact on vegetation, that in turn may affect the habitat for surface-dwelling grazers like the riffle beetle.

EB/CE Source: U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants; Final Rule To List Three Aquatic Invertebrates in Comal and Hays Counties, TX, as Endangered. Federal Register 62(243): 66295-66304.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Comal Springs riffle beetle exposed to malathion at maximum use rates is 1-4% for other grains, corn, and developed uses and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 17% |
| Spray drift areas – mortality | NA |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 17% |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 6% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

This species is a detritivore. There is no reproduction information available for this species. Larvae have been collected with adults in the gravel substrate of the spring headwaters and not on submerged wood as is typical of most *Heterelmis* species (Brown and Barr 1988). Usual water depth in occupied habitat is 2 to 10 cm (1 to 4 in) although the beetle may also occur in slightly deeper areas within the spring runs. The Comal Springs riffle beetle is not a subterranean species. It occurs in the gravel substrate and shallow riffles in spring runs.

Recall from the “Approach to the Effects Analysis” section of the main body of the Opinion that specific considerations were made for species that occur in Bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Comal Springs riffle beetle does occupy other aquatic habitats that accumulate potentially high levels of malathion, they can mitigate their potential exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use [^] | Effects associated with each use H >50% M 1-50% L <1% |
|----------------------|------------------------------|------------------------|------|---------------------------------------|------|---|--|
| | | Acres | % | Acres | % | | |
| Mosquito Control | D | 69,045 | 5.57 | 0 | 0 | 2,3 | 2H 3 |
| Developed | D,I | 48,934 | 3.95 | 2,447 | 0.2 | 2,3 | 2H 3 |
| Open Space Developed | D,I | 98,254 | 7.92 | 4,913 | 0.4 | 2,3 | 2H 3 |
| Corn | D,I | 22,043 | 1.78 | 4,101 | 0.33 | 2,3 | 2H 3 |
| Other Grains | D,I | 21,876 | 1.76 | 21,876 | 1.76 | 2,3 | 2H 3 |
| Wheat | D,I | 9,167 | 0.74 | 9,167 | 0.74 | 2,3 | 2H 3 |
| Cotton | D,I | 5,778 | 0.47 | 5,528 | 0.45 | 2,3 | 2H 3 |
| Other Crops | D,I | 2,920 | 0.24 | 0 | 0 | 2,3 | 2H 3 |
| Nurseries | D,I | 289 | 0.02 | 289 | 0.02 | 2,3 | 2H 3 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use [^] | Effects associated with each use H >50% M 1-50% L <1% |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|---|--|
| | | Acres | % | Acres | % | | |
| Other Row Crops | D,I | 113 | <0.01 | 113 | <0.01 | 2,3 | 2H 3 |
| Orchards and Vineyards | D,I | 98 | <0.01 | 45 | <0.01 | 2,3 | 2H 3 |
| Vegetables and Ground Fruit | D,I | 9 | <0.01 | 8 | <0.01 | 2,3 | 2H 3 |
| Pasture | D,I | 2 | <0.01 | 2 | <0.01 | 2,3 | 2H 3 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 209,483 | 16.89 | 48,489 | 3.90 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 209,483 | 16.89 | 48,489 | 3.90 | | |
| TOTAL⁴: | | 278,528 | 22.45 | 48,489 | 3.90 | | |

[^]We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

acres in species range: 1,240,346 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 11,502 acres, 0.93%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers substantially reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Comal Springs riffle beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Comal Springs riffle beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 17.0% mortality of individuals and a loss of about 17.0% of dietary items in use areas. In addition, there could be up to 6.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the Comal Springs riffle beetle (bin 2, specifically) would maintain a high concentration of toxins, including malathion, if exposed due to their small size and low water flow. The aquatic habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized.

However, the rain restriction and aquatic habitat buffer conservation measures described above are anticipated to address the concerns related to surface run-off contamination, and reduce the run-off potential into the aquatic habitat areas where these dragonfly reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is made and the species' habitat by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the water body.

Developed and open space developed uses (described as residential uses) make up the majority of overlap in the range of this species that are anticipated to cause mortality. New residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied to, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to further reduce the contribution of malathion from residential uses into the Comal riffle beetle's range. For other agricultural use applications, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific crop) which are also anticipated to further reduce the amount of malathion that could enter the aquatic environment.

In addition, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.90% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high

for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range, and conservation measures will be implemented as described above, further reducing the risk of exposure to malathion.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Comal Springs riffle beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------------|------------------------------|------------|
| <i>Stygoparnus comalensis</i> | Comal Springs dryopid beetle | 454 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Population size/location(s) unknown

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The main threat to the habitat of these aquatic invertebrates is a reduction or loss of water of adequate quantity and quality, due primarily to human withdrawal of water from the San Antonio segment of the Edwards Aquifer (Balcones Fault Zone) and other activities. Total withdrawal from the San Antonio region of the Edwards Aquifer has been increasing since at least 1934, when the total well discharge was 101,900 ac-ft (Edwards Underground Water District 1989). The human population in the region is expected to increase (Technical Advisory Panel 1990, Edwards Underground Water District 1993), which will result in increased demand for water from the aquifer. There is an integral connection between the water in the aquifer west of the springs and the water serving as habitat for this species. Water in the Edwards Aquifer flows from west to east or northeast and withdrawal or contamination of water in the western part of the aquifer can have a direct effect on the quantity and quality of water flowing toward the springs and at the spring openings. Prior to wells being drilled into the aquifer, almost all of the water entering the aquifer eventually exited at springs (Guadalupe-Blanco River Authority 1988).

In addition to a loss of water, a decrease in the water level in the aquifer could lead to decreased water quality at the springs. The Balcones Fault Zone— San Antonio Region is bounded on the south and east by a “bad water” interface across which the groundwater quality abruptly deteriorates to greater than 1000 mg/L total dissolved solids. Crossing the bad water interface, groundwater goes from fresh to saline or brackish. Lowered water levels resulting from groundwater pumpage and/or decreased recharge may at some point result in deterioration of water quality in the fresh water section of the aquifer through movement of the bad water interface. The Comal and San Marcos Springs are less than 305 and 62 m (1,000 and 200 ft), respectively, from the bad water interface (TWC 1989, Edwards Underground Water District 1992b). Although the data are inconclusive at present, even a small movement of the water may negatively impact the species. Other possible effects of reduced spring flow exist. These include changes in the chemical composition of the water in the aquifer and at the springs, a decrease in

current velocity and corresponding increase in siltation, and an increase in temperature and temperature fluctuations in the aquatic habitat (McKinney and Watkins 1993).

Another threat to the habitat of this species is the potential for groundwater contamination. Pollutants of concern include, but are not limited to, those associated with human sewage (particularly septic tanks), leaking underground storage tanks, animal/feedlot waste, agricultural chemicals (especially insecticides, herbicides, and fertilizers) and urban runoff (including pesticides, fertilizers, and detergents). Pipeline, highway, and railway transportation of hydrocarbons and other potentially harmful materials in the Edwards Aquifer recharge zone and its watershed, with the attendant possibility of accidents, present a particular risk to water quality in Comal and San Marcos Springs. Comal and San Marcos Springs are both located in urbanized areas. Hueco Springs is located alongside River Road, which is heavily traveled for recreation on the Guadalupe River, and may be susceptible to road runoff and spills related to traffic. Fern Bank Springs is in a relatively remote, rural location and its principal vulnerability is probably to contaminants associated with leaking septic tanks, animal/feedlot wastes, and agricultural chemicals. Of the counties containing portions of the San Antonio segment of the Edwards Aquifer, the potential for acute, catastrophic contamination of the aquifer is greatest in Bexar, Hays, and Comal Counties because of the greater level of urbanization compared to the western counties. Although spill or contamination events that could affect water quality do happen to the west of Bexar County, dilution and the time required for the water to reach the springs may lessen the threat from that area. As aquifer levels decrease, however, dilution of contaminants moving through the aquifer may also decrease. The Texas Water Commission reported that in 1988, within the San Antonio segment of the Edwards Aquifer, Bexar, Hays, and Comal Counties had the greatest number of land-based oil and chemical spills in central Texas that affected surface and/or groundwater with 28, 6, and 4 spills, respectively (TWC 1989). The Texas Water Commission (1989), using the assessment tool DRASTIC (Aller, et al. 1987), classified aquifers statewide according to their pollution potential. The Edwards Aquifer (Balcones Fault Zone—Austin and San Antonio Regions) was ranked among the highest in pollution potential of all major Texas aquifers. The project's objective was to identify areas sensitive to groundwater pollution from a contaminated land surface based on the hydrogeologic setting. The area of particular concern was the Edwards Aquifer recharge zone and its watershed.

The effect of natural droughts in south central Texas will increase in severity due to the large increase in human groundwater withdrawals (Wanakule 1990). This species' limited habitat is likely to be lost through flow during minor or severe drought. At present, competition is not known to be a significant threat to this species. However, two exotic snail species, *Thiara granifera* and *Thiara tuberculata*, are common in the spring runs and, as grazers, may compete for food. Another exotic species, the giant ramshorn snail (*Marisa cornuarietis*), is present in two of the spring runs and may colonize the other runs at low flow levels.

EB/CE Source: U.S. Fish and Wildlife Service. 1997. Endangered and Threatened Wildlife and Plants; Final Rule To List Three Aquatic Invertebrates in Comal and Hays Counties, TX, as Endangered. Federal Register 62(243): 66295-66304.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bins 2 and 3 would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects

Risk to the species from labeled uses across the range: . Mortality for the Comal Springs dryopid beetle exposed to malathion at maximum use rates is 1-4% for other grains, corn, and developed uses and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 17% |
| Spray drift areas – mortality | Up to 39% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 17% |
| Spray drift areas – effects to dietary items | Up to 39% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 6% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Although specific food requirements of this species are unknown, potential food sources include detritus (decomposed plant materials), leaf litter, and decaying roots.

They are presumed to be associated with air-filled voids inside the spring orifices since all other known dryopid beetle larvae are terrestrial. Elmid and dryopid beetles have a mass of tiny, hydrophobic (unwettable) hairs on their underside where they maintain a thin bubble of air through which gas exchange occurs (Chapman 1982). This method of respiration loses its effectiveness as the level of dissolved oxygen in the water decreases. A number of aquatic insects that use dissolved oxygen rely on flowing water to obtain oxygen. The Comal Springs dryopid beetle is a spring adapted, aquatic species dependent on high-quality, unpolluted

groundwater that has low levels of salinity and turbidity. The species is generally associated with water that has adequate levels of dissolved oxygen for respiration (Brown 1987, p. 260; Arsuffi 1993, p. 18).

Recall from the “Approach to the Effects Analysis” section of the main body of the Opinion that specific considerations were made for species that occur in Bins 3 and 4 and that they were modeled in such a way that likely resulted in overestimation of estimated environmental concentrations, thus overestimating potential exposure. While the Comal Springs dryopid beetle does occupy other aquatic habitats that accumulate potentially high levels of malathion, they can mitigate their potential exposure to malathion by at least partially using these higher flowing aquatic habitats, reducing their overall risk.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use [^] | Effects associated with bin H >50% M 1-50% L <1% |
|----------------------|------------------------------|------------------------|------|---------------------------------------|------|---|---|
| | | Acres | % | Acres | % | | |
| Mosquito Control | D | 69,045 | 5.57 | 0 | 0 | 2,3 | 2H 3 |
| Developed | D,I | 48,934 | 3.95 | 2,447 | 0.20 | 2,3 | 2H 3 |
| Open Space Developed | D,I | 98,254 | 7.92 | 4,913 | 0.40 | 2,3 | 2H 3 |
| Corn | D,I | 22,043 | 1.78 | 4,101 | 0.33 | 2,3 | 2H 3 |
| Other Grains | D,I | 21,876 | 1.76 | 21,876 | 1.76 | 2,3 | 2H 3 |
| Wheat | D,I | 9,167 | 0.74 | 9,167 | 0.74 | 2,3 | 2H 3 |
| Cotton | D,I | 5,778 | 0.47 | 5,573 | 0.45 | 2,3 | 2H 3 |
| Other Crops | D,I | 2,920 | 0.24 | 0 | 0 | 2,3 | 2H 3 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bin(s) associated with use [^] | Effects associated with bin H >50% M 1-50% L <1% |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|---|---|
| | | Acres | % | Acres | % | | |
| Nurseries | D,I | 289 | 0.02 | 289 | 0.02 | 2,3 | 2H 3 |
| Other Row Crops | D,I | 113 | <0.01 | 124 | <0.01 | 2,3 | 2H 3 |
| Orchards and Vineyards | D,I | 98 | <0.01 | 45 | <0.01 | 2,3 | 2H 3 |
| Vegetables and Ground Fruit | D,I | 9 | <0.01 | 8 | <0.01 | 2,3 | 2H 3 |
| Pasture | D,I | 2 | <0.01 | 3 | <0.01 | 2,3 | 2H 3 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 209,483 | 16.89 | 48,546 | 3.90 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 209,483 | 16.89 | 48,546 | 3.90 | | |
| TOTAL⁴: | | 278,528 | 22.45 | 48,546 | 3.90 | | |

[^]We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

acres in species range: 1,240,346 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 11,502 acres, 0.93%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. In many cases, these buffers substantially reduce exposure to aquatic organisms and subsequent risk of direct and indirect effects.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Comal Springs dryopid beetle. As discussed below,

even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Comal Springs dryopid beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 17.0% mortality of individuals, up to 39.0% mortality from spray drift, a loss of about 17.0% of dietary items in use areas, and an additional loss of up to 39.0% of dietary items due to spray drift. In addition, there could be up to 6.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the Comal Springs dryopid beetle (bin 2, specifically) would maintain a high concentration of toxins, including malathion, if exposed due to their small size and low water flow. The aquatic habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized.

However, the rain restriction and aquatic habitat buffer conservation measures described above are anticipated to address the concerns related to surface run-off contamination, and reduce the run-off potential into the aquatic habitat areas where these dragonfly reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is made and the species' habitat by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the water body.

Developed and open space developed uses (described as residential uses) make up the majority of overlap in the range of this species that are anticipated to cause mortality. New residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied to, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to further reduce the contribution of malathion from residential uses into the Comal springs dryopid beetle's range. For other agricultural use applications, the allowable number of applications has been reduced to a maximum of 2 - 4, (previously ranging from 3-13 applications/year, depending on the specific

crop) which are also anticipated to further reduce the amount of malathion that could enter the aquatic environment.

In addition , we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.90% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range, and conservation measures will be implemented as described above, further reducing the risk of exposure to malathion.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Comal Springs dryopid beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------------------|--------------------------------|------------|
| <i>Neonympha mitchellii francisci</i> | Saint Francis' satyr butterfly | 455 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The historic range for St. Francis Satyr butterfly (SFS) consists solely of the area currently known to be occupied by the species within Ft. Bragg (Stephen Hall, NC Natural Heritage Program, June 28, 2010, pers. comm.). Despite extensive survey efforts, the SFS has never been detected outside of Ft. Bragg. The current distribution is much reduced from the proposed historic range. At Ft. Bragg, there have been observations of both extinctions and new subpopulations. Outside artillery impact areas, the type location discovered in 1983 now supports only occasional, apparently transient individuals. Of the two sites known in 1994, one currently supports a large subpopulation, and the other is inundated by beaver and unoccupied by butterflies. Since 2000, four additional subpopulations have been discovered, of which one is large, one is declining, and two have occasional transient individuals. Within artillery impact areas, the distribution of sites has changed as described above, and there are now thought to be seven large subpopulations. Thus, there are now known to be nine large and one declining subpopulations at Ft. Bragg (Kuefler et al. 2008).

As discussed in the 2020 5-Year Review, efforts are underway to augment existing populations at Ft. Bragg with releases of captive-reared adults. A limited number of adults were released in July and August 2009 at an unoccupied site in the northwest sector of Ft. Bragg in a pilot attempt to establish a new breeding population. In 2011, an experimental habitat restoration project created four additional sites to establish new subpopulations. Adults have been successfully released to these sites.

The distribution of SFS at the local subpopulation level is most closely tied to grassy wetlands with numerous sedges that are created and maintained through a regular disturbance regime (Hall 1993, Hall 2003, Kuefler 2008). The most influential disturbances for these sites are beaver impoundments, which create inundated regions highly favorable to sedge growth (Hall 2003, Bartel et al. 2010). Beavers, eliminated from North Carolina in the late 1800s, are now common on the landscape. Since beavers are also abundant outside of Ft. Bragg, there is potential for SFS habitat creation or maintenance. Although there is a general policy of leaving beavers on Ft.

Bragg, they are removed when they flood roads and become pests. Until the early 2000s, this was true even near SFS habitat. Now, Ft. Bragg is working to maintain beavers in watersheds where SFS is found and throughout the training lands. Disturbance from periodic fires also contributes to shaping SFS habitat. Fire resets succession, where grassy wetlands naturally succeed to shrub lands and then hardwood forest, although at the local level it can reduce SFS populations.

The primary threats to the SFS at the time it was listed as Endangered were overcollection and habitat loss. These threats remain relevant. In addition, small population size, limited dispersal ability and highly restricted distribution range make the SFS highly vulnerable. Environmental stochasticity has always influenced population structure, although current habitat conditions persist under limited disturbance regimes, which greatly affect population fluctuations. With the elimination of natural controls to create wetlands and then prevent succession, suitable habitat has become much less prevalent and can be easily eliminated by small-scale, short-term environmental events. The few remaining subpopulations that constitute the metapopulation are under high pressure to act as source populations for new colonization.

EB/CE Source: U.S. Fish and Wildlife Service. 2020. Saint Francis' Satyr (*Neonympha mitchellii francisci*) 5-Year Review: Summary and Evaluation. Raleigh Ecological Services Field Office, Raleigh, North Carolina. 34 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects

Risk to the species from labeled uses across the range: Mortality for Saint Francis satyr butterflies exposed to malathion at maximum use rates is 2-7% for cotton, other crops, corn, and developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 22% |
| Spray drift areas – mortality | Up to 79% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |

| | |
|--|------|
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 13% |
| MOSQUITO CONTROL | |
| Direct - mortality | 0.3% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Saint Francis satyr butterfly is an early summer brooder and probably completes its development in less than 80 days, with pupation taking about 2 weeks of this time. The second brood probably overwinters in the fourth late larval instar as in the nominate subspecies (US FWS SOS 2016). First broods emerge about May 5th and are usually gone by June 6th; the second flight period runs from about July 26th to August 21st. Because the height of feeding and reproductive activities for this butterfly most likely occur from May through August, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 1,930 | 0.29 | 0 | 0 |
| Open space developed | D,I | 44,782 | 6.66 | 2,239 | 0.33 |
| Developed | D,I | 43,540 | 6.47 | 2,177 | 0.32 |
| Corn | D,I | 21,428 | 3.19 | 2,230 | 0.33 |
| Other Crops | D,I | 16,110 | 2.4 | 0 | 0 |
| Cotton | D,I | 15,241 | 2.27 | 8,303 | 1.23 |
| Other Row Crops | D,I | 1,443 | 0.21 | 1,443 | 0.21 |
| Vegetables and Ground Fruit | D,I | 1,037 | 0.15 | 1,037 | 0.15 |
| Other Grains | D,I | 1,032 | 0.15 | 918 | 0.14 |
| Wheat | D,I | 415 | 0.06 | 394 | 0.06 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Nurseries | D,I | 290 | 0.04 | 290 | 0.04 |
| Orchards and vineyards | D,I | 21 | <0.01 | 19 | <0.01 |
| Pasture | D,I | 1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 145,339 | 21.62 | 19,050 | 2.81 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 145,339 | 21.62 | 19,050 | 2.81 |
| TOTAL⁴: | | 147,269 | 21.91 | 19,050 | 2.81 |

acres in species range: 672,644 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 136,933 acres, 20.4%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Saint Francis’ satyr butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion..

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Saint Francis' satyr butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Saint Francis' satyr butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals, up to 79.0% mortality from spray drift. In addition, there could be up to 0.3% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.81% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Saint Francis' satyr butterfly exists solely within the Fort Bragg military installation in North Carolina, putting it in close proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application

footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species, and where a large proportion of individuals of the population is lost, the area of suitable habitat may be recolonized. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Saint Francis' satyr butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|--------------------------|------------|
| <i>Polyphylla barbata</i> | Mount Hermon June beetle | 456 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The primary threat to these species at the time of listing was habitat destruction due to sand mining (Service 1998). Much of the historical habitat for the species was destroyed by mining and the remaining habitat has been degraded and heavily fragmented. Based on current research, it appears that efforts to restore degraded habitat have not been successful. Mining activity has been reduced since the species was listed, and many of the quarries are either closed or nearing closure (McGraw 2004b; Davilla, pers. comm. 2006). However, approximately 80% of the original 405 ha (1,000 ac) of sand parkland has already been destroyed, much of which was directly due to mining (Lee 1994; McGraw 2004b). As a result, even minor losses of the remaining habitat are now important to the future status of the species. Early mines did not require habitat conservation measures, and three of the six mines operated in sandhills habitat were closed and left as is with no habitat restoration or revegetation attempted. Where restoration of sandhills habitat has been attempted, it has met with limited success (Davilla, pers. comm. 2006; Schettler, pers. comm. 2006). Residual effects from mining, including habitat fragmentation, also pose a serious challenge to future conservation efforts.

Alteration of habitat due to suppression of natural fire cycles is now the predominant threat preventing the recovery of the species. Fire suppression continues throughout the Santa Cruz sandhills and conversion of habitat is widespread. Introduction of fast-growing and hardy non-native species has exacerbated this problem. Arnold (pers. comm. 2007a) believes that populations of this species are in a state of decline and that the reduction in available habitat due to successional processes is now largely to blame. Rates of annual encroachment indicated by McGraw's unpublished data (2004) at around 0.8% annually will reduce remaining “islands” of open habitat quickly. As these successional processes continue, increased habitat fragmentation, reduction in fragment sizes, and declines in numbers of individuals and populations will increase the risk of stochastic extinction events, further reducing chances for recovery of these species. The result of the threats to these species mentioned above has likely been a decline in numbers across most of the occupied sandhills habitat. A lack of consistent monitoring efforts makes interpretation of population trends speculative. The closest reliable measure that can be used to

infer population trends for these species is related to available habitat. Sand parkland habitat has been reduced by approximately 80% over a 60-year period. While the foremost threat to sandhills habitat identified at the time of listing, sand mining, has been much reduced, habitat is still being lost via this mechanism and other threats have become more severe. Habitat conversion in the sandhills due to the suppression of natural disturbance factors, such as fire, is a continuing threat to sandhills habitat. Conversion of the patch mosaic created by episodic fires to a uniform habitat “frozen” in a late successional stage would eliminate necessary habitat for many species, including this species and other listed species endemic to the Zayante sandhills. Considering that this conversion rate may be accelerating and habitat fragmentation is increasing, open habitat species that are already rare in the sandhills are unlikely to recover without the employment of more aggressive management strategies.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Zayante band-winged grasshopper (*Trimerotropis infantilis*) and Mount Hermon June beetle (*Polyphylla barbata*) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office, California. 33 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects

Risk to the species from labeled uses across the range: Mortality for the Mount Hermon June beetle exposed to malathion at maximum use rates is 5% for developed, 18% for open space developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 24% |
| Spray drift areas – mortality | Up to 14% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 24% |
| MOSQUITO CONTROL | |

| | |
|--------------------|------|
| Direct - mortality | 100% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Mount Hermon June beetle (MHJB) is known only from the Zayante sand hills ecosystem in the Ben Lomond-Mount Hermon-Scotts Valley area of Santa Cruz County, California in sand parkland and other sandy areas in chaparral and ponderosa pine (*Pinus ponderosa*) stands (USFWS 2009).

The MHJB is believed to require about 2-3 years to mature from an egg through the adult form. Most of the life cycle is spent in larval stages. For 1 to 2 months during summer (mid June to late July), MHJB emerge as imagos (adult forms) to reproduce. Males are strong fliers, emerging from their burrows low to the ground in search of females (Natureserve 2015). Females are thought to be fossorial, remaining just below the surface in burrows. Females are believed to lay eggs at the bottom of their burrows and die a short time later. The life cycle continues as newly hatched larvae tunnel from the burrow in search of roots. Males generally live for no more than one week while the life span of the females is unknown (US FWS SOS 2016).

The larvae are subterranean and feed on plant roots, primarily those of grass and pine. They may also feed on the roots of monkeyflower (*Mimulus sp.*), oak (*Quercus sp.*), fern (phylum *Pteridophyta*), other plants, subterranean stem material, and fungal mycorrhizae (62 FR 3616; USFWS 2009). The small mouthparts and limited flight period of MHJB suggest that adults of this species do not feed (62 FR 3616; NatureServe 2015; USFWS 2009).

The MHJB is known to frequent developed, open-space developed, and right of ways to migrate/travel through (Chad Mitcham pers. comm. 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 39,177 | 100 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | <1 | <0.01 | <1 | <0.01 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Open Space Developed | D,I | 7,181 | 18.6 | 359 | 0.93 |
| Developed | D,I | 2,146 | 5.58 | 107 | 0.28 |
| Orchards and Vineyards | D,I | 7 | 0.02 | <0.01 | <0.01 |
| Other Crops | D,I | 2 | <0.01 | <0.01 | <0.01 |
| Other Grains | D,I | <1 | <0.01 | <0.01 | <0.01 |
| Pasture | D,I | <1 | <0.01 | <0.01 | <0.01 |
| Wheat | D,I | <1 | <0.01 | <0.01 | <0.01 |
| Corn | D,I | <1 | <0.01 | <0.01 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 9,337 | 24.25 | 466 | 1.28 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 9,337 | 24.25 | 466 | 1.28 |
| TOTAL⁴: | | 48,514** | 100 [#] | 466 | 1.28 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 38,460 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 0.12 acres, 0.0003%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Mount Hermon

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

June beetle, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mount Hermon June beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Mount Hermon June beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 24.0% mortality of individuals, up to 14.0% mortality from spray drift. In addition, there could be up to 100.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.28% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and timing restrictions for mosquito control use, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications

per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Mount Hermon June beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------|---------------------|-------------------|
| <i>Cicindela ohlone</i> | Ohlone tiger beetle | 457 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Ohlone tiger beetle is endemic to Santa Cruz County, California, where it is known only from coastal terraces supporting patches of native grassland habitat (Freitag et al. 1993). Ohlone tiger beetle habitat is associated with either Watsonville loam or Bonnydoon soil types, both of which are characterized by shallow, pale, poorly drained clay or sandy clay soil that bakes to a hard crust by summer, after winter and spring rains cease. Adult beetles are typically found along trails or barren areas among low, sparse vegetation within the grassland habitat. Ohlone tiger beetles require these open areas for construction of larval burrows, thermoregulation, and foraging. The density of burrows decreases with increasing vegetation cover. At the time of listing in 2001, 16 occurrences of the Ohlone tiger beetle were known from five geographic areas; since listing, nine occurrences have been potentially extirpated, a decline of 56%, and the seven remaining occurrences are distributed in only three geographic areas. Since 2009, 8 sites have been confirmed or assumed to be present, while the 8 remaining sites are thought to be extirpated or potentially extirpated (Note: surveys are not routinely conducted at all previously known locations).

Threats to the Ohlone tiger beetle, including habitat fragmentation and destruction due to urban development, habitat degradation due to invasion of non-native plants, potential threats due to collection, pesticides, and recreational use of habitat, and vulnerability to random local extirpations continue to imperil the continued existence of this species. In particular, encroachment by non-native plants has become a much more serious threat since the species was listed. Much of the habitat of this species is suitable for development and is unprotected from these threats. This species remains in danger of extinction “throughout all or a significant portion of its range” (section 3(6) of the Act) and, therefore, meets the Act’s definition of endangered.

EB/CE Sources: U.S. Fish and Wildlife Service. 2009. Ohlone Tiger Beetle (*Cicindela ohlone*) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office, California. 27 pp.

U.S. Fish and Wildlife Service. 2019. 5-Year Review Ohlone Tiger Beetle (*Cicindela ohlone*). Ventura Field Office, California. 5 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects

Risk to the species from labeled uses across the range: Mortality for the Ohlone tiger beetle exposed to malathion at maximum use rates is 12% for developed, 15% for open space developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 28% |
| Spray drift areas – mortality | Up to 1.6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 28% |
| Spray drift areas – effects to dietary items | Up to 1.6% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 100% |
| Sublethal | NA |
| Indirect - mortality | 100% arthropods |

Risk modifiers:

The Ohlone tiger beetle is found in the city of Scotts Valley to the eastern edge of Santa Cruz. The five currently recognized geographic areas are: west of the city of Soquel, within the city of Scotts Valley, west of the city of Santa Cruz, north of the city of Santa Cruz, and northwest of the city of Santa Cruz (2009 5-Year Review).

The Ohlone tiger beetle habitat consists of small patches of grassland and coastal terrace prairies. Both adult and larval Ohlone tiger beetles are found where grasses are low and sparse enough to leave bare ground. Trails and trampled areas appear to be especially attractive to the Ohlone tiger

beetle. These soil conditions appear to be critical for oviposition, burrow creation, and the burrow environmental conditions necessary for larval Ohlone tiger beetles.

After mating, the Ohlone tiger beetle female excavates a hole in the soil and oviposits a single egg (Pearson 1988; Kaulbars and Freitag 1993; Hayes, pers. comm. 1998). After the larva emerges from the egg and becomes hardened, it enlarges the chamber that contained the egg into a tunnel (Pearson 1988) and undergoes three instars (larval development stages). This period can take 1 to 4 years, but a 2-year period is the most common (Pearson 1988). The Ohlone tiger beetle is active and reproduces from late January to early April. This beetle is likely to be exposed in developed locales (right of way, developed, open space developed) because it occurs in these areas (no name pers. comm 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 102,938 | 100 | NA | NA |
| Vegetables and Ground Fruit | D,I | 42 | 0.04 | 42 | 0.04 |
| Open Space Developed | D,I | 15,870 | 15.43 | 793 | 0.77 |
| Developed | D,I | 12,362 | 12.02 | 618 | 0.60 |
| Other Crops | D,I | 129 | 0.13 | 0 | 0 |
| Nurseries | D,I | 118 | 0.11 | 0 | 0 |
| Orchards and Vineyards | D,I | 52 | 0.05 | 0 | 0 |
| Other Grains | D,I | 36 | 0.04 | 0 | 0 |
| Pasture | D,I | 27 | 0.03 | 0 | 0 |
| Wheat | D,I | 24 | 0.03 | 0 | 0 |
| Rice | D,I | 12 | 0.02 | 0 | 0 |
| Corn | D,I | 6 | 0.01 | 0 | 0 |
| Cotton | D,I | <1 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | <1 | <0.01 | 0 | 0 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 28,677 | 27.93 | 1,453 | 1.41 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 28,677 | 27.93 | 1,453 | 1.41 |
| TOTAL⁴: | | 131,614 ^{##} | 100* | 1,453 | 1.41 |

*Use overlaps with range are additive and cannot be greater than 100%.

Overlap acreage greater than acres in species range.

acres in species range: 102,828 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 61.0 acres, 0.005%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Ohlone tiger beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measure described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

The Ohlone tiger beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 28.0% mortality of individuals, up to 1.6% mortality from spray drift, a loss of about 28.0% of dietary items in use areas, and an additional loss of up to 1.6% of dietary items due to spray drift. In addition, there could be up to 100.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.41% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Ohlone tiger beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------------|---------------------------------|------------|
| <i>Trimerotropis infantilis</i> | Zayante band-winged grasshopper | 458 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The primary threat to species at the time of listing was habitat destruction due to sand mining (Service 1998). Much of the historical habitat for the species was destroyed by mining and the remaining habitat has been degraded and heavily fragmented. Based on current research, it appears that efforts to restore degraded habitat have not been successful. Mining activity has been reduced since the species was listed, and many of the quarries are either closed or nearing closure (McGraw 2004b; Davilla, pers. comm. 2006). However, approximately 80% of the original 405 ha (1,000 ac) of sand parkland has already been destroyed, much of which was directly due to mining (Lee 1994; McGraw 2004b). As a result, even minor losses of the remaining habitat are now important to the future status of the species. Early mines did not require habitat conservation measures, and three of the six mines operated in sandhills habitat were closed and left as is with no habitat restoration or revegetation attempted. Where restoration of sandhills habitat has been attempted, it has met with limited success (Davilla, pers. comm. 2006; Schettler, pers. comm. 2006). Residual effects from mining, including habitat fragmentation, also pose a serious challenge to future conservation efforts.

Alteration of habitat due to suppression of natural fire cycles is now the predominant threat preventing the recovery of the species. Fire suppression continues throughout the Santa Cruz sandhills and conversion of habitat is widespread. Introduction of fast-growing and hardy non-native species has exacerbated this problem. Arnold (pers. comm. 2007a) believes that the species is in a state of decline and that the reduction in available habitat due to successional processes is now largely to blame. Rates of annual encroachment indicated by McGraw's unpublished data (2004) at around 0.8% annually will reduce remaining "islands" of open habitat quickly. As these successional processes continue, increased habitat fragmentation, reduction in fragment sizes, and declines in numbers of individuals and populations will increase the risk of stochastic extinction events, further reducing chances for recovery of these species.

The result of the threats to these species mentioned above has likely been a decline in numbers across most of the occupied sandhills habitat. A lack of consistent monitoring efforts makes interpretation of population trends speculative. At least three populations are believed to be

extirpated. The closest reliable measure that can be used to infer population trends for this species is related to available habitat. Sand parkland habitat has been reduced by approximately 80% over a 60-year period. While the foremost threat to sandhills habitat identified at the time of listing, sand mining, has been much reduced, habitat is still being lost via this mechanism and other threats have become more severe. Habitat conversion in the sandhills due to the suppression of natural disturbance factors, such as fire, is a continuing threat to sandhills habitat. Conversion of the patch mosaic created by episodic fires to a uniform habitat “frozen” in a late successional stage would eliminate necessary habitat for many species, including the this species and the other listed species endemic to the Zayante sandhills. Considering that this conversion rate may be accelerating and habitat fragmentation is increasing, open habitat species that are already rare in the sandhills are unlikely to recover without the employment of more aggressive management strategies.

EB/CE Source: U.S. Fish and Wildlife Service. 2009. Zayante band-winged grasshopper (*Trimerotropis infantilis*) and Mount Hermon June beetle (*Polyphylla barbata*) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office, California. 33 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Zayante band-winged grasshopper exposed to malathion at maximum use rates will be 9% for developed, 12% for open space developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 22% |
| Spray drift areas – mortality | Up to 1.3% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 22% |

| MOSQUITO CONTROL | |
|--------------------|------|
| Direct - mortality | 100% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Zayante band-winged grasshopper (ZBWG) is known only from Santa Cruz County, California. The Zayante band-winged grasshopper is currently believed to be limited to the five remaining areas of open sand parkland habitat; however, there are differing perspectives on the total number of occupied areas and/or populations. The five areas where populations presently occur are: 1) Quail Hollow County Park; 2) Quail Hollow Quarry area; 3) the area between East Zayante Road, Olympia Wellfield, and Mt. Hermon Road; 4) Mt. Hermon area between Graham Hill and Mt. Hermon Roads and from the old Kaiser/Hanson Quarry to East Zayante Road; and 5) the area between Kings Village Road/Blue Bonnet Lane and Green Valley Road in the city of Scotts Valley (USFWS 2009).

Adults live for approximately one month (USFWS 2009) and breeding takes place from July through November (USFWS 2009). Females oviposit eggs directly into loose, sandy soil. The eggs overwinter in the soil and nymphs will begin to appear in May, with the first adults appearing in July. Breeding season occurs between July and November, and adults live for approximately one month. They rely heavily on the presence of silver bush lupine (*Lupinus albifrons*), which makes up more than 60% of their diet (USFWS 2009).

The ZBWG is a diurnal herbivore. Sixty percent of the diet of the Zayante band-winged grasshopper is composed of the foliage of the silver bush lupine (*Lupinus albifrons*) (USFWS 2009). Activity rates of this species are low; they spend most of their time resting (46%) or walking, jumping, or flying (45%); reproductive (4%) and feeding (5%) activities occur much less frequently (McGraw 2004). The Zayante band-winged grasshopper require the presence of Zayante soils, and the occurrence of Zayante sandhills habitat and the associated plant species (66 FR 9219).

The ZBWG is known to use developed and open space developed areas for traveling through, migrating, breeding and foraging but no agricultural areas, pasture, or golf courses (Chad Mitchum, pers. comm. 2016 co-occurrence information, USFWS field office request).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------------------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 132,655 | 100 | NA | NA |
| Open Space Developed | D,I | 17,080 | 12.89 | 854 | 0.64 |
| Developed | D,I | 12,530 | 9.46 | 626 | 0.47 |
| Vegetables and Ground Fruit | * | 36 | 0.03 | 36 | 0.03 |
| Nurseries | * | 118 | 0.09 | 0 | 0 |
| Other Crops | * | 101 | 0.08 | 0 | 0 |
| Orchards and Vineyards | * | 65 | 0.05 | 0 | 0 |
| Other Grains | * | 27 | 0.02 | 0 | 0 |
| Wheat | * | 20 | 0.01 | 0 | 0 |
| Pasture | * | 19 | 0.01 | 0 | 0 |
| Rice | * | 6 | <0.01 | 0 | 0 |
| Corn | * | 5 | <0.01 | 0 | 0 |
| Cotton | * | <1 | <0.01 | 0 | 0 |
| Other Row Crops | * | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 29,610 | 22.35 | 1,480 | 1.11 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 29,610 | 22.35 | 1,480 | 1.11 |
| TOTAL⁴: | | 162,265 [#] | 100 ^{**} | 1,480 | 1.11 |

**Use overlaps with range are additive and cannot be greater than 100%.

Overlap acreage greater than acres in species range.

acres in species range: 132,484 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 96 acres, 0.007%

Overall Usage: ☐ High ☐ Medium ☒ Low

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Zayante band-winged grasshopper, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Zayante band-winged grasshopper. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Zayante band-winged grasshopper has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 22.0% mortality of individuals, up to 1.3% mortality from spray drift. In addition, there could be up to 100.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where

exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the grasshopper populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.11% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and timing restrictions for mosquito control applications, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Zayante band-winged grasshopper in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------|-------------------------|------------|
| <i>Rhadine infernalis</i> | [Unnamed] ground beetle | 459 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

This species occurs in five of the six karst regions— Helotes, University of Texas at San Antonio (UTSA), Stone Oak, Culebra Anticline, and Government Canyon. Scientists have delineated three subspecies (*Rhadine infernalis ewersi*, *Rhadine infernalis infernalis*, *Rhadine infernalis* ssp.), and described and named two of these in scientific literature (Barr 1960, Barr and Lawrence 1960). In a report, scientists characterized the third subspecies as distinct, but not named (Reddell 1998). Only three caves, all on Department of Defense land, contain the subspecies *Rhadine infernalis ewersi*. Sixteen caves contain the subspecies *Rhadine infernalis infernalis* and lie in the Government Canyon, Helotes, UTSA, and Stone Oak regions. Six caves in the Culebra Anticline region contain the unnamed subspecies. *Rhadine infernalis* is now known from 39 caves. The species is a troglobite, which describes species restricted to the subterranean environment and that typically exhibit morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Troglotic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Bexar County, Texas. Within this habitat, these species depend on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter, animal droppings, and animal carcasses. It is imperative to consider that while this species spends its entire life underground, its ecosystem is dependent on the overlying surface habitat.

Threats to this species and its habitat include destruction and/or deterioration of habitat by construction; filling of caves and karst features; loss of impermeable cover; contamination from septic effluent, sewer leaks, run-off, pesticides, and other sources; predation by and competition with red-imported fire ants (RIFA); and vandalism (65 FR 81419). Currently, this species faces the same threats that it did at the time it was listed. However, climate change has since been identified as a threat to this species and is discussed in the recovery plan. Also, while the karst fauna areas known to support one or more listed species are undeveloped now, some of them are subject to imminent development.

EB/CE Sources: U.S. Fish and Wildlife Service. 2000. Endangered and Threatened Wildlife and Plants; Final Rule to List Nine Bexar County, Texas Invertebrate Species as Endangered. Federal Register 65(248):81419-81433.

U.S. Fish and Wildlife Service. 2011. *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name), Madla Cave meshweaver (*Cicurina madla*), Braken Bat Cave meshweaver (*C. venii*), Government Canyon Bat Cave meshweaver (*C. vespera*), Robber Baron Cave meshweaver (*C. baronia*), Cokendolpher Cave harvestman (*Texella cokendolpheri*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), and Helotes mold beetle (*Batrisodes venyivi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas. 23 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality to *Rhadine infernalis* exposed to malathion at maximum use rate is 1-23% for wheat, corn, other grains, open space developed, and developed and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 43% |
| Spray drift areas – mortality | Up to 6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 43% |
| Spray drift areas – effects to dietary items | Up to 6% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 94.5% |
| Sublethal | NA |
| Indirect - mortality | 94.5% arthropods |

Risk modifiers:

The *Rhadine infernalis* ground beetle (RIGB) is known from 36 to 39 caves in Bexar County, Texas (NatureServe 2015). The habitat for the RIGB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

Very little is known about the reproductive strategy of RIGB.

Nutrients in most karst ecosystems are derived from the surface (Barr 1968, Poulson and White 1969, Howarth 1983, Culver 1986) either directly (organic material washed in or brought in by animals) or indirectly by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglaphiles and troglobites that grow on the leaves or feces rather than the original material itself (Elliott 1994, Gounot 1994). Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features (Howarth 1983, Holsinger 1988, Elliott and Reddell 1989).

RIGB is an herbivore and invertivore (USFWS 2011). It is an opportunistic feeder on organic matter, fungus, microbes, cave crickets, and other invertebrates (USFWS 2011).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 759,912 | 94.5 | 26 | <0.01 |
| Developed | D,I | 185,244 | 23.04 | 9,262 | 1.15 |
| Open Space Developed | D,I | 110,171 | 13.71 | 5,509 | 0.69 |
| Other Grains | D,I | 20,786 | 2.59 | 20,786 | 2.59 |
| Corn | D,I | 11,426 | 1.42 | 4,101 | 0.51 |
| Wheat | D,I | 9,916 | 1.23 | 9,916 | 1.23 |
| Other Crops | D,I | 3,767 | 0.47 | 0 | 0 |
| Nurseries | D,I | 2,052 | 0.26 | 2,052 | 0.26 |
| Cotton | D,I | 1,894 | 0.24 | 1,844 | 0.23 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|-------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Other Row Crops | D,I | 362 | 0.05 | 362 | 0.05 |
| Vegetables and Ground Fruit | D,I | 66 | <0.01 | 66 | <0.01 |
| Orchards and Vineyards | D,I | 41 | <0.01 | 25 | <0.01 |
| Pasture | D,I | 1 | <0.01 | <1 | <0.01 |
| Rice | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 345,727 | 43.05 | 53,923 | 6.71 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 345,727 | 43.05 | 53,923 | 6.71 |
| TOTAL⁴: | | 1,105,639 ^{**} | 100 [#] | 53,949 | 6.716 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 803,853 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 44,498 acres, 5.5%

Overall Usage: ☐ High ☒ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction and aquatic habitat buffers: *Rhadine infernalis* is closely associated with the underground streams that create the cave systems it lives in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting *Rhadine infernalis*.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Conservation Measures

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, additional species-specific conservation measures will be implemented as outlined below. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

All agricultural uses are prohibited within 100 feet of the critical habitat of this species, which encompasses all confirmed locations of the species. As the critical habitat for this species already includes a 344-foot buffer where pesticides cannot be applied to protect the foraging area of cave crickets (which are an important food source for the species), this additional measure extends the area where malathion cannot be applied to 444 feet around cave entrances. This extended buffer would substantially decrease the fraction of spray drift entering critical habitat and reduce the risk of exposure.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the [Unnamed] ground beetle.

The [Unnamed] ground beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is medium based on standard usage data, however, implementation of the general and species-specific conservation measures described above is expected to further reduce the likelihood of exposure. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (5.5%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 6.71% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. We anticipate a loss of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of individual [unnamed] ground beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species include developed and open space developed (residential uses), ‘other grains,’ corn, and wheat (agricultural uses).

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

To further prevent exposure from use on corn (one of the main agricultural use drivers), the allowable number of applications has been reduced to a maximum of three applications per year from five per year, which is anticipated to substantially reduce the contribution of malathion from use on corn that could enter the karst environment.

In order to further address exposure and the resultant effects from all agricultural uses of malathion within the range of *Rhadine infernalis*, a species-specific measures will be implemented. This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. These conservation measures prohibit malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland

Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items.

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the [Unnamed] ground beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------------|---------------------|------------|
| <i>Batrisesodes venyivi</i> | Helotes mold beetle | 460 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Batrisesodes venyivi, the Helotes mold beetle, is known from a few caves in the vicinity of Helotes, Texas, northwest of San Antonio. As discussed in the 2020 5-Year Review, the species has been found in two additional caves. After clarifying past records, the species was believed to be present in seven caves in three karst fauna regions in 2020. The species addressed in the 2011 5-Year Review, including Helotes mold beetle (*Batrisesodes venyivi*), are troglobites, which describes species restricted to the subterranean environment and that typically exhibit morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Troglotic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Bexar County. Within this habitat, this species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter, animal droppings, and animal carcasses. It is imperative to consider that while this species spends its entire life underground, its ecosystem is dependent on the overlying surface habitat.

Threats to this species and its habitat include destruction and/or deterioration of habitat by construction; filling of caves and karst features; loss of impermeable cover; contamination from septic effluent, sewer leaks, run-off, pesticides, and other sources; predation by and competition with red-imported fire ants (RIFA); and vandalism (65 FR 81419). Currently, this species faces the same threats that it did at the time it was listed. However, climate change was not identified as a threat to this species in the original listing document and this threat is discussed in greater detail in the recovery plan (Service 2011). For the purposes of the recovery program, a karst fauna area (KFA) is an area known to support one or more locations of a listed species. A KFA is distinct in that it acts as a system that is separated from other KFAs by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglotic fauna. Karst fauna areas should be far enough apart so that if a catastrophic event (i.e., contamination of the water supply, flooding, disease) were to destroy one of the areas, that event would not likely destroy any other area occupied by that species. The conservation and recovery

of this endangered and cryptic species is dependent upon the long-term preservation of its habitat. Most endangered karst invertebrates are difficult to detect during in-cave faunal surveys; therefore, their conservation strategies focus on the delineation, study, and management of occupied KFAs. According to the downlisting recovery criterion in the recovery plan, three KFAs within each karst fauna region (KFR) should be protected and at least six KFAs (of medium or high quality) should be protected rangewide if the species occurs in one KFR. To be considered protected, these areas must provide perpetual protection from threats such as RIFA, habitat destruction, and contaminants. Based on a review of available data in the 2020 5-Year Review, two preserves in the Government Canyon State Natural Area (Lithic Ridge Cave and Sotol Pit) and two areas in the Scenic Overlook Cave Cluster (Scenic Overlook Cave and San Antonio Ranch Pit) meet the requirements of high quality KFAs for the Helotes mold beetle. The Helotes Hilltop Preserve would meet the definition of a medium quality KFA if additional acreage and protection of the drainage basin are implemented. While these areas appear to currently be high or medium quality, many could be planned for development, which would reduce their quality. There are no areas in the University of Texas at San Antonio (UTSA) KFR that meet or may meet the definition of a high or medium quality KFA.

EB/CE Sources: U.S. Fish and Wildlife Service. 2000. Endangered and Threatened Wildlife and Plants; Final Rule to List Nine Bexar County, Texas Invertebrate Species as Endangered. Federal Register 65(248):81419-81433.

U.S. Fish and Wildlife Service. 2011. *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name), Madla Cave meshweaver (*Cicurina madla*), Braken Bat Cave meshweaver (*C. venii*), Government Canyon Bat Cave meshweaver (*C. vespera*), Robber Baron Cave meshweaver (*C. baronia*), Cokendolpher Cave harvestman (*Texella cokendolpheri*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), and Helotes mold beetle (*Batrisodes venyivi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas. 23 pp.

U.S. Fish and Wildlife Service. 2020. Helotes Mold Beetle (*Batrisodes venyivi*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office, Texas. 35 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality to Helotes mold beetles exposed to malathion at maximum use rate is 1-23% for wheat, corn, other grains, open space

developed, and developed and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 43% |
| Spray drift areas – mortality | Up to 6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 43% |
| Spray drift areas – effects to dietary items | Up to 6% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 94.5% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Helotes mold beetle (HMB) is known from caves (San Antonio Ranch Pit, Tight Cave, Scenic Overlook, Helotes Hilltop) in Bexar County, Texas. The habitat for the HMB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

Very little is known about the reproductive strategy of the HMB.

Due to the paucity of light and limited capability for photosynthesis, karst ecosystems are almost entirely dependent upon surface plant and animal communities for nutrient and energy input. Karst ecosystems receive nutrients from the surface in the form of leaf litter and other organic debris that have washed or fallen into the caves, from tree and other vascular plant roots, or through the feces, eggs, or dead bodies of troglophiles and trogoxenes (i.e., cave crickets, raccoons).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 759,912 | 94.5 | 26 | <0.01 |
| Developed | D,I | 185,244 | 23.04 | 9,262 | 1.15 |
| Open Space Developed | D,I | 110,171 | 13.71 | 5,509 | 0.69 |
| Other Grains | D,I | 20,786 | 2.59 | 20,786 | 2.59 |
| Corn | D,I | 11,426 | 1.42 | 4,101 | 0.51 |
| Wheat | D,I | 9,916 | 1.23 | 9,916 | 1.23 |
| Other Crops | D,I | 3,767 | 0.47 | 0 | 0 |
| Nurseries | D,I | 2,052 | 0.26 | 2,052 | 0.26 |
| Cotton | D,I | 1,894 | 0.24 | 1,844 | 0.23 |
| Other Row Crops | D,I | 362 | 0.05 | 362 | 0.05 |
| Vegetables and Ground Fruit | D,I | 66 | <0.01 | 66 | <0.01 |
| Orchards and Vineyards | D,I | 41 | <0.01 | 25 | <0.01 |
| Pasture | D,I | 1 | <0.01 | <1 | <0.01 |
| Rice | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 345,726.92 | 43.05 | 53,923 | 6.71 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 345,726.92 | 43.05 | 53,923 | 6.71 |
| TOTAL⁴: | | 1,105,638.62** | 100 [#] | 53,949 | 6.716 |

[#]Use overlaps with range are additive and cannot be greater than 100%.^{**}Overlap acreage greater than acres in species range.

acres in species range: 803,853 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 44,498 acres, 5.5%

Overall Usage: ☐ High ☒ Medium ☐ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

General Conservation Measures:

Rain restriction and aquatic habitat buffers: The Helotes mold beetle is closely associated with the underground streams that create the cave systems it lives in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the Helotes mold beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Conservation Measures:

In addition to the general conservation measures described above, an additional species-specific conservation measure will be implemented as outlined below. This species-specific measure is now part of the Action and will be included in *BulletinsLive! Two*.

All agricultural uses are prohibited within 100 feet of the critical habitat of this species, which encompasses all confirmed locations of the species. As the critical habitat for this species already includes a 344-foot buffer where pesticides cannot be applied to protect the foraging area of cave crickets (which are an important food source for the species), this additional measure extends the area where malathion cannot be applied to 444 feet around cave entrances. This extended buffer would substantially decrease the fraction of spray drift entering critical habitat and reduce the risk of exposure.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Helotes mold beetle.

The Helotes mold beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is medium based on standard usage data, however, implementation of the general and species-specific conservation measures described above is expected to substantially reduce the likelihood of exposure. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (5.5%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 6.71% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. We anticipate a loss of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the beetle populations. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of individual Helotes mold beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species include developed and open space developed (residential uses), 'other grains,' corn, and wheat (agricultural uses).

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

To further prevent exposure from use on corn and cotton (two of the main agricultural use drivers), the allowable number of applications has been reduced to a maximum of 2 for cotton and 3 applications/year for corn, reduced from 3 and 5 per year respectively. These reductions are anticipated to reduce the contribution of malathion from use on corn and cotton that could enter the karst environment.

In order to further address exposure and the resultant effects from all agricultural uses of malathion within the range of the Helotes mold beetle, a species-specific measures will be implemented. This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. These conservation measures prohibit malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items.

We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Helotes mold beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------|-------------------------|------------|
| <i>Rhadine exilis</i> | [Unnamed] ground beetle | 461 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Rhadine exilis is known from 35 caves in north and northwest Bexar County, Texas. Twenty-one are located on Department of Defense (DOD) land in the Stone Oak karst region. The remainder are distributed among the Helotes, University of Texas at San Antonio (UTSA), and Stone Oak karst regions, while one location lies in the Government Canyon region. One of the non-DOD sites is located in a county road right-of-way, one is located in a state-owned natural area, and the remainder are located on private property. Ongoing efforts by the DOD to locate and inventory karst features on Camp Bullis and to document the karst fauna communities in caves on Camp Bullis resulted in discovery of 18 of the 35 caves mentioned above (Veni 1994b; James Reddell, pers. comm. 1997). *Rhadine exilis* is now known from 51 caves. The species is a troglobite, which describes species restricted to the subterranean environment and that typically exhibit morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment. Troglotic habitat includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock) in Bexar County, Texas. Within this habitat, this species depends on high humidity, stable temperatures, and nutrients derived from the surface. Examples of nutrient sources include leaf litter, animal droppings, and animal carcasses. It is imperative to consider that while this species spends its entire life underground, its ecosystem is dependent on the overlying surface habitat.

Threats to this species and its habitat include destruction and/or deterioration of habitat by construction; filling of caves and karst features; loss of impermeable cover; contamination from septic effluent, sewer leaks, run-off, pesticides, and other sources; predation by and competition with red-imported fire ants (RIFA); and vandalism (65 FR 81419). Currently, this species faces the same threats that it did at the time it was listed. However, climate change has since been identified as a threat to this species and is discussed in the recovery plan. Also, while the karst fauna areas known to support one or more listed species are undeveloped now, some of them are subject to imminent development.

EB/CE Sources: U.S. Fish and Wildlife Service. 2000. Endangered and Threatened Wildlife and Plants; Final Rule to List Nine Bexar County, Texas Invertebrate Species as Endangered. Federal Register 65(248):81419-81433.

U.S. Fish and Wildlife Service. 2011. *Rhadine exilis* (no common name), *Rhadine infernalis* (no common name), Madla Cave meshweaver (*Cicurina madla*), Braken Bat Cave meshweaver (*C. venii*), Government Canyon Bat Cave meshweaver (*C. vespera*), Robber Baron Cave meshweaver (*C. baronia*), Cokendolpher Cave harvestman (*Texella cokendolpheri*), Government Canyon Bat Cave spider (*Neoleptoneta microps*), and Helotes mold beetle (*Batrisodes venyivi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas. 23 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality to *Rhadine exilis* beetles exposed to malathion at maximum use rate is 1-23% for wheat, corn, other grains, open space developed, and developed and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 43% |
| Spray drift areas – mortality | Up to 6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 43% |
| Spray drift areas – effects to dietary items | Up to 6% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 94.5% |
| Sublethal | NA |
| Indirect - mortality | 94.5% arthropods |

Risk modifiers:

The *Rhadine exilis* ground beetle (REGB) is known from 45 to 50 caves in Bexar County, Texas. (NatureServe 2015). The habitat for the REGB includes caves and mesocavernous voids in karst limestone (a terrain characterized by landforms and subsurface features, such as sinkholes and caves, which are produced by solution of bedrock).

Very little is known about the reproductive strategy of REGB.

Nutrients in most karst ecosystems are derived from the surface (Barr 1968, Poulson and White 1969, Howarth 1983, Culver 1986) either directly (organic material washed in or brought in by animals) or indirectly by feeding on the karst invertebrates that feed on surface-derived nutrients. In some cases, the most important source of nutrients for a target troglobite may be the fungus, microbes, and/or smaller troglaphiles and troglobites that grow on the leaves or feces rather than the original material itself (Elliott 1994, Gounot 1994). Tree roots can penetrate into caves and may also provide direct nutrient input to shallow caves. In deeper cave reaches, nutrients enter through water containing dissolved organic matter percolating vertically through karst fissures and solution features (Howarth 1983, Holsinger 1988, Elliott and Reddell 1989).

REGB is an herbivore and invertivore (USFWS 2011). It is an opportunistic feeder on organic matter, fungus, microbes, cave crickets, and other invertebrates (USFWS 2011).

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 759,912 | 94.5 | 0 | 0 |
| Developed | D,I | 185,244 | 23.04 | 9,262 | 1.15 |
| Open Space Developed | D,I | 110,171 | 13.71 | 5,509 | 0.69 |
| Other Grains | D,I | 20,786 | 2.59 | 20,786 | 2.59 |
| Corn | D,I | 11,426 | 1.42 | 4,101 | 0.51 |
| Wheat | D,I | 9,916 | 1.23 | 9,916 | 1.23 |
| Other Crops | D,I | 3,767 | 0.47 | 0 | 0 |
| Nurseries | D,I | 2,052 | 0.26 | 2,052 | 0.26 |
| Cotton | D,I | 1,894 | 0.24 | 1,844 | 0.23 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|-------------------------|------------------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Other Row Crops | D,I | 362 | 0.05 | 362 | 0.05 |
| Vegetables and Ground Fruit | D,I | 66 | <0.01 | 66 | <0.01 |
| Orchards and Vineyards | D,I | 41 | <0.01 | 24 | <0.01 |
| Pasture | D,I | 1 | <0.01 | <1 | <0.01 |
| Rice | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 345,726 | 43.05 | 53,923 | 6.71 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 345,726 | 43.05 | 53,923 | 6.71 |
| TOTAL⁴: | | 1,105,637 ^{**} | 100 [#] | 53,923 | 6.71 |

[#]Use overlaps with range are additive and cannot be greater than 100%.

^{**}Overlap acreage greater than acres in species range.

acres in species range: 803,853 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 44,498 acres, 5.5%

Overall Usage: ☐ High ☒ Medium ☐ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

General Conservation Measures

Rain restriction and aquatic habitat buffers: The [no common name] Beetle is closely associated with the underground streams that create the cave systems it lives in and may experience effects of malathion through effects to the aquatic system. Rain restrictions (which allow for malathion to degrade before runoff events can occur) and aquatic habitat buffers required of all agricultural and residential uses will reduce the level of effects impacting the [no common name] Beetle.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application. In addition, exposure to aquatic organisms is reduced due to buffers from waterways, which specify on the label a distance from water bodies where pesticides are not to be applied, and restrictions to application during periods where rain is not forecasted within 24 hours or when the soil is not saturated.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Species-specific Conservation Measure

In addition to the above general label changes that would apply to all uses specified on the label, an additional species-specific conservation measure will be implemented as outlined below. The following species-specific measure is now part of the Action and will be included in *BulletinsLive! Two*.

All agricultural uses are prohibited within 100 feet of the critical habitat of this species, which encompasses all confirmed locations of the species. As the critical habitat for this species already includes a 344-foot buffer where pesticides cannot be applied to protect the foraging area of cave crickets (which are an important food source for the species), this additional measure extends the area where malathion cannot be applied to 444 feet around cave entrances. This extended buffer would substantially decrease the fraction of spray drift entering critical habitat and reduce the risk of exposure.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the [Unnamed] ground beetle.

The [Unnamed] ground beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is medium based on standard usage data, however, implementation of the general and species-specific conservation measures is expected to substantially reduce the likelihood of exposure. For the portion of the species range

that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (5.5%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 6.71% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. We anticipate a loss of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of individual [unnamed] ground beetles that are not directly exposed to malathion.

The karst habitats occupied by this species are susceptible to groundwater contamination from surface runoff because of the rapid penetration of karst rock and little natural filtration. Pesticides have been identified as a contaminant of groundwater for this species and they may originate from surface use sites (multiple uses, see R-Plots) that reach groundwater on which the species depends. The main use sites driving the exposure for this species include developed and open space developed (residential uses), 'other grains,' corn, and wheat (agricultural uses).

To address run-off from the use drivers listed above, and thus exposure to this species, the general conservation measures (described above) including the rain-restriction and aquatic buffers are anticipated to contribute to reducing surface run-off contaminated with malathion and spray drift into the porous karst habitat areas where these beetles reside, minimizing the potential for mortality of the species and its prey. These measures are designed to reduce malathion contaminated run-off by creating enough physical space (buffers) or time (48-hour rain restriction) between malathion application and a rain event that would transport malathion into the karst habitat. This is done by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the karst environment.

To further prevent exposure to malathion from residential uses (developed and open space developed UDLs), new residential label restrictions will limit the amount being applied, the type of equipment used to apply, the area in which it can be applied, the amount of time between treatments, and the number of treatments that can be made. Together, these new restrictions are anticipated to substantially reduce the contribution of malathion from residential uses into the karst habitat within the range of this species.

To further prevent exposure from use on corn (one of the main agricultural use drivers), the allowable number of applications has been reduced to a maximum of 3 applications/year from 5 per year, which is anticipated to substantially reduce the contribution of malathion from use on corn that could enter the karst environment.

In order to further address exposure and the resultant effects from all agricultural uses of malathion within the range of *Rhadine exilis*, a species-specific measures will be implemented.

This measure is designed to reduce spray drift and runoff into cave entrances and protect cave crickets, a main food source for this species. These conservation measures prohibit malathion use within 100 feet of known cave entrances where this species is known to exist, in addition to an already existing 344-foot no use buffer (designated in the Balcones Canyonland Conservation Plan) where pesticides cannot be applied to protect the foraging area of cave crickets. This effectively creates an area of 444 feet around cave entrances where malathion cannot be applied, and is anticipated to substantially decrease the fraction of spray drift entering the caves where this species exists, thus reducing exposure and mortality of the species and its food items. We anticipate these conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). As such, we anticipate malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the [Unnamed] ground beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--------------------------------------|--------------------------|------------|
| <i>Pseudocopaodes eunus obscurus</i> | Carson wandering skipper | 462 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

At the time of listing in 2001, only two Carson wandering skipper (CWS) populations were known, one in Washoe County, Nevada, and one in Lassen County, California. In 2004, a population was located in Douglas County, Nevada. An additional population in Washoe County was confirmed in 2005. Many additional occupied sites have been found around Honey Lake associated with the Lassen County population. The long-term persistence of the two newly-discovered populations in Douglas and Washoe Counties has yet to be determined. At this time, the Douglas County site appears more promising as a persistent population while the Spanish Springs Valley Site #2B in Washoe County appears less promising as a long-term population; both are vulnerable due to small geographic area and population size.

While known CWS populations and distribution have increased since listing, all of these populations remain at risk. Current threats to these populations are primarily due to development, non-native plant invasion, livestock grazing, recreational activities (e.g., off-road vehicles use), and small and restricted population vulnerabilities.

EB/CE Source: U.S. Fish and Wildlife Service. 2012. Carson Wandering Skipper (*Pseudocopaodes eunus obscurus*) 5-Year Review: Summary and Evaluation. Nevada Fish and Wildlife Office, Reno. 44 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Carson wandering skipper butterflies exposed to malathion at maximum use rates is 2% each for pasture and developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 5.3% |
| Spray drift areas – mortality | Up to 2.4% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 3% |
| MOSQUITO CONTROL | |
| Direct - mortality | 6.2% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Little is known about the Carson wandering skipper biology. Carson wandering skipper larvae feed solely on succulent, green leaves of saltgrass from March through June to complete its life cycle (USFWS 2006). After several instar stages, the pupae emerge as adults in May or June. The life span of an adult is 1 to 2 weeks, but they may live longer where abundant nectar sources exist. Carson wandering skippers produce only one brood per year during the June to mid-July flight season (USFWS 2006). Because the height of feeding and reproductive activities for this butterfly occur from March through June or July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Species is partially in California and data below is all from EPA SUUM.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 55,051 | 6.28 | 6,486 | 0.74 |
| Developed | D,I | 17,251 | 1.97 | 877 | 0.1 |
| Pasture | D,I | 15,868 | 1.81 | 15,076 | 1.72 |
| Open Space Developed | D,I | 7,311 | 0.83 | 351 | 0.04 |
| Other grains | D,I | 2,126 | 0.24 | 2,126 | 0.24 |
| Other crops | D,I | 1,984 | 0.23 | 0 | 0 |
| Wheat | D,I | 1,946 | 0.22 | 1,946 | 0.22 |
| Vegetables and Ground Fruit | D,I | 89 | 0.01 | 88 | 0.01 |
| Corn | D,I | 45 | <0.01 | 0 | <0.01 |
| Nurseries | D,I | 25 | <0.01 | 0 | <0.01 |
| Orchards and Vineyards | D,I | 15 | <0.01 | 0 | <0.01 |
| Rice | D,I | 8 | <0.01 | 0 | <0.01 |
| Cotton | D,I | 6 | <0.01 | 0 | <0.01 |
| Other Crops | D,I | 1 | <0.01 | 0 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 46,673.96 | 5.37 | 20,464 | 2.36 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 46,673.96 | 5.37 | 20,464 | 2.36 |
| TOTAL⁴: | | 101,725.44 | 11.65 | 26,950 | 3.100 |

acres in species range: 876,542 acres

% of range in California (i.e., where CalPUR data is available): 84%

Range overlap with Federal lands: 493,868 acres, 56.3%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75%

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Carson wandering skipper, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Carson wandering skipper, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Carson wandering skipper. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Carson wandering skipper has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of range is low based on mostly CalPUR usage data (84%). For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 5.3%

mortality of individuals, up to 2.4% mortality from spray drift. In addition, there could be up to 6.2% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations and short flight periods.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.10% of the non-Federal portion of the species range annually based on mostly CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Carson wandering skipper occurs in or near pasture in Nevada and California. New restrictions on the pasture UDL will prohibit application of malathion within three days prior to bloom of alfalfa (the primary constituent of the pasture UDL), during bloom, and until petal fall is complete, thus reducing mortality of pollinators, such as the skipper, attracted to the alfalfa flowers. In addition, a reduction to two applications per year will be implemented for pasture.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Carson wandering skipper in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------|----------------------------|------------|
| <i>Lednia tumana</i> | Meltwater lednian stonefly | 1849 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Species/Populations neither constrained nor widespread

Number of Populations: Multiple populations (numerous)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The meltwater lednian stonefly was originally described by Ricker in 1952 (Baumann 1975, p. 18) from the Many Glacier area of Glacier National Park (GNP), Montana (Baumann 1982, pers. comm.). The meltwater lednian stoneflies are known to occur in 113 streams (109 in GNP, 2 south of GNP on National Forest Land, 1 south of GNP on tribal lands, and 1 north of GNP in Waterton Lakes National Park in Canada. Meltwater lednian stonefly occupy relatively short reaches of streams [mean = 565 m (1,854 ft); range = 1–2,355 m (3– 7,726 ft)] below meltwater sources (Giersch and Muhlfeld 2015, in progress). Meltwater lednian stoneflies can attain moderate to high densities [(350–5,800 per square m) (32–537 per square ft)] (e.g., Logan Creek: Baumann and Stewart 1980, p. 658; NPS 2009, entire; Muhlfeld et al. 2011, p. 342; Giersch 2016, pers. comm.). Given this range of densities and a coarse assessment of available habitat, the abundance of meltwater lednian stonefly is estimated to be in the millions of individuals, however, no population trend information is available for the meltwater lednian stonefly.

The meltwater lednian stonefly occupies a relatively narrow range of alpine habitats that are expected to become fragmented and degraded by climate change. Densities and estimated abundance of the meltwater lednian stonefly are currently relatively high. In addition, some meltwater lednian stonefly populations continue to persist in meltwater habitats supplied by seasonal snowpack. Habitats for the meltwater lednian stonefly originate from meltwater sources that will be impacted by climate change, including glaciers, rock glaciers and small ice fields, perennial and seasonal snowpack, alpine springs, and glacial lake outlets (Hauer et al. 2007; Giersch et al. 2017). The alteration or loss of these meltwater sources and perennial habitat has direct consequences on meltwater lednian stonefly populations. Desiccation (drying) of these habitats, even periodically, could eliminate entire populations of the meltwater lednian stonefly because nymphs need perennial flowing water to breathe and to mature before reproducing (Stewart and Harper 1996,). Given that the species is believed to be a poor disperser (similar to other Plecopterans; Baumann and Gaufin 1971), recolonization of previously occupied habitats is not expected following dewatering and extirpation events. Lack of recolonization by the species is expected to lead to further isolation between extant occupied streams. Western glacier

stoneflies have decreased in distribution among and within 6 streams in GNP where the species was known to occur in the 1960s and 1970s (Giersch et al. 2015).

Due to the anticipated near-term reduction of meltwater from seasonal snowpack and future reduction of flow from other meltwater sources in the foreseeable future, drought is expected to affect meltwater lednian stonefly populations occupying habitat supplied by those meltwater sources. As a result of this anticipated loss of habitat and populations, only a few refugia populations are expected to persist in the longer term. Recolonization of habitats where known populations are extirpated is not anticipated, given the poor dispersal abilities of the species. Threats to meltwater lednian stonefly habitat are currently occurring rangewide and are expected to continue into the foreseeable future. The meltwater lednian stonefly was proposed for listing as threatened under the Endangered Species Act (Act) in 2016.

EB/CE Sources: U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Western Glacier Stonefly as an Endangered or Threatened Species; Proposed Threatened Species Status for Meltwater Lednian Stonefly and Western Glacier Stonefly. Federal Register 81(192):68379-6839.

U.S. Fish and Wildlife Service. 2019. Recovery Outline Meltwater lednian stonefly (*Lednia tumana*) and Western glacier stonefly (*Zapada glacier*). Montana Ecological Services Office, Helena. 14 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bin 2 waters and in the terrestrial phase would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

Terrestrial Phase: Mortality for meltwater lednian stonefly adults exposed to malathion at maximum use rates is <1% .

Aquatic Phase: Mortality for meltwater stonefly nymphs exposed to malathion at maximum use rates is <1.

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|-------------------------------------|
| Use areas – mortality | 0% for both Terrestrial and Aquatic |

| | |
|---|---------------------------------------|
| Spray drift areas – mortality | Up to 0% for Terrestrial |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 0% for both Terrestrial and Aquatic |
| Spray drift areas – effects to dietary items | Up to 0% for Terrestrial |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 0 |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The meltwater lednian stonefly is a small insect that begins life as an aquatic nymph and later matures into a winged adult that lives on land. The nymph, or aquatic juvenile stage, of the meltwater lednian stonefly is dark red-brown on its dorsal surface and pink on the ventral surface, with light grey-green legs (Baumann and Stewart 1980, p. 658). Mature nymphs can range in size from 4.5 to 6.5 mm (0.18 to 0.26 in.) (Baumann and Stewart 1980, p. 655). Nymphs mature into the adult terrestrial phase that has wings and body sizes ranging from 4 to 6 mm (0.16 to 0.24 in.) (Baumann 1975, p. 79).

Nemourid stonefly larvae are typically herbivores or detritivores, and their feeding mode is generally that of a shredder or collector-gatherer (Baumann 1975, p. 1; Stewart and Harper 1996, pp. 218, 262).

Adult stoneflies have no mouth parts and therefore do not feed.

Eggs and larvae of all North American species of stoneflies, including the meltwater lednian stonefly, are aquatic (Stewart and Harper 1996, p. 217). Meltwater lednian stoneflies are thought to emerge from their aquatic environments in August and September to mature to adulthood and breed (Baumann and Stewart 1980, p. 658; Giersch 2010a, pers. comm.).

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

(Anticipated usage within the range based on past usage data)

Species is found 100% on Federal Lands in Glacier National Park and the Flathead National Forest in the Great Bear and Bob Marshall Wilderness areas.

acres in species range: 10,613 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 10,613 acres, 100%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the meltwater lednian stonefly. As discussed below, even though the vulnerability is high for this species, the risk is low, and the likelihood of exposure to malathion is low because the species range is wholly on Federal lands. We do not expect species-level effects to occur.

The meltwater lednian stonefly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is anticipated to be low, as described above. We anticipate usage within the range will be low, based primarily on the malathion usage data we acquired indicating that past malathion usage has occurred on public lands for a variety of uses, but usage has been minimal (see Usage section of Opinion) on Federal lands, with only localized applications occurring on a rare basis. We expect any adverse effects to listed resources to be minimal, considering the small scale and low levels of past usage and in light of Federal agency programs that are designed to understand, avoid, and minimize the effects to listed species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Meltwater lednian stonefly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------|-------------------------|------------|
| <i>Lycaena hermes</i> | Hermes copper butterfly | 1984 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Proposed Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Hermes copper butterfly is a small-sized butterfly currently found in San Diego County, California, United States, and northwestern Baja California, Mexico. Adults are active May through July, when females deposit single eggs exclusively on *Rhamnus crocea* shrubs (spiny redberry; Thorne 1963; Emmel and Emmel 1973) in coastal sage scrub and chaparral vegetation. Adult occupancy and feeding are also associated with presence of the shrub *Eriogonum fasciculatum* (California buckwheat). Out of 95 historically recorded occurrences, there are currently 45 considered or presumed extant. In the United States, there is currently only one known extant occurrence with marine climate influence, four with montane climate influence, and the remainder at intermediate elevations and a more arid climate.

While Hermes copper butterfly permanent population and habitat loss due to development is still a significant stressor, and population numbers have been depressed by the recent drought (one monitored core population was not detected in 2017 or 2018; Marschalek and Deutschman 2017; Marschalek 2018, pers. comm.), the primary cause of population loss over the past 15 years (as of the 2020 SSA) has been wildfire. We identified threats to Hermes copper butterfly attributable primarily to megafires (large wildfires), small and isolated populations, and to a lesser extent, habitat loss due to increased wildfire frequency and fragmentation resulting from the combined impacts of existing development, possible future (limited) development, and existing dispersal barriers. These threats increase the risk of extirpation of Hermes copper butterfly populations rangewide. Hermes copper butterfly occupies scattered areas of sage scrub and chaparral habitat in an arid region susceptible to wildfires of increasing frequency and size. The likelihood that the species will be burned by catastrophic wildfires, combined with the isolation and small size of extant populations, makes Hermes copper butterfly particularly vulnerable to population extirpation rangewide. Wildfires are considered a factor in 34 estimated historical occurrence extirpations, only one of which occurred before 2003, and only four of which appear to have been naturally re-established. Hermes copper butterflies rarely survive wildfire because all immature life stages inhabit host plant foliage, and spiny redberry typically burns to the ground and resprouts from stumps (Deutschman et al. 2010, p. 8; Marschalek and Klein 2010, p. 8). The

primary means to reduce and mitigate the stressor of wildfire is thought to be assisted recolonization. Eggs and adults were translocated in 2015 to a burned area where the species had been extirpated and at least one adult was observed there in 2016, but there were no documented breeding or adult detections in 2017 or 2018. Thus, the outcome of the translocation experiment remains uncertain.

EB/CE Source: U.S. Fish and Wildlife Service. 2020. Species Status Assessment for the Hermes copper butterfly (*Lycaena [Hermelycaena] hermes*) Version 1.1. Carlsbad Fish and Wildlife Office, California. 90 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Hermes copper butterfly exposed to malathion at maximum use rates is 9% for open space developed and 15% for developed, and <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 24.5% |
| Spray drift areas – mortality | Up to 11.1% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 25% |
| MOSQUITO CONTROL | |
| Direct - mortality | 67.5% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Not much is known regarding the biology of the Hermes copper butterfly. Little is known in particular about the larval stage, as this life stage is little-studied and extremely difficult to find in the field (Marschalek and Deutschman 2009, pp. 400, 401). Hermes copper larvae feed exclusively on spiny redberry (*Rhamnus crocea*), and adults nectar exclusively on California buckwheat (*Eriogonum fasciculatum*). The Hermes copper requires woody canopy openings in coastal sage scrub and southern mixed chaparral with a northern exposure in stands of spiny redberry and adjacent stands of California buckwheat. These elements appear to be components of suitable habitat for Hermes copper butterfly. Breeding season for the Hermes copper is in early summer.

Most occupied areas of the Hermes copper habitat are surrounded by suburban development (pers. comm Alison Anderson US FWS Co-occurrence ATF 2016). They are likely to travel through, forage, and breed in agricultural areas, managed forests, developed areas with easements and utilities present as well as rangeland (pers. comm Alison Anderson US FWS Co-occurrence ATF 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Agricultural usage based on CalPUR data

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|--------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 235,696 | 67.51 | 0 | 0 |
| Nurseries | D,I | 217 | 0.06 | 0.1 | 0.0002 |
| Developed | D,I | 52,804 | 15.12 | 2,640 | 0.76 |
| Open Spaced Developed | D,I | 32,329 | 9.26 | 1,616 | 0.46 |
| Orchards and vineyards | D,I | 21 | 0.06 | 0 | 0 |
| Other Crops | D,I | 16 | <0.01 | 0 | 0 |
| Wheat | D,I | 10 | <0.01 | 0 | 0 |
| Pasture | D,I | 9 | <0.01 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 1 | <0.01 | 0 | 0 |
| Cotton | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 85,405 | 24.55 | 4,256.1 | 1.22 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 85,405 | 24.55 | 4,256.1 | 1.22 |
| TOTAL ⁴ : | | 321,101 | 92.06 | 4,256.1 | 1.22 |

acres in species range: 349,151 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 115,364 acres, 33.0%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Hermes copper butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Hermes copper butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

The Hermes copper butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 24.5% mortality of individuals, up to 11.1% mortality from spray drift. In addition, there could be up to 67.5% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the butterfly populations, dispersal barriers, lack of specific host or food plants, and the sedentary nature of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.22% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and timing restrictions for mosquito control applications, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Hermes copper butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------|----------------|------------|
| <i>Hesperia dacotae</i> | Dakota Skipper | 3412 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Dakota skipper (*Hesperia dacotae*) inhabits remnants of tallgrass prairie and mixed-grass prairie in the north-central United States and into southern Saskatchewan and Manitoba Provinces of Canada. Within the native prairie patches where it persists, the species relies on high-quality habitat conditions – diverse native grassland plant communities – and on natural or human disturbances that maintain the integrity of these plant communities while minimizing mortality to vulnerable life stages. The Dakota skipper's range once comprised native prairie in five States and Canada, extending from Illinois to Saskatchewan; it now occurs only in native prairie remnants in portions of three States and two Canadian provinces. As of 2018, we estimate there are 76 metapopulations consisting of 150 distinct subpopulations that persist (67 Present and 83 Unknown status subpopulations) across 3 states and 2 Canadian provinces (USFWS, unpublished geodatabase). Using the methodology in the SSA and accounting for new populations, approximately 56 subpopulations have become extirpated since the time of listing, with the majority of subpopulations lost occurring in Minnesota. Many of the sites that became extirpated, however, were small and isolated populations where a low likelihood of persistence was anticipated based on poor habitat quality. While the number of known Dakota skipper subpopulations is in decline, new subpopulations have been discovered in areas not previously surveyed at the far western edge of its range. A total of 36 new subpopulations have been found, 34 in North Dakota and 2 in South Dakota, and the full extent of similar habitat in these areas have not been fully surveyed.

Populations may also be influenced significantly at local, landscape, regional, and continental scales by other factors that include activities such as grazing, haying, burning, pesticide use, and lack of management. The primary factors supporting the determination of threatened species status for the Dakota skipper are habitat loss and degradation of native prairies, including conversion of native prairie for agriculture or other development; ecological succession and encroachment of invasive species and woody vegetation; certain fire, haying, and grazing management that reduces the availability of certain native-prairie grasses and flowering herbaceous plants to the Dakota skipper; some fire management; flooding; existing regulatory

mechanisms that are inadequate to mitigate threats to the species; loss of genetic diversity; small size and isolation of remnant patches of native prairie; indiscriminate use of herbicides that reduces or eliminates nectar sources; climate conditions such as drought; and other unknown factors.

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling. Federal Register 79 FR 63672.

U.S. Fish and Wildlife Service. 2019. Dakota skipper (*Hesperia dacotae*) 5-Year Review: Summary and Evaluation. Minnesota – Wisconsin Field Office, Bloomington. 9 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Dakota skipper butterflies exposed to malathion at maximum use rates is 1-15% for vegetables and ground fruit, other row crops, pasture, other grains, open space developed, wheat, and corn, and is <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 38% |
| Spray drift areas – mortality | Up to 85% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 4% |
| MOSQUITO CONTROL | |
| Direct - mortality | 30% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Dakota skipper has an obligate relationship with primarily pasture and haylands wherever those practices are carried out on native unplowed prairie. The Dakota skipper may carry out all life cycle activities in pasture or haylands if the nature, intensity, and extent of land use activities maintain the species essential habitat features, including nectar for adults and certain native grass species for immature stages. Certain land management activities may result in high mortality, depending on their timing and extent (Phil Delphey pers. comm. US FWS ATF Co-occurrence analysis 2016).

The Dakota skipper has been found historically in some rights-of-ways, along both highways and railroads. As with native haylands and pastures, the rights-of-ways where the Dakota skipper may occur are comprised of a high diversity of native prairie plant species. The species is not likely to occur where the plant species are primarily non-native, where extensive disturbance of the soil has occurred previously, or where plant diversity is low (Phil Delphey pers. comm. US FWS ATF Co-occurrence analysis 2016).

The Dakota skipper is univoltine (has a single flight per year), with an adult flight period that occurs from the middle of June through the end of July and lasts two to four weeks. The species lays eggs on broadleaf plants and grasses, the eggs hatch after 7-20 days, then larvae crawl to the base of grasses and form shelters at or below the ground surface. The species has 6-7 larval stages (instars) and overwinter at ground level or underground shelters during the fourth or fifth instar. In the spring the larvae resume feeding, and undergo two additional molts before they pupate. Therefore, the Dakota Skipper is vulnerable to the effects of malathion throughout its entire lifecycle; especially vulnerable are the larval and adult stages if applications are made from April through August.

A reassessment of crop UDL showed that usage data in the “Other Row Crops” may be overestimated. This UDL is composed of sunflower, peanuts, tobacco, sugar beets, and hops, of which, only hops is a registered use site on malathion labels and is thus the only crop in this layer that is relevant in our analysis. USDA data shows that 96% of hops are grown in the Pacific Northwest region (Idaho, Oregon, and Washington), with some small farms in Florida reporting occasional hop production. Given the highly specific regions that hops are grown in, we can assume that the potential exposure to malathion from “other row crops” use sites is 0 outside the areas indicated above.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 9,888,707 | 30.1 | 3,613 | 0.01 |
| Corn | D,I | 4,817,683 | 14.66 | 63,507 | 0.19 |
| Wheat | D,I | 3,926,461 | 11.95 | 299,179 | 0.91 |
| Open Space Developed | D,I | 1,218,119 | 3.71 | 60,906 | 0.19 |
| Other Grains | D,I | 967,779 | 2.95 | 92,838 | 0.28 |
| Pasture | D,I | 520,245 | 1.58 | 84,794 | 0.26 |
| Other row crops | D,I | 446,162 | 1.36 | 38,754 | 0.12 |
| Vegetables and Ground Fruit | D,I | 405,406 | 1.23 | 39,129 | 0.12 |
| Other crops | D,I | 204,497 | 0.62 | 0 | 0 |
| Developed | D,I | 176,767 | 0.54 | 8,838 | 0.03 |
| Nurseries | D,I | 862 | <0.01 | 862 | <0.01 |
| Orchards and Vineyards | D,I | 12 | <0.01 | <1 | <0.01 |
| Christmas Trees | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 12,683,994 | 38.63 | 688,807 | 2.13 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 12,683,994 | 38.63 | 688,807 | 2.13 |
| TOTAL⁴: | | 22,572,701 | 68.73 | 692,419 | 2.14 |

acres in species range: 32,854,240 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 1,417,995 acres, 4.31%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Dakota Skipper, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Dakota Skipper, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Dakota Skipper. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Dakota Skipper has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 38.0% mortality of individuals, up to 85.0% mortality from spray drift. In addition, there could be up to 30.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where

the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the butterfly populations and short flight period.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 2.14% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Dakota skipper occurs in or near pasture in the Dakotas and Minnesota. New restrictions on the pasture UDL will prohibit application of malathion within three days prior to bloom of alfalfa (the primary constituent of the pasture UDL), during bloom, and until petal fall is complete, thus reducing mortality of pollinators, such as the skipper, attracted to the alfalfa flowers. In addition, a reduction to two applications per year will be implemented for pasture.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Dakota Skipper in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--------------------------|-------------------------------|------------|
| <i>Papaipema eryngii</i> | Rattlesnake-master borer moth | 3670 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Candidate

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The rattlesnake-master borer moth inhabits primarily high quality remnant prairies and also some grassland, savanna, barrens, glades, and open woodland habitats in Arkansas, Illinois, Kansas, Kentucky, Missouri, and Oklahoma. The only host plant for the moth is rattlesnake-master (*Eryngium yuccifolium*) on which the moth larvae develop and eggs overwinter. Within known populations, the species relies on presence of its host plant and connectivity to other sites with host plant presence to have resilient populations. The habitat range for the rattlesnake-master borer moth is narrow and appears to be limiting for the species. Although the rattlesnake master plant is widely distributed across 26 States and is a common plant in remnant prairies, it is a conservative species, meaning it is not found in disturbed areas, with relative frequencies of less than 1%. Almost all of the sites with extant populations of the rattlesnake-master borer moth are isolated from one another, with the populations in Kentucky, North Carolina, and Oklahoma occurring within a single site for each State, thus precluding recolonization from other populations. These small, isolated populations are likely to become unviable over time due to: lower genetic diversity, reducing their ability to adapt to environmental change; the effects of stochastic events; and their inability to recolonize areas where they are extirpated. Rattlesnake-master borer moths have life-history traits that make them more susceptible to outside stressors. They are univoltine (having a single flight per year), do not disperse widely, and are monophagous (have only one food source). The life history of the species makes it particularly sensitive to fire, which is the primary practice used in prairie management. The species is only safe from fire once it bores into the root of the host plant, which makes adult, egg, and first larval stages subject to mortality during prescribed burns and wildfires.

Rattlesnake-master borer moth populations may be positively or negatively influenced by land management activities that affect the host plant, including grazing, mowing, or fire (prescribed or naturally occurring), and negatively influenced by conversion of prairie, and herbicide or pesticide treatments. The ongoing effects of habitat loss, fragmentation, degradation, and modification from agriculture, development, flooding, invasive species, and secondary succession have resulted in fragmented populations and population declines. Rattlesnake-master

borer moths are affected by habitat fragmentation and population isolation. Fire and grazing cause direct mortality to the moth and destroy food plants if the intensity, extent, or timing is not conducive to the species' biology. Although fire management is a threat to the species, lack of management is also a threat, and at least one site has become extirpated likely because of the succession to woody habitat. The species is sought after by collectors and the host plant is easy to identify, making the moth susceptible to collection, and thus many sites are kept undisclosed to the public.

EB/CE Sources: U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notification of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register 81(232);87246-87272.

U.S. Fish and Wildlife Service. 2020. Species Status Assessment Report for the Rattlesnake-Master Borer Moth (*Papaipema eryngii*) Version 1.1. Region 3, Bloomington, Minnesota. 66 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Rattlesnake-master borer moth exposed to malathion at maximum use rates is 4-8% for open space developed, developed, and corn, respectively and is <1% for all other use types. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 21.5% |
| Spray drift areas – mortality | Up to 23.8% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 12% |
| MOSQUITO CONTROL | |

| | |
|--------------------|-------|
| Direct - mortality | 43.9% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Rattlesnake-master borer moth has an obligate relationship with the rattlesnake-master plant, the host plant, and is restricted to mesic prairies and associated wetlands with a large amount of the rattlesnake-master plant and no fire during the dormant season. Other requirements are unknown.

The Rattlesnake-master borer moth adults are active at night from September through October, and infrequently travel far from their host plant (<2km). Eggs are laid and overwinter in leaf litter or on old stems. The larvae of this species bore only into stems and roots of the rattlesnake-master plant (*Eryngium yuccifolium*) and pupate within the host plant. Therefore, the rattlesnake-master borer moth is most likely vulnerable to the effects of malathion throughout most of its lifecycle, especially vulnerable are the larval and adult stages if applications are made from Spring through October.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 5,344,512 | 43.9 | 181 | <0.01 |
| Corn | D,I | 1,055,071 | 8.68 | 38,595 | 0.32 |
| Developed | D,I | 916,332 | 7.54 | 45,817 | 0.38 |
| Open Space Developed | D,I | 485,100 | 3.99 | 24,255 | 0.2 |
| Other Crops | D,I | 67,633 | 0.56 | 0 | 0 |
| Wheat | D,I | 50,362 | 0.41 | 29,898 | 0.25 |
| Rice | D,I | 22,065 | 0.18 | 22,065 | 0.18 |
| Pasture | D,I | 8,464 | 0.07 | 4,852 | 0.04 |
| Other Grains | D,I | 4,214 | 0.03 | 3,952 | 0.03 |
| Vegetables and Ground Fruit | D,I | 2,633 | 0.02 | 848 | <0.01 |
| Nurseries | D,I | 2,324 | 0.02 | 2,324 | 0.02 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Cotton | D,I | 1,374 | 0.01 | 805 | <0.01 |
| Orchards and Vineyards | D,I | 1,246 | 0.01 | 1,129 | <0.01 |
| Other Row Crops | D,I | 449 | <0.01 | 453 | <0.01 |
| Christmas Trees | D,I | 13 | <0.01 | 8 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 2,617,280 | 21.54 | 175,001 | 1.44 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 2,617,280 | 21.54 | 175,001 | 1.44 |
| TOTAL⁴: | | 7,961,792 | 65.44 | 175,182 | 1.44 |

acres in species range: 12,152,394 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 1,905,998 acres, 15.68%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Rattlesnake-master borer moth. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Rattlesnake-master borer moth has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 21.5% mortality of individuals, up to 23.8% mortality from spray drift. In addition, there could be up to 43.9% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the moth populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.44% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops and new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the Rattlesnake-master borer moth exists in remnant prairies across a number of states such as Arkansas, Kentucky, Oklahoma, and Illinois where it can occur in proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Pesticides are not a known threat to this species.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Rattlesnake-master borer moth in the wild.

Conclusion: Not likely to jeopardize, conference

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--|----------------------|------------|
| <i>Cyclargus thomasi bethunebakeri</i> | Miami Blue butterfly | 4508 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The only confirmed metapopulation of Miami blue is currently restricted to a few, small insular areas in the extreme southern portion of its historical range, on islands contained within the Key West National Wildlife Refuge (KWNWR) in Florida. The population at Bahia Honda State Park appears to be extirpated. The butterfly's range, which once extended from the Keys north along the Florida coasts to about St. Petersburg and Daytona, is now substantially reduced, with an estimated >99% decline in area occupied.

Many factors likely contributed to the Miami blue's decline, and numerous major threats, acting individually or synergistically, continue today. Habitat loss, degradation, and modification from human population growth and associated development and agriculture have impacted the Miami blue, curtailing its range. Environmental effects from climatic change, especially sea level rise, are expected to become severe in the future, resulting in additional habitat losses.

Efforts to control salt marsh mosquitoes, *Aedes taeniorhynchus*, among others, have increased as human activity and population have increased in south Florida. To control mosquito populations, second-generation organophosphate (naled) and pyrethroid (permethrin) adulticides are applied by mosquito control districts throughout south Florida. In a rare case in upper Key Largo, another organophosphate (malathion) was applied in 2011 when the number of permethrin applications reached its annual limit. All three of these compounds have been characterized as being highly toxic to nontarget insects by the EPA (2002, p. 32; 2006a, p. 58; 2006b, p. 44). The use of such pesticides (applied using both aerial and ground-based methods) to control mosquitoes presents a potential risk to nontarget species, including the Miami blue butterfly. The potential for mosquito control chemicals to drift into nontarget areas and persist for varying periods of time has been well documented. Hennessey and Habeck (1989, pp. 1–22; 1991, pp. 1–68) and Hennessey et al. (1992, pp. 715–721) illustrated the presence of mosquito spray residues long after application in habitat of the Schaus swallowtail and other imperiled species in both the upper and lower Keys. Residues of aerially applied naled were found 6 hours after application in a pineland area that was 820 yards (750 m) from the target area; residues of fenthion (an

adulticide no longer used in the Keys) applied via truck were found up to 55 yards (50 m) downwind in a hammock area 15 minutes after application in adjacent target areas (Hennessey et al. 1992, pp. 715–721). Aspects of the Miami blue's natural history may increase its potential to be exposed to and affected by mosquito control pesticides and other chemicals. For example, host plants and nectar sources are commonly found at disturbed sites and often occur along roads in developed areas, where chemicals are applied.

Mosquito control practices currently pose no risk to the Miami blue within KWNWR. However, mosquito control activities, including the use of larvicides and adulticides, are being implemented within suitable and potential habitat for the Miami blue elsewhere in its range (Carroll and Loye 2006, pp. 14–15). The findings of Zhong et al. (2010, pp. 1961–1972) and Pierce (2009, pp. 1–17) along with other studies suggest that aerial or truck-based applications of mosquito control chemicals may pose a threat to the Miami blue, if the butterfly exists in other, unknown locations. Additionally, mosquito control practices potentially may limit expansion of undocumented populations or colonization of new areas. If the Miami blue colonizes new areas or if additional populations are discovered or reintroduced, adjustments in mosquito control (and other) practices may be needed to help safeguard the subspecies.

EB/CE Source: U.S. Fish and Wildlife Service. 2012. Endangered and Threatened Wildlife and Plants; Listing of the Miami Blue Butterfly as Endangered Throughout Its Range; Listing of the Cassius Blue, Ceraunus Blue, and Nickerbean Blue Butterflies as Threatened Due to Similarity of Appearance to the Miami Blue Butterfly in Coastal South and Central Florida. Federal Register 77(67):20948-20986.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Miami blue butterflies exposed to malathion at maximum use rates is 1% for open space developed, 5% for developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|------------|
| Use areas – mortality | 8.1% |
| Spray drift areas – mortality | Up to 7.8% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |

| | |
|--|---------------------------------------|
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to symbiotic ants | 8% |
| Spray drift areas – effects to symbiotic ants | Up to 7.8% |
| Plants affected – decline in growth | 8% |
| MOSQUITO CONTROL | |
| Direct - mortality | 25.2% |
| Sublethal | NA |
| Indirect - mortality | 25.2% arthropods (symbiotic ants) |

Risk modifiers:

The Miami blue is one of the rarest insects in North America, with only one known population remaining, and that is in the Key West National Wildlife Refuge. The Miami blue is also a myrmecophile; *C. floridanus* was the primary ant symbiont, commonly found tending larvae; other ant species were encountered less often.

Miami blue butterfly eggs are generally laid singly, but may be clustered on developing leaves, shoot tips, and flower buds. There are four stages of development (egg, larvae, pupa, adult) and a generation can be 30-40 days. Diapause occurs in December-April but multiple, overlapping broods are observed year-round (Pyle 1981, p. 489) and adults and larvae can be found every month of the year. Therefore, the Miami blue butterfly is vulnerable to the effects of malathion throughout its entire lifecycle.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|------------------------|------------------------------|------------------------|------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 996,000 | 25.2 | 193,527 | 19.43 |
| Developed | D,I | 205,840 | 5.21 | 10,292 | 0.26 |
| Open Space Developed | D,I | 64,878 | 1.64 | 3,244 | 0.08 |
| Orchards and Vineyards | D,I | 27,355 | 0.69 | 8,209 | 0.21 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Vegetables and Ground Fruit | D,I | 11,178 | 0.28 | 1,785 | 0.05 |
| Other Crops | D,I | 8,186 | 0.21 | 0 | 0 |
| Other grains | D,I | 2,652 | 0.07 | 2,652 | 0.07 |
| Nurseries | D,I | 1,974 | 0.05 | 1,974 | 0.05 |
| Corn | D,I | 125 | <0.01 | 0 | 0 |
| Rice | D,I | 14 | <0.01 | 0 | 0 |
| Other Row Crops | D,I | 1 | <0.01 | 1 | <0.01 |
| Christmas Trees | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 322,200 | 8.19 | 28,156 | 0.72 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 322,200 | 8.19 | 28,156 | 0.72 |
| TOTAL⁴: | | 1,318,201 | 33.39 | 221,683 | 20.15 |

acres in species range: 3,947,862 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 1,910,911 acres, 48.4%

Overall Usage: ☒ High ☐ Medium ☐ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Miami Blue

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Miami Blue butterfly. As discussed below, even though the vulnerability, risk, and past malathion usage are high for this species, the likelihood of exposure to malathion is low because the only extant population is on federal lands (KWNWR) , and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Miami Blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is high based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 8.1% mortality of individuals, up to 7.8% mortality from spray drift, a loss of about 8.1% of symbiotic ants in use areas, and an additional loss of up to 7.8% of symbiotic ants due to spray drift. In addition, there could be up to 25.2% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 20.15% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Where a large proportion of individuals of the population is lost, the area of suitable habitat will not be recolonized due to the isolated and fragmented nature of the butterfly populations.

Malathion usage in the non-Federal portion of the species range (>50% of the total range) is high (20.15%) and, if the species is present, we anticipate exposure could occur in these areas.

Aspects of the Miami blue's natural history increase its potential to be exposed to and adversely affected by mosquito control pesticides and other chemicals. For example, host plants and nectar sources are commonly found at disturbed sites and often occur along roads in developed areas, where chemicals are applied and we anticipate similar application patterns for malathion. Furthermore, malathion was specifically described as a threat to the Miami blue butterfly in the species' final listing rule. Additionally, symbiotic ants will be lost from malathion use, which will likely reduce the survivability and reproduction of individual Miami blue butterflies that are not directly exposed to malathion.

However, approximately 48.4% of the Miami blue butterfly's species range overlaps with Federal lands, where, as noted above, we anticipate usage will be low. Additionally, the only extant population of Miami blue butterflies occurs in KWNWR, where mosquito control does not pose a risk to the butterfly. We anticipate usage within the KWNWR will be low, based primarily on the malathion usage data we acquired indicating that past malathion usage has occurred on public lands for a variety of uses, but usage has been minimal (see Usage section of Opinion) on Federal lands, with only localized applications occurring on a rare basis. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and timing restrictions for mosquito applications, will further reduce the risk of exposure to any individuals that might occur outside of the wildlife refuge. For example, the Miami blue butterfly may occur in areas where mosquito treatment with malathion is anticipated to occur. The conservation measure described above will prohibit malathion use for mosquito control during most daylight hours, when this butterfly is most active. This is anticipated to further limit the exposure and resultant mortality of this species.

We expect any adverse effects to listed resources to be minimal, considering the small scale and low levels of past usage and in light of Federal agency programs that are designed to understand, avoid, and minimize the effects to listed species. We anticipate this level of malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Miami Blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---------------------------------------|-------------------------|------------|
| <i>Cicindela nevadica lincolniana</i> | Salt Creek tiger beetle | 4910 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The Salt Creek tiger beetle has very specific habitat requirements and occurs in saline wetlands on exposed saline mud flats or along mud banks of streams and seeps that contain salt deposits and are sparsely vegetated (Carter 1989; Spomer and Higley 1993; LaGrange 1997; Nebraska Game and Parks Commission (NGPC) 1999; Spomer et al. 2004). Larvae have been found only on moist salt flats and salt-encrusted banks of Little Salt Creek in northern Lancaster County (Spomer et al. 2004), Nebraska. Salt Creek tiger beetles require open, barren salt flat areas for construction of larval burrows, thermoregulation, foraging, and for use as dispersal corridors (Spomer and Higley 1993; Higley 2002, pers. comm.; Spomer 2005, pers. comm.). Field work in upper reach of Little Salt Creek resulted in the encouraging discovery of saline wetlands with what appears to be relatively intact hydrology. Four metapopulations of Salt Creek tiger beetles still remain, but these are all located on Little Salt Creek.

The type and level of threats faced by the Salt Creek tiger beetle have varied over time. Our initial concern about wide spread commercial and residential development occurring along Little Salt Creek has declined given that the City of Lincoln is developing to the east and south and not to the north in the Little Salt Creek area. Substantial progress has been made by the Saline Wetlands Conservation Partnership and other entities toward acquisition, restoration, and management of saline wetlands and streams along Little Salt and Rock Creeks; those actions have protected Salt Creek tiger beetle habitat from direct and indirect threats. Progress has been made toward rearing, propagation, and reintroduction with experimental larvae reintroductions occurring at several areas along Little Salt Creek and its associated tributaries. Generally, population surveys show a downward trend over time. Existing metapopulations are all located along stream banks in high risk habitat adjacent to Little Salt Creek. This occupied habitat, located within the high banks of Little Salt Creek and a few tributaries, is subject to scouring by flood water. There is also considerable concern that these sites cannot provide sufficient prey for developing larvae. Saline wetlands, a lower-risk habitat because it is located away from Little Salt Creek, in most cases no longer provides suitable habitat for the subspecies; saline wetlands with intact hydrology remain rare. For these reasons, metapopulations of the Salt Creek tiger

beetle remain on the brink of extinction even though progress has been made at achieving recovery priorities including acquisition, restoration and management of saline wetland and stream habitats and rearing, propagation, and reintroduction research involving successful reintroduction of larvae into occupied habitat.

EB/CE Source: U.S. Fish and Wildlife Service. 2016. Salt Creek tiger beetle 5-Year Review. Nebraska Ecological Services Field Office, Wood River, Nebraska. 22 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Salt Creek tiger beetles exposed to malathion at maximum use rates is 1%, 4%, 5%, and 31%, respectively, for pasture, open space developed, developed, and corn, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 42.4% |
| Spray drift areas – mortality | Up to 49.7% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 42.4% |
| Spray drift areas – effects to dietary items | Up to 49.7% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 52% |
| Sublethal | NA |
| Indirect - mortality | 52% arthropods |

Risk modifiers:

The Salt Creek tiger beetle occurs in remnant saline wetlands on exposed mudflats and along the banks of streams and seeps that contain salt deposits. Moist, saline, open flats are needed for thermoregulation, reproduction, and foraging. The Salt Creek tiger beetle typically has a 2-year

life cycle of egg, larval, and adult stages (Ratcliffe and Spomer 2002, unpaginated; Allgeier 2005, pp. 3–4). Eggs are laid and after two weeks, upon hatching, each larva excavates a burrow where it lives for the next 2 years; the burrow is enlarged by the larva as it grows. Larvae are sedentary predators, catching prey that passes nearby. Larval tiger beetles ambush prey passing near the burrow entrance. Once it has captured its prey, the larval tiger beetle pulls it into the burrow with the aid of two pairs of hooks on the abdomen. These hooks also function to prevent the larva from being pulled from its burrow by larger prey or predators. Larvae are more directly affected by a limited food supply than adults because they are not as mobile as adults and almost never leave their burrows.

Following pupation, adults emerge from the burrows in the late spring to early summer of their second year and mate. Adult Salt Creek tiger beetles prey on other insects on sandbars, mid-stream gravel areas, and salt flats (USFWS 2015). Adults are mobile predators as they use their mandibles to catch other pray insects and microorganisms. Reproduction takes place in May, June, and July.

The Salt Creek tiger beetle has one of the most restricted ranges of any insect in the United States (Spomer and Higley 1993; Spomer et al. 2004), only occurring along limited segments of Little Salt Creek and adjacent remnant saline wetlands in Lancaster County, Nebraska (USFWS 2016b).

The Salt Creek tiger beetle makes use of mudflats where beetles live, breed, and forage. If pesticide applications are made, it would be in these areas where these beetles would be impacted the most (no name pers. comm. US FWS ATF co-occurrence analysis 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 541,726 | 52.73 | 0 | 0 |
| Corn | D,I | 320,438 | 31.19 | 19,757 | 1.92 |
| Developed | D,I | 55,048 | 5.36 | 2,752 | 0.27 |
| Open Space Developed | D,I | 43,277 | 4.21 | 2,164 | 0.21 |
| Pasture | D,I | 10,602 | 1.03 | 10,574 | 1.03 |
| Wheat | D,I | 3,557 | 0.35 | 3,557 | 0.35 |
| Other Crops | D,I | 1,331 | 0.13 | 0 | 0 |
| Other Grains | D,I | 889 | 0.09 | 889 | 0.09 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Nurseries | D,I | 278 | 0.03 | 278 | 0.03 |
| Vegetables and Ground Fruit | D,I | 65 | <0.01 | 62 | <0.01 |
| Christmas Trees | D,I | 7 | <0.01 | 1 | <0.01 |
| Other Row Crops | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 435,492 | 42.42 | 40,034 | 3.91 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 435,492 | 42.42 | 40,034 | 3.91 |
| TOTAL⁴: | | 977,219 | 95.15 | 40,034 | 3.91 |

acres in species range: 1,027,342 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 624.5 acres, 0.06%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Salt Creek Tiger beetle, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year,

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Salt Creek tiger beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Salt Creek tiger beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 42.4% mortality of individuals, up to 49.7% mortality from spray drift, a loss of about 42.4% of dietary items in use areas, and an additional loss of up to 49.7% of dietary items due to spray drift. In addition, there could be up to 52.0% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the beetle populations.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 3.91% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and timing restrictions for mosquito control applications, will further reduce the risk of exposure to malathion. For example, the Salt Creek tiger beetle is endemic to Lancaster County, Nebraska, where agricultural crops are prevalent. The

conservation measure reducing application number and rate on various crops, including some of those occurring within the species' range, such as corn and pasture, is anticipated to decrease exposure and the resultant mortality of individuals.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Salt Creek tiger beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------|-----------------------|------------|
| <i>Bombus franklini</i> | Franklin's bumble bee | 5066 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Franklin's bumble bee was first described in 1921 and is thought to have the most limited distribution of all known North American bumble bee species (Plowright and Stephen 1980, p. 479; Xerces Society and Thorp, 2010, p. 6), and one of the most limited geographic distributions of any bumble bee in the world (Frison 1923, p. 315; Williams 1998, p.129). Elevations where it has been observed range from 162 m (540 ft) in the northern part of its range, to over 2,340 m (7,800 ft) in the south of its historical range. All confirmed specimens have been found in an area about 306 km (190 mi) to the north and south, and 113 km (70 mi) east to west, between 122° to 124° west longitude and 40° 58' to 43° 30' north latitude in Douglas, Jackson, and Josephine Counties in southern Oregon, and Siskiyou and Trinity Counties in northern California (Thorp 1999, p. 3; Thorp 2005c, p. 1; International Union for Conservation of Nature 2009, p. 1).

Twenty three of the 43 sites where *B. franklini* has been located are privately owned, 18 are on Federal land (U.S. Forest Service and Bureau of Land Management), one site is on State land, and one is on municipal land. *B. franklini* is a primitively eusocial bumble bee, living in colonies made up of a queen and her offspring – males and workers. The nesting biology of *B. franklini* is unknown (Xerces Society and Thorp 2010, p. 10), but they likely nest underground in abandoned rodent burrows or similar cavities that offer resting and sheltering places, food storage, nesting and room for the colony to grow, as is typical for other eusocial *Bombus* species (Plath 1927, pp. 122-128; Hobbs 1968, p. 157; Thorp et al. 1983, p. 1; Thorp 1999, p. 5). It may also occasionally nest on the ground (Thorp et al. 1983, p.1) or in rock piles (Plowright and Stephen 1980, p. 475), and has even been found nesting in a residential garage in the city limits of Medford, Oregon (Thorp 2017, pers. comm.).

EB/CE Source: U.S. Fish and Wildlife Service. 2018. Species Status Assessment for the Franklin's bumble bee (*Bombus franklini*), Version 1. Oregon Fish and Wildlife Office, Portland. 73 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality of Franklin's bumble bee exposed to malathion at maximum use rates is 1% for open space developed and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 3.3% |
| Spray drift areas – mortality | Up to 6.2% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 2% |
| MOSQUITO CONTROL | |
| Direct - mortality | 7% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

No information available at this time.

This species is partially in California, see use and usage information below.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

Usage data for the range based on data from Cal PUR and EPA's SUUM:

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 864,647 | 7.1 | 37 | <0.01 |
| Open space developed | D,I | 157,443 | 1.29 | 7,872 | 0.06 |
| Pasture | D,I | 102,082 | 0.84 | 102,082 | 0.84 |
| Developed | D,I | 84,631 | 0.69 | 4,232 | 0.03 |
| Wheat | D,I | 22,345 | 0.18 | 22,345 | 0.18 |
| Other Crops | D,I | 16,758 | 0.14 | 0 | 0 |
| Other Grains | D,I | 12,420 | 0.10 | 11,659 | 0.1 |
| Orchards and Vineyards | D,I | 4,460 | 0.04 | 276 | <0.01 |
| Vegetables and Ground Fruit | D,I | 3,958 | 0.03 | 3,751 | 0.03 |
| Nurseries | D,I | 293 | <0.01 | 293 | <0.01 |
| Corn | D,I | 214 | <0.01 | 69 | <0.01 |
| Other Row Crops | D,I | 186 | <0.01 | 92 | <0.01 |
| Christmas Trees | D,I | 47 | <0.01 | 42 | <0.01 |
| Rice | D,I | 15 | <0.01 | 15 | <0.01 |
| Cotton | D,I | 5 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 404,859 | 3.37 | 152,728 | 1.27 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 404,859 | 3.37 | 152,728 | 1.27 |
| TOTAL⁴: | | 1,269,506 | 10.47 | 152,765 | 1.28 |

Agricultural usage in California only based on CalPUR data

| Use type | Risk to species ⁵ | Estimated usage in range ⁶ | |
|-----------------------------|------------------------------|---------------------------------------|----------------|
| | | Acres | % |
| Pasture | D,I | 199.3 | 0.00164 |
| Vegetables and Ground Fruit | D,I | 340.2 | 0.00279 |
| Wheat | D,I | 32.7 | 0.00027 |
| Total | | 572.2 | 0.00470 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

⁵ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

⁶ Estimated usage in the range is based on information about annual past usage.

acres in species range: 12,185,254 acres

% of range in California (i.e., where CalPUR data is available): 36%

Range overlap with Federal lands: 7,856,052 acres, 64.5%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Franklin’s bumblebee, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Franklin's bumble bee. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Franklin's bumble bee has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 3.3% mortality of individuals, up to 6.2% mortality from spray drift. In addition, there could be up to 7.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.28% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps with only a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, Franklin's bumblebee is endemic to southern Oregon and far northern California, where land in pasture is prevalent. The conservation measure reducing application number and rate on various crops, including pasture, is anticipated to decrease exposure and the resultant mortality of individuals.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Franklin's bumble bee in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------|--------------------------------------|------------|
| <i>Strymon acis bartrami</i> | Bartram's scrub-hairstreak butterfly | 5067 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Populations of Bartram's scrub-hairstreak have become increasingly localized as pine rockland habitat has been lost or altered through anthropogenic activity (Lenczewski 1980, p. 43; Baggett 1982, p. 78; Hennessey and Habeck 1991, p. 4; Schwarz et al. 1996, p. 59; Salvato and Hennessey 2003, p. 243; Salvato and Hennessey 2004, p. 223; Salvato and Salvato 2010a, p. 91; 2010b, p. 154). Destruction of pine rocklands for economic development has reduced this habitat in Miami-Dade County, including Everglades National Park (ENP), to about 11% of its natural extent, from approximately 74,000 ha (183,000 ac) to only 8,140 ha (20,100 ac) in 1996 (Kernan and Bradley 1996, p. 2). Outside of ENP, only about 1% of the Miami Rock Ridge pinelands have escaped clearing, and much of what is left is in small remnant fragments isolated from other natural areas (Herndon 1998, p. 1).

Habitat loss, fragmentation, degradation, and associated pressures from increased human population are major threats; these threats are expected to continue, placing these butterflies at greater risk. Although efforts are being made to conserve natural areas and apply prescribed burns, the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the future. Based on our analysis of the best available information, there is no evidence to suggest that vulnerability to collection and risks associated with scientific or conservation efforts will change and, instead, are likely to continue into the future. At this time, we consider predation, parasitism, and disease to be threats to this species due to its current tenuous status. We have no information to suggest that vulnerability to these threats will change in the future. We find that existing regulatory mechanisms, due to their inherent limitations and constraints, are inadequate to address threats to this species throughout its range. We have no information to indicate that poaching, inconsistent fires, pesticide use, or habitat loss will be ameliorated in the future by enforcement of existing regulatory mechanisms. Therefore, we find it reasonably likely that the effects on the Bartram's scrub-hairstreak will continue at current levels or potentially increase in the future. Effects of small population size, isolation, and loss of genetic diversity are likely significant threats as well as natural changes to habitat and anthropogenic factors (e.g., pesticides, fire, processes affected by climate change). Collectively,

these threats have impacted the butterflies in the past, are impacting this species now, and will continue to impact this species in the future.

Efforts to control salt marsh mosquitoes (*Aedes taeniorhynchus*) among others, have increased as human activity and population have increased in south Florida. To control mosquito populations, second-generation organophosphate (naled) and pyrethroid (permethrin) adulticides are applied using both aerial and ground-based methods by mosquito control districts throughout south Florida. The use of such pesticides to control mosquitoes presents a potential risk to nontarget species, including the Bartram's scrub-hairstreak. The Long Pine Key region of ENP is not treated with pesticides for mosquito control. Outside of the ENP, occupied butterfly habitat within Miami-Dade County remains vulnerable to the effects of adulticide applications.

However, use of mosquito control pesticides within Miami-Dade County pine rockland habitat areas is limited. On Big Pine Key, Salvato (2001) and Hennessey et al. (1992) suggested declines in populations of the Bartram's scrub-hairstreak were partly attributable to mosquito control chemical applications. Specifically, Salvato (2001) noted that butterflies, such as the Bartram's scrub hairstreak, were particularly vulnerable to truck applications based on their tendency to roost within low-lying vegetation (including along roadsides), an area with maximal exposure to ground-based treatments. Miami-Dade County and the Florida Key Mosquito Control District coordinate annually with the Service in order avoid or minimize any impacts to pine rockland and butterfly habitat. In addition, extensive no spray and buffer zones have been established around Bartram's scrub hairstreak critical habitat both on Big Pine Key and throughout Miami-Dade County.

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Endangered Status for the Florida Leafwing and Bartram's Scrub-Hairstreak Butterflies. Federal Register 79(155):47222-47244.

U.S. Fish and Wildlife Service. October 2015. Status of the Species – Bartram's scrub-hairstreak butterfly. Available at:

https://www.fws.gov/verobeach/StatusoftheSpecies/20151006_SOS_BartramsScrubHairstreak.pdf

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Bartram's scrub-hairstreak butterfly exposed to malathion at maximum use rates is 1-8% for other crops, orchards

and vineyards, open space developed, other grains, and developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 18.8% |
| Spray drift areas – mortality | Up to 12.7% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 13% |
| MOSQUITO CONTROL | |
| Direct - mortality | 49.9% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Bartram's scrub-hairstreak butterfly reproduction and larval development occur entirely within the pine rocklands, and the species is multivoltine, with an entire life cycle of about 2-3 months. Continuous broods are maintained. Females lay the eggs singly on both the lower and upper surface of the host plant. Therefore, the Bartram's scrub-hairstreak butterfly is vulnerable to the effects of malathion throughout its entire lifecycle.

Because of their use of the croton and their choice of roosting sites, the former Bartram's scrub-hairstreak population on Big Pine Key may have been deleteriously impacted by exposure to seasonal pesticide applications designed to control mosquitoes. The potential for mosquito control chemicals to drift into non-target areas on the island and to persist for varying periods of time has been well documented (Hennessey and Habeck 1989, pp. 1–22; 1991, pp. 1–68; Hennessey et al. 1992, pp. 715–721; Pierce 2009, pp. 1–17). If exposed, studies have indicated that both immature and adult butterflies could be affected (Zhong et al. 2010, pp. 1961–1972; Bargar 2012, pp. 1–7). Truck-applied pesticides were found to drift considerable distances from target areas with residues that persisted for weeks on the host plant (Pierce 2009, pp. 1–17), possibly threatening larvae. Salvato (2001, p. 13) suggested that adult Bartram's scrub-hairstreak were particularly vulnerable to aerial applications based on their tendency to roost within the pineland canopy, an area with maximal exposure to such treatments.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 3,887,883 | 49.88 | 97,243 | 2.5 |
| Developed | D,I | 617,139 | 7.92 | 30,857 | 0.40 |
| Other Grains | D,I | 372,467 | 4.78 | 18,255 | 0.23 |
| Open Space Developed | D,I | 280,514 | 3.60 | 14,026 | 0.18 |
| Orchards and Vineyards | D,I | 83,687 | 1.07 | 63,968 | 0.82 |
| Other Crops | D,I | 80,175 | 1.03 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 13,846 | 0.18 | 1,785 | 0.02 |
| Rice | D,I | 12,455 | 0.16 | 411 | <0.01 |
| Nurseries | D,I | 4,074 | 0.05 | 4,074 | 0.05 |
| Corn | D,I | 1,227 | 0.02 | 36 | <0.01 |
| Other Row Crops | D,I | 21 | <0.01 | 21 | <0.01 |
| Pasture | D,I | 8 | <0.01 | 8 | <0.01 |
| Christmas Trees | D,I | <1 | <0.01 | <1 | <0.01 |
| Cotton | D,I | <1 | <0.01 | 0 | 0 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 1,465,614 | 18.85 | 133,421 | 1.75 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 1,465,614 | 18.85 | 133,421 | 1.75 |
| TOTAL⁴: | | 5,353,497 | 68.73 | 230,664 | 4.25 |

acres in species range: 7,794,473 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 2,577,175 acres, 33.1%

Overall Usage: ☐ High ☐ Medium ☒ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Bartram’s hairstreak Butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Bartram’s hairstreak Butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Reduced citrus application rate: The reduction in the maximum application rate for citrus is expected to reduce potential environmental concentrations to one-third of modeled values, reducing the effects to species, prey, host fish, and pollinators on and adjacent to these use areas.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Bartram’s scrub-hairstreak Butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure

to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Bartram's scrub-hairstreak Butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 18.8% mortality of individuals, up to 12.7% mortality from spray drift. In addition, there could be up to 49.9% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 4.25% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the species range. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use and mosquito adulticide, will further reduce the risk of exposure to malathion. For example, the Bartram's scrub-hairstreak butterfly may occur in areas where mosquito treatment with malathion is anticipated to occur. The conservation measure described above will prohibit malathion use for mosquito control during most daylight hours, when this butterfly is most active. This is anticipated to further limit the exposure and resultant mortality of this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Bartram's scrub-hairstreak Butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------------------|-------------------------|------------|
| <i>Euchloe ausonides insulanus</i> | Island Marble Butterfly | 5610 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Historically, the island marble butterfly has always been rare (Guppy and Shepard 2001, p. 161) and was only known from Vancouver Island and the Canadian Gulf Islands, which are part of the same geologic formation as the San Juan Archipelago. It is now considered extirpated from Canada (last known specimen collected in 1908). Reasons for the disappearance are unknown, but hypotheses include increased parasitoid loads associated with the introduction of the cabbage white butterfly or heavy grazing of natural meadows by cattle and sheep, which severely depressed the butterfly's presumed larval food plant. The butterfly was discovered on San Juan Island, Washington, in 1998 by John Fleckenstein, a biologist with the Natural Heritage Program of the Washington Department of Natural Resources (WDNR); that discovery was published in 2001 by Guppy and Shepard (p. 160). There were five identified populations of island marble butterfly, and the number and distribution of populations declined since 2006. Currently, the species is only observed in one location at San Juan Island National Historic Park (American Camp). In 2006, abundance was estimated “probably less than 500 butterflies, possibly as low as 300 individuals” with uncertain accuracy.

Primary threats include habitat loss and degradation from plant succession and invasion by plants that displace larval host plants; browsing by black-tailed deer (*Odocoileus hemionus*), European rabbits (*Oryctolagus cuniculus*), and brown garden snails (*Cornu aspersum*); storm surges; direct predation by spiders and wasps, and incidental predation by black-tailed deer; and vulnerabilities associated with small population size and environmental and demographic stochasticity, and other chance events that increase mortality or reduce reproductive success. Threats have affected the island marble butterfly throughout the entirety of its range, are ongoing, and are likely to persist into the foreseeable future. Other causes of habitat loss for the island marble butterfly that have likely resulted in the extirpation of the island marble butterfly from much of its former range include: (1) development; (2) road maintenance activities; (3) agricultural practices; and (4) herbivory by black-tailed deer and livestock. When considered individually and

cumulatively, these threats are of a high magnitude. Despite existing regulatory mechanisms and other conservation efforts, the threats to the subspecies remain sufficient to put the subspecies in danger of extinction or likely to become so in the foreseeable future.

Each year since 2013, the National Park Service has collected and reared a small number of eggs and larvae in a captive-rearing Program. In 2015, the captive individuals emerged from diapause much later than the wild population. Despite the use of the experimental plots for oviposition by these late-flying, captive-reared females, none of the eggs and larvae tracked in the experimental plots survived. The high mortality was attributed to increased predation pressure by late-season spiders and wasps (Lambert 2015d, p. 14). Results of captive-rearing were better in 2016, when captive-reared island marble butterflies emerged in synchrony with the wild population.

Survivorship from egg to fifth instar larvae was also higher in the experimental plots in 2016; three percent of the tracked larvae survived to the fifth instar, which is a relatively high survival rate for the island marble butterfly. After recovery efforts and captive-rearing between 2013-2018, over 500 captive-raised butterflies have been released to supplement the extant population at American Camp. Despite considerable advances in habitat restoration, new habitat establishment, captive rearing, herbivore exclusion, and outreach and education, the number of individual island marble butterflies remains small in the single remaining population.

EB/CE Sources: U.S. Fish and Wildlife Service. 2020. Recovery Outline Island Marble Butterfly. Washington Fish and Wildlife Office, Lacey. 10 pp.

U.S. Fish and Wildlife Service. 2006. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Island Marble Butterfly (*Euchloe ausonides insulanus*) as Threatened or Endangered. Federal Register 71(219):66292-66298.

U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; 12-Month Findings on Petitions To List Island Marble Butterfly, San Bernardino Flying Squirrel, Spotless Crake, and Sprague's Pipit as Endangered or Threatened Species. Federal Register 81(65):19527-19542.

U.S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; Endangered Status for the Island Marble Butterfly and Designation of Critical Habitat. Federal Register 85(87):26786-26820.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for island large marble butterflies exposed to malathion at maximum use rates is ~1% each for open space developed and developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 3% |
| Spray drift areas – mortality | Up to 9% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 3% |
| MOSQUITO CONTROL | |
| Direct - mortality | NA |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The island marble butterfly is a highly endemic species that lives its entire lifecycle within upland grasslands, sand dunes, or coastal lagoon habitat. The flight season for this butterfly is remarkably long, from sometime in April into June in many or even all years in the San Juan Islands, Washington, while individuals rarely live more than two weeks (average about nine days) (NatureServe 2015). Larvae have five instar stages before over-wintering as pupae. The island marble butterfly is univoltine, meaning just one brood is produced each year. Eggs may be observed for a week beyond when adults are observed, and larvae have been observed into mid-July. Because the height of feeding and reproductive activities for this butterfly occur essentially from April through July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

The island marble butterfly is found at American Camp, San Juan Island National Historic Park, Washington. The National Park Service (NPS) is the caretaker for the largest parcel (600 ac) of suitable habitat and the largest population of island marble butterflies in this area. In 2006, the NPS developed a Conservation Agreement for the island marble butterfly and this document provides guidance for conserving the island marble butterfly on lands administered by the NPS, and specifically for implementation of grassland restoration activities at American Camp.

Overall, patch occupancy surveys have clearly demonstrated a decline in the number of sites occupied by the island marble, the number of island marble adults, larvae, and eggs observed,

and the number of suitable island marble of habitat patches. In 2011, ~46 adults, four larvae, and one egg were observed.

Overall Risk: ☐ High ☒ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | * | 0 | 0 | 0 | 0 |
| Developed | D,I | 6,341 | 1.60 | 317 | 0.08 |
| Open Space Developed | D,I | 5,421 | 1.36 | 271 | 0.07 |
| Other crops | D,I | 288 | 0.07 | 0 | 0 |
| Other grains | D,I | 115 | 0.03 | 115 | 0.03 |
| Vegetables and Ground Fruit | D,I | 23 | <0.01 | 23 | <0.01 |
| Corn | D,I | 18 | <0.01 | 0 | 0 |
| Pasture | D,I | 13 | <0.01 | 12 | <0.01 |
| Nurseries | D,I | 11 | <0.01 | 11 | <0.01 |
| Orchards and Vineyards | D,I | 10 | <0.01 | 10 | <0.01 |
| Christmas Trees | D,I | 3 | <0.01 | 1 | <0.01 |
| Wheat | D,I | <1 | <0.01 | 1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 12,243 | 3.13 | 761 | 0.20 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 12,243 | 3.13 | 761 | 0.20 |
| TOTAL⁴: | | 12,243 | 3.13 | 761 | 0.20 |

acres in species range: 397,449 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 2,324 acres, 0.58%

Overall Usage: ☐ High ☐ Medium ☒ Low

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the island marble butterfly. As discussed below, even though the vulnerability is high and risk is medium for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measure described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The island marble butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is medium. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 3.0% mortality of individuals, up to 9.0% mortality from spray drift. We do not anticipate mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where a large proportion of individuals of the population is lost, the area of suitable habitat will not be recolonized.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.20% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar

levels of usage in the future. Even though the vulnerability is high and risk is medium for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and plants used for feeding and nectaring may be affected in localized areas over the duration of the action. Additionally, the conservation measures described above, including new restrictions for residential use, will further reduce the risk of exposure to malathion. For example, the island marble butterfly exists in the San Juan Islands in Washington. While these islands are not highly developed, the butterfly on occasion can be in proximity to residential and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Though agricultural practices may threaten this species, pesticides specifically are not a known threat. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the island marble butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------------------|--|------------|
| <i>Euphydryas editha taylori</i> | Taylor's (=whulge) Checkerspot Butterfly | 7495 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The distribution of the Taylor's checkerspot butterfly has been reduced from more than 80 populations to the 14 occupied locations with small populations that are known rangewide today. Some of the populations that have been extirpated disappeared in the past decade, and some declined from robust population sizes of 1,000s of individual butterflies to zero within a 3-year interval and have not returned (Stinson 2005, p. 94). In the south Puget prairies, only one native local population remains, while others are the result of reintroduction efforts. Most remaining populations of Taylor's checkerspot butterflies are small; 5 of the 14 known populations are estimated to have fewer than 100 individuals.

The threats of land development and loss of habitat from conversion to other uses (agriculture); the impacts of military training and recreation; existing and likely future habitat fragmentation, habitat disturbance; long-term fire suppression; and ongoing loss and degradation of habitat associated with native and non-native invasive species continue. These factors have resulted in the present isolation and limited distribution of the subspecies, and are currently ongoing and will continue into the foreseeable future. The combination of ongoing threats coupled with small population sizes and highly variable population dynamics leads us to conclude that the Taylor's checkerspot butterfly is currently in danger of extinction throughout its range.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Taylor's Checkerspot Butterfly and Threatened Status for the Streaked Horned Lark. Federal Register 78(192):61452-61503.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Taylor's checkerspot butterflies exposed to malathion at maximum use rates is 5% for open space developed and 7% for developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 13.2% |
| Spray drift areas – mortality | Up to 38.4% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 13% |
| MOSQUITO CONTROL | |
| Direct - mortality | 1.5% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Taylor's checkerspot butterfly flight period begins in late April and extends into early July. In Oregon, the flight season may last for up to 45 days. Eggs hatch after 13 to 15 days (Murphy et al 2004, p. 25) and then live colonially in a loose silk web during early development. Larvae then enter diapause during mid- to late summer and overwinter in this state until the following late winter or early spring (late February or March). Because the height of feeding and reproductive activities for this butterfly occur essentially from April through July, it may be more vulnerable to the effects of malathion during the larval and adult stages if applications are made at this time.

Taylor's checkerspot lives on and immediately adjacent to Forest Service Roads, roads on private lands, and roads on a Department of Defense installation. This species also inhabits a powerline corridor in Oregon. Therefore, this species uses "right of ways" for all life history functions (no name per.comm USFWS ATF Co-occurrence analysis 2016).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 3,058 | 1.47 | 0 | 0 |
| Open space developed | D,I | 14,055 | 6.78 | 703 | 0.34 |
| Developed | D,I | 11,259 | 5.43 | 563 | 0.27 |
| Christmas trees | D,I | 649 | 0.31 | 541 | 0.26 |
| Other Crops | D,I | 486 | 0.23 | 0 | 0 |
| Corn | D,I | 250 | 0.12 | 250 | 0.12 |
| Orchards and Vineyards | D,I | 238 | 0.11 | 238 | 0.11 |
| Vegetables and Ground Fruit | D,I | 198 | 0.10 | 198 | 0.10 |
| Other Grains | D,I | 196 | 0.09 | 143 | 0.07 |
| Pasture | D,I | 110 | 0.05 | 57 | 0.03 |
| Nurseries | D,I | 71 | 0.03 | 71 | 0.03 |
| Wheat | D,I | 50 | 0.02 | 50 | 0.02 |
| Other Row Crops | D,I | 2 | <0.01 | 2 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 27,566 | 13.28 | 2,816 | 1.35 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 27,566 | 13.28 | 2,816 | 1.35 |
| TOTAL⁴: | | 30,624 | 14.75 | 2,816 | 1.35 |

acres in species range: 207,417 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 16,760 acres, 8.08%

Overall Usage: ☐ High ☐ Medium ☒ Low

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Taylor's (=whulge) Checkerspot, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Taylor's (=whulge) Checkerspot Butterfly. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Taylor's (=whulge) Checkerspot Butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 13.2% mortality of individuals, up to 38.4% mortality from spray drift. In addition, there could be up to 1.5% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where

exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to isolated and fragmented nature of the butterfly populations and the limited flight capability of this species.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.35% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use and timing restrictions for mosquito control, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Taylor's (=whulge) Checkerspot Butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|----------------------------------|----------------------------|------------|
| <i>Anaea troglodyta floralis</i> | Florida leafwing butterfly | 8083 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Population size/location(s) unknown

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Populations of Florida leafwing have become increasingly localized as pine rockland habitat has been lost or altered through anthropogenic activity (Lenczewski 1980, p. 43; Baggett 1982, p. 78; Hennessey and Habeck 1991, p. 4; Schwarz et al. 1996, p. 59; Salvato and Hennessey 2003, p. 243; Salvato and Hennessey 2004, p. 223; Salvato and Salvato 2010a, p. 91; 2010b, p. 154). Destruction of pine rocklands for economic development has reduced this habitat in Miami-Dade County, including Everglades National Park (ENP), to about 11% of its natural extent, from approximately 74,000 ha (183,000 ac) to only 8,140 ha (20,100 ac) in 1996 (Kernan and Bradley 1996, p. 2). Outside of ENP, only about 1% of the Miami Rock Ridge pinelands have escaped clearing, and much of what is left is in small remnant fragments isolated from other natural areas (Herndon 1998, p. 1).

Habitat loss, fragmentation, degradation, and associated pressures from increased human population are major threats; these threats are expected to continue, placing these butterflies at greater risk. Although efforts are being made to conserve natural areas and apply prescribed burns, the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the future. Based on our analysis of the best available information, there is no evidence to suggest that vulnerability to collection and risks associated with scientific or conservation efforts will change and, instead, are likely to continue into the future. At this time, we consider predation, parasitism, and disease to be threats to this species due to its current tenuous status. We have no information to suggest that vulnerability to these threats will change in the future. We find that existing regulatory mechanisms, due to their inherent limitations and constraints, are inadequate to address threats to these butterflies throughout their ranges. We have no information to indicate that poaching, inconsistent fires, pesticide use, or habitat loss will be ameliorated in the future by enforcement of existing regulatory mechanisms. Therefore, we find it reasonably likely that the effects on the Florida leafwing will continue at levels consistent with the 2014 5-year review or potentially increase in the future. Effects of small population size, isolation, and loss of genetic diversity are likely significant threats as well as natural changes to habitat and anthropogenic factors (e.g., pesticides, fire, processes affected by

climate change). Collectively, these threats have impacted the butterflies in the past, are impacting these butterflies now, and will continue to impact these butterflies in the future.

The Florida leafwing butterfly is currently known to occur only within the Long Pine Key area within ENP (Miami-Dade County). Populations on Big Pine Key, in the lower Florida Keys (Monroe County), as well as the Navy Wells Pineland Preserve and the various parcels that compose the Richmond Pine Rocklands in Miami-Dade County are no longer extant (Salvato and Salvato 2010a). The extant population within the Everglades remains threatened by inconsistent fire management of pine rockland habitat, small population size, and illegal poaching.

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Endangered Status for the Florida Leafwing and Bartram's Scrub-Hairstreak Butterflies. Federal Register 79(155):47222-47244.

U.S. Fish and Wildlife Service. 2015. Biological Opinion on Everglades National Park Fire Management Plan; Service CPA Code: 04EF2000- 2013-CPA-0083; Service Consultation Code: 04EF2000-20 1 3-F-0294. Available at:
https://www.fws.gov/verobeach/SFESO/images/biologicalopinion/20150630_letter_Service%20to%20ENP_BO%20ENP%20FMP%202013%20CPA%200083.pdf

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Florida leafwing butterflies exposed to malathion at maximum use rates is 1-8% for other crops, orchards and vineyards, open space developed, other grains, and developed, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 19% |
| Spray drift areas – mortality | Up to 14% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |

| | |
|--|-----|
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 13% |
| MOSQUITO CONTROL | |
| Direct - mortality | 52% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

The Florida leafwing butterfly reproduction and larval development occur entirely within the pine rocklands, and the species is multivoltine, with an entire life cycle of about 2-3 months. Continuous broods are maintained. Females lay the eggs singly on both the lower and upper surface of the host plant. Therefore, the Florida leafwing butterfly is vulnerable to the effects of malathion throughout its entire lifecycle.

Because of their use of the croton and their choice of roosting sites, the former Florida leafwing population on Big Pine Key may have been deleteriously impacted by exposure to seasonal pesticide applications designed to control mosquitoes. The potential for mosquito control chemicals to drift into non-target areas on the island and to persist for varying periods of time has been well documented (Hennessey and Habeck 1989, pp. 1–22; 1991, pp. 1–68; Hennessey et al. 1992, pp. 715–721; Pierce 2009, pp. 1–17). If exposed, studies have indicated that both immature and adult butterflies could be affected (Zhong et al. 2010, pp. 1961–1972; Bargar 2012, pp. 1–7). Truck applied pesticides were found to drift considerable distances from target areas with residues that persisted for weeks on the host plant (Pierce 2009, pp. 1–17), possibly threatening larvae. Salvato (2001, p. 13) suggested that adult Florida leafwings were particularly vulnerable to aerial applications based on their tendency to roost within the pineland canopy, an area with maximal exposure to such treatments. Therefore, based on the information above, we identify pine rocklands, and associated rockland hammock and hydric pine flatwood communities with pineland croton for larval development and ample roosting sites for adults and limited or restricted pesticide application, to be a PBF for this subspecies.

Pesticide spraying practices by the Mosquito Control District at National Key Deer Refuge have changed to reduce pesticide use over the years. No spray zones that include the core habitat used by pine rockland butterflies and several linear miles of pine rockland habitat within the Refuge-neighborhood interface were excluded from truck spray applications (Anderson 2012, pers. comm.; Service 2012, p. 32). These exclusions and buffer zones encompass over 95% of extant croton distribution on Big Pine Key and include the majority of known and historical Florida leafwing population centers on the island (Salvato 2012, pers. comm.).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|----------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | *Due to no spray zone, see above | 4,320,381 | 52.2 | 852,936 | 10.31 |
| Developed | D,I | 646,845 | 7.82 | 32,342 | 0.39 |
| Other grains | D,I | 386,025 | 4.66 | 18,255 | 0.22 |
| Open space developed | D,I | 313,009 | 3.78 | 15,650 | 0.19 |
| Orchards and Vineyards | D,I | 108,308 | 1.31 | 93,337 | 1.13 |
| Other Crops | D,I | 92,255 | 1.11 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 15,021 | 0.18 | 1,785 | 0.02 |
| Rice | D,I | 12,478 | 0.15 | 411 | <0.01 |
| Nurseries | D,I | 4,224 | 0.05 | 4,224 | 0.05 |
| Corn | D,I | 1,304 | 0.02 | 36 | <0.01 |
| Pasture | D,I | 56 | <0.01 | 15 | <0.01 |
| Other Row Crops | D,I | 22 | <0.01 | 22 | <0.01 |
| Cotton | D,I | <1 | <0.01 | 0 | 0 |
| Christmas Trees | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 1,579,546 | 19.12 | 166,077 | 2.01 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 1,579,546 | 19.12 | 166,077 | 2.01 |
| TOTAL⁴: | | 1,579,546 | 19.12 | 166,077 | 2.01 |

acres in species range: 8,276,413 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 2,578,211 acres, 31.15%

Overall Usage: ☒ High ☐ Medium ☐ Low¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Florida leafwing Butterfly, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Florida leafwing Butterfly, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

Reduced citrus application rate: The reduction in the maximum application rate for citrus is expected to reduce potential environmental concentrations to one-third of modeled values, reducing the effects to species, prey, host fish, and pollinators on and adjacent to these use areas.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Florida leafwing butterfly. As discussed below, even though the vulnerability, risk, and past malathion usage are high for this species, the likelihood

of exposure to malathion is low because the only extant population is on federal lands (Everglades National Park, ENP). We do not expect species-level effects to occur.

The Florida leafwing butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is high based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portions of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 19.0% mortality of individuals, up to 14.0% mortality from spray drift. In addition, there could be up to 52.0% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 2.01% of the non-Federal portion of the species range annually based on standard past usage data. Where exposure occurs and all individuals of the population are lost, or a large proportion of the population is lost, in any given year or due to incremental losses over time, the area of suitable habitat will not be recolonized.

However, the only extant population of Florida leafwing butterflies occurs in Everglades National Park, where malathion is not used. We anticipate usage within ENP will be low, based primarily on the malathion usage data we acquired indicating that past malathion usage has occurred on public lands for a variety of uses, but usage has been minimal (see Usage section of Opinion) on Federal lands, with only localized applications occurring on a rare basis. Additionally, the conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion for any individuals that may occur outside of the national park. For example, the Florida leafwing butterfly may occur in areas where mosquito treatment with malathion is anticipated to occur. The conservation measure described above will prohibit malathion use for mosquito control during most daylight hours, when this butterfly is most active. This is anticipated to further limit the exposure and resultant mortality of this species.

We expect any adverse effects to listed resources to be minimal, considering the small scale and low levels of past usage and in light of Federal agency programs that are designed to understand, avoid, and minimize the effects to listed species. We anticipate this level of malathion usage will not result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Florida leafwing butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|------------------------|---------------------|------------|
| <i>Dinacoma caseyi</i> | Casey's June beetle | 8503 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Casey's June beetle has a limited distribution, an extremely limited ability to disperse, and a limited number of unoccupied habitats suitable for reintroduction and management. Expanding, and perhaps even maintaining, the current species' range will require moving females into unoccupied habitat or augmenting declining areas.

The threats posed by habitat loss and modification are the greatest impediments to recovery. Development of formerly occupied habitats, impacts to occupied habitat from adjacent developed areas, human activities and natural events (such as flood or drought) with potential to cause adult mortality are threats of moderate but imminent magnitude throughout the majority of the species' limited range. Smoke Tree Ranch affords protection from existing threats to approximately 126.8 ac (51.3 ha) where there is a conservation easement and ongoing compliance monitoring. Additional protection of occupied and undeveloped formerly occupied habitats is necessary for recovery.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Recovery Outline for Casey's June Beetle. Carlsbad Fish and Wildlife Office, California. 21 pp.

Overall Vulnerability: ☒ **High** ☐ **Medium** ☐ **Low**

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Casey's June beetle exposed to malathion at maximum use rates is 4% for open space developed and 18% for

developed. All other use sites are <1%. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 23% |
| Spray drift areas – mortality | Up to 8.7% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 23% |
| MOSQUITO CONTROL | |
| Direct - mortality | 45.1% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Both male and female Casey's June beetles emerge from underground burrows between late March and early June, with abundance peaks generally occurring in April and May. Females are flightless, emerging only briefly at dusk to mate and then re-entering the ground, presumably to deposit eggs. Males flying in the area are attracted to females by pheromones sometimes even prior to complete emergence of the female. The larval life-stage of Casey's June beetle has not been well-studied. We believe that the larval cycle for the species is likely one year, based on the absence of larvae (grubs) in burrows during the adult flight season.

Casey's June beetle is known to reproduce, forage, and travel through agricultural areas, developed areas (road medians in particular in right of ways), and golf courses (Chris Gregory pers. comm. 2016 co-occurrence information, USFWS field office request). Males may be more likely to be exposed traveling through areas as females are flightless but both are susceptible if applications are made between March and June.

Casey's June beetle is found on the Reservation for the Agua Caliente Band of Cahuilla Indians.

Casey's June beetle larvae, like other June beetle species, are assumed to feed on organic matter or detritus, and associated decaying organisms, below ground (76 FR 58954). It is assumed that Casey's June beetle larvae do not require any particular species of host plants for feeding. However, native plant species are likely an important habitat component because native plant species are an integral component of the ecosystem in which Casey's June beetle evolved (76 FR 58954). In addition, areas with higher soil moisture are associated with higher densities of vegetation and microorganisms, such as fungi and bacteria, believed to provide a more diverse

food source for beetle larvae (74 FR 32857). Adult Casey's June beetles have not been observed feeding and have not been associated with any particular species or type of plant (76 FR 58954), therefore it is uncertain as to what food sources upon which they rely.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

No CalPUR usage data are listed here; the only reported usage was for developed/open space developed

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 8,966 | 45.19 | NA | NA |
| Developed | D,I | 3,639 | 18.34 | 182 | 0.92 |
| Open Space Developed | D,I | 964 | 4.86 | 48 | 0.24 |
| Other Crops | D,I | 2 | <0.01 | 0 | 0 |
| Orchards and Vineyards | D,I | 1 | <0.01 | 1 | <0.01 |
| Vegetables and Ground Fruit | D,I | 1 | <0.01 | 1 | <0.01 |
| Wheat | D,I | <1 | <0.01 | 0 | 0 |
| Pasture | D,I | <1 | <0.01 | <1 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 4,606.96 | 23.25 | 232 | 1.17 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 4,606.96 | 23.25 | 232 | 1.17 |
| TOTAL⁴: | | 13,573.21 | 68.44 | 232 | 1.17 |

acres in species range: 19,842 acres

% of range in California (i.e., where CalPUR data is available): 100%

Range overlap with Federal lands: 11,177 acres, 56.3%

Overall Usage: ☐ High ☐ Medium ☒ Low

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Casey’s June Beetle, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Casey's June beetle. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. Therefore, we do not expect species-level effects to occur.

The Casey's June beetle has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on CalPUR usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 23.0% mortality of individuals, up to 8.7% mortality from spray drift. In addition, there could be up to 41.5% mortality of individuals from malathion use in mosquito control efforts. Use sites where

the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. Where exposure occurs and all individuals of the population are lost, or a large proportion of the population is lost, in any given year or due to incremental losses over time, the area of suitable habitat will not be recolonized.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 1.17% of the non-Federal portion of the species range annually based on CalPUR past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, where the species occurs near residential and other developed areas, limiting residential uses of malathion to two applications per year (reduced from as many as necessary), to spot treatments only, reduces the application footprint and likelihood of exposure to this species.

We anticipate a loss of individuals may occur if malathion is used within the range of the species, and plants that are a necessary habitat component may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Casey's June beetle in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|---|---------------------------------|------------|
| <i>Icaricia (Plebejus) shasta charlestonensis</i> | Mount Charleston blue butterfly | 9001 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Single population

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Based on current and historical occurrences or locations (Austin 1980, pp. 20–24; Weiss et al. 1997, Map 3.1; Boyd and Murphy 2008, p. 4; Pinyon 2011, Figure 9–11; Thompson et al. 2012, pp. 75–85), the geographic range of the Mount Charleston blue butterfly is in the upper elevations of the Spring Mountains, centered on lands managed by the Forest Service in the Spring Mountains National Recreation Area (SMNRA) of the Humboldt-Toiyabe National Forest within Upper Kyle and Lee Canyons, Clark County, Nevada. The majority of the occurrences or locations are along the upper ridges in the Mount Charleston Wilderness and in the Upper Lee Canyon area, while a few are in Upper Kyle Canyon. The number of locations where the Mount Charleston blue butterfly has been observed during surveys has decreased in the last 20 years, and the number of Mount Charleston blue butterfly observations at one historically important site (i.e., Las Vegas Ski and Snowboard Resort) has also declined. While detection probabilities “may vary with environmental variables, such as weather conditions; different observers; or local habitats” (MacKenzie and Kendall 2002, p. 2388), the decrease in observations is most likely attributable to decreases in distribution and numbers of Mount Charleston blue butterflies. Year-to-year fluctuations in population numbers can also occur due to variations in precipitation and temperature, which affect both the Mount Charleston blue butterfly and its larval host plant (Weiss et al. 1997, pp. 2–3 and 31–32). However, the failure to detect Mount Charleston blue butterflies at many of the known historical locations during the past 20 years, especially in light of increased survey efforts since 2006, indicates a reduction in the butterfly’s distribution and a likely decrease in total population size. Estimates of population size for the Mount Charleston blue butterfly are not available. At the majority of the presumed occupied locations, the Mount Charleston blue butterfly has not been observed since the mid- to late-1990s. This subspecies has a limited distribution within 267.1 ac (108.1 ha) of habitat at only three known occupied locations, and based on numbers of observations made at these locations in a single season, the populations are likely small.

Threats facing the Mount Charleston blue butterfly increase the risk of extinction of the subspecies, given its few occurrences in a small area. The loss and degradation of habitat due to changes in natural fire regimes and succession; the implementation of recreational development projects and fuels reduction projects; and the increases in non-native plants will increase the inherent risk of extinction of the remaining few occurrences of the Mount Charleston blue butterfly. The threat to the Mount Charleston blue butterfly from collection is expected to be reduced by the Forest Service's closure order on collection. However, due to the small number of discrete populations, overall small metapopulation size, close proximity to roads and trails, and restricted range, we have determined that unpermitted and unlawful collection is a threat to the subspecies and may continue to be in the future. Other existing regulatory mechanisms have not provided effective protection to the Mount Charleston blue butterfly and its habitat. These threats are likely to be exacerbated by the impact of climate change, which is anticipated to increase drought and extreme precipitation events.

EB/CE Source: U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for Mount Charleston Blue Butterfly; Final Rule. Federal Register 78(182):57750-57775.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to the species from labeled uses across the range: The species range is wholly on Federal lands. While we cannot rule out adverse effects to the species, we anticipate any effects that may occur will be minimal and highly localized on small sites.

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

(Anticipated usage within the range based on past usage data)

Based on Federal usage data, malathion usage has been minimal.

acres in species range: 5,574 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 5,574 acres, 100%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Mount Charleston blue butterfly. As discussed below, even though the vulnerability is high for this species, the risk is low, and the likelihood of exposure to malathion is low because the species range is wholly on Federal lands. We do not expect species-level effects to occur.

The Mount Charleston blue butterfly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is anticipated to be low, as described above. We anticipate usage within the range will be low, based primarily on the malathion usage data we acquired indicating that past malathion usage has occurred on public lands for a variety of uses, but usage has been minimal (see Usage section of Opinion) on Federal lands, with only localized applications occurring on a rare basis. We expect any adverse effects to listed resources to be minimal, considering the small scale and low levels of past usage and in light of Federal agency programs that are designed to understand, avoid, and minimize the effects to listed species.

Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Mount Charleston blue butterfly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------|--------------------------|------------|
| <i>Zapada glacier</i> | Western glacier stonefly | 10123 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Threatened

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (numerous)

Species Trends: Unknown population trends

Pesticides noted ☐

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

The western glacier stonefly was originally described in 1971 from adult specimens collected from five locations in Glacier National Park (Baumann and Gaufin 1971, p. 277). The western glacier stoneflies are small insects that begin life in aquatic environments, then emerge from the water as short-lived adults on nearby vegetation. They are found in high-elevation, fishless, alpine streams (Baumann and Stewart 1980, p. 658; MNHP 2010a) originating from meltwater sources, including glaciers and small icefields, snowpack, alpine springs, and glacial lake outlets (Hauer et al. 2007, p. 107; Giersch et al. 2017, p. 2584). Western glacier stoneflies are known to occur in 16 streams (6 in Glacier National Park, 4 in Grand Teton National Park, and 6 in the Absaroka/Beartooth Wilderness; Giersch et al. 2017, p. 2584; Giersch 2017, pers. comm.). We estimate abundance to be in the tens of thousands of individuals, and they have decreased in distribution among and within the 6 streams in Glacier National Park. The western glacier stonefly occupies a relatively narrow range of alpine habitats that are expected to become fragmented and degraded by climate change.

Desiccation of their habitats, even periodically, could eliminate entire populations of the western glacier stonefly because nymphs need perennial flowing water to breathe and to mature before reproducing (Stewart and Harper 1996, p. 217). Habitats for the western glacier stonefly originate from meltwater sources that will be impacted by climate change, including glaciers, rock glaciers and small ice fields, perennial and seasonal snowpack, alpine springs, and glacial lake outlets (Hauer et al. 2007; Giersch et al. 2017). The alteration or loss of these meltwater sources and perennial habitat has direct consequences on western glacier stonefly populations. Desiccation (drying) of these habitats, even periodically, could eliminate entire populations of the western glacier stonefly because nymphs need perennial flowing water to breathe and to mature before reproducing (Stewart and Harper 1996). Given that the species is believed to be a poor disperser (similar to other Plecopterans; Baumann and Gaufin 1971), recolonization of previously occupied habitats is not expected following dewatering and extirpation events. Lack of recolonization by the species is expected to lead to further isolation between extant occupied streams. Western glacier stoneflies have decreased in distribution among and within 6 streams in

GNP where the species was known to occur in the 1960s and 1970s (Giersch et al. 2015). There are no active conservation programs that we are aware of for the western glacier stonefly. The northern distributional limits of the species are not known, and specimens were not found during surveys of potential habitat in Banff and Jasper National Parks in Canada (Hirose 2016, pers. comm.).

EB/CE Sources: U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Western Glacier Stonefly as an Endangered or Threatened Species; Proposed Threatened Species Status for Meltwater Lednian Stonefly and Western Glacier Stonefly. Federal Register 81(192):68379-6839.

U.S. Fish and Wildlife Service. 2019. Recovery Outline Meltwater lednian stonefly (*Lednia tumana*) and Western glacier stonefly (*Zapada glacier*). Montana Ecological Services Office, Helena. 14 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion in bin 2 waters and in the terrestrial phase would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range:

Terrestrial Phase: Mortality for western glacier stonefly adults exposed to malathion at maximum use rates is <1% for all use types (open space developed, developed, wheat, pasture, other grains, and other crops).

Aquatic Phase: Mortality for western glacier stonefly nymphs exposed to malathion at maximum use rates is <1% for all use types (developed, wheat, pasture, other grains, and other crops).

The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| DIRECT (all uses except mosquito control) | |
|---|---------------------------------------|
| Use areas – mortality | 0.07% for Terrestrial and Aquatic |
| Spray drift areas – mortality | Up to 0.53% for Terrestrial |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |

| | |
|--|-----------------------------------|
| Use areas – effects to dietary items | 0.07% for Terrestrial and Aquatic |
| Spray drift areas – effects to dietary items | Up to 0.53% for Terrestrial |
| Plants affected – decline in growth | |
| MOSQUITO CONTROL | |
| Direct - mortality | 0 |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Nemouridae nymphs are typically herbivores or detritivores, and their feeding mode is generally that of a shredder or collector-gatherer (Baumann 1975, p. 1; Stewart and Harper 1996, pp. 218, 262) (USFWS, 2016).

Adult stoneflies have no mouth parts and therefore do not feed.

Eggs and nymphs of Nemouridae stoneflies are aquatic (Stewart and Harper 1996, p. 217), and nymphs rely on perennial water sources to breathe through gills, similar to fish (USFWS, 2016).

Overall Risk: ☐ High ☐ Medium ☒ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bins associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|----------------------|------------------------------|------------------------|-------|---------------------------------------|-------|--|--|
| | | Acres | % | Acres | % | | |
| Mosquito Control | * | 0 | 0 | 0 | 0 | NA | NA |
| Open space developed | D,I | 31 | 0.06 | 2 | <0.01 | 2 | unknown |
| Developed | D,I | 5 | <0.01 | <1 | <0.01 | 2 | 2H** |
| Wheat | D,I | 3 | <0.01 | 2 | <0.01 | 2 | 2H |
| Pasture | D,I | 1 | <0.01 | 1 | <0.01 | 2 | 2H |
| Other Grains | D,I | <1 | <0.01 | <1 | <0.01 | 2 | 2H |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | | Bins associated with use type [^] | Effect associated with bin H >50% M 1-50% L <1% |
|---|------------------------------|------------------------|-------|---------------------------------------|------|--|--|
| | | Acres | % | Acres | % | | |
| Other Crops | D,I | <1 | <0.01 | 0 | 0 | 2 | unknown |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 40 | 0.11 | 5 | 0.05 | | |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 40 | 0.11 | 5 | 0.05 | | |
| TOTAL⁴: | | 40 | 0.11 | 5 | 0.05 | | |

**aquatic bin information based on other species of stonefly

[^]We consider the Bin 2 estimates as an upper bound of Bin 3 & 4 exposures.

acres in species range: 55,498 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 51,595 acres, 92.9%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Rain restriction: Given the relatively short half-life of malathion and rapid degradation via hydrolysis and other processes, persistence of malathion in storm run-off into most aquatic habitats is not anticipated to last longer than 48 hours under typical pH values, (ie. 6.5-8.5) and water temperatures corresponding to growing season. Restricting malathion application to periods where rain is not forecasted for at least 48 hours or when the soil is not saturated will provide time for the pesticide to degrade before runoff into aquatic habitats can occur, decreasing exposure and risk to the Western glacier stonefly during its aquatic phase.

Aquatic habitat buffers: Application buffers, which specify on the label a distance from water bodies where pesticides are not to be applied, are designed to reduce spray drift from entering sensitive non-target areas, thereby providing protection to aquatic species. While the exact amount of spray drift reduction depends on the physical traits of the aquatic ecosystem (e.g. flow rate, volume, etc.) as well as the application method, we can expect (based on AgDRIFT

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

modeling) spray drift reductions ranging from 40 to 91%, with low flow and low volume aquatic habitats receiving the most reduction in spray drift deposition. These buffers would substantially reduce exposure to the aquatic phases of the species.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Western glacier stonefly. As discussed below, even though the vulnerability is high for this species, the risk is low, and the likelihood of exposure to malathion is low because the majority of the species range is on federal lands. Furthermore, the implementation of the general conservation measures described above is expected to reduce the likelihood of exposure for any uses that do occur on federal lands or for any individuals that may occur outside of federal lands. We do not expect species-level effects to occur.

The Western glacier stonefly has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is low. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 0.07% mortality of individuals (both terrestrial and aquatic), up to 0.53% mortality from spray drift in terrestrial areas, a loss of about 0.07% of dietary items in use areas (both terrestrial and aquatic), and an additional loss of up to 0.53% of dietary items due to spray drift in terrestrial areas. We do not anticipate mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. The water bodies used by the western glacier stonefly (bin 2, specifically) would maintain a high concentration of contaminants, including malathion, if exposed due to their small size and low water flow. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to poor dispersal capacity of this species.

However, the rain restriction and aquatic habitat buffer conservation measures described above are anticipated to address the concerns related to surface run-off contamination, and reduce the run-off potential into the aquatic habitat areas where these stoneflies reside, minimizing the potential for malathion to reach these environments. They are designed to create enough physical space (buffers) or time (48-hour rain restriction) between when the application of malathion is

made and the species' habitat by taking into account the half-lives of malathion in soils and water with respect to the time it may take the run-off to reach the water body.

In addition, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 0.06% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range and a large proportion (92.9%) of the species range is on federal lands (i.e., Glacier National Park, Grand Teton National Park, and Absaroka/Beartooth Wilderness), and conservation measures will be implemented as described above, further reducing the risk of exposure to malathion.

We anticipate a loss of a small number of individuals may occur if malathion is used within the range of the species and exposure occurs, and dietary items may be affected in localized areas over the duration of the action. While we anticipate that small numbers of individuals may be affected over the duration of the proposed action, we do not expect species-level effects to occur. Pesticides are not a known threat to this species. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Western glacier stonefly in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|--------------------------|-----------------------|------------|
| <i>Oarisma poweshiek</i> | Poweshiek skipperling | 10147 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

A final rule to list the Poweshiek skipperling was published in the Federal Register on November, 24, 2014, when we determined Poweshiek skipperlings were in danger of extinction throughout all or a portion of their range (79 FR 63672). Poweshiek skipperlings are obligate residents of undisturbed (remnant, untilled) high-quality prairie, ranging from wet-mesic tallgrass prairie to dry-mesic mixed-grass prairie. A drastic decline in this species was observed rangewide. Between 1985 and 2003, researchers surveyed 10 or more sites in 7 different years (excluding new sites in the first year); the average positive detection rate for those years is 71% rangewide. Since 2003, the percent of surveyed sites with positive detections of the species has dropped to an average of 31% each year (2004–2013), with a low of 12% at sites surveyed in 2012 and 2013. The Poweshiek skipperling was once a common prairie butterfly widely dispersed in eight States, extended from Michigan to North Dakota, and portions of Manitoba, Canada. However, its range is now substantially reduced such that the Poweshiek skipperling is restricted to small patches of fragmented native prairie remnants in portions of two States and one Canadian province. The species is presumed extirpated from Illinois and Indiana, and the status of the species is unknown in four of the six States with relatively recent records (within the last 20 years). Survey data indicate that the Poweshiek skipperling has declined to zero or to undetectable levels in approximately 96% of sites where it was recorded. Since listing, the number of populations has declined. Out of the 298 historically documented Poweshiek skipperling sites, there are currently 7 sites where the species is considered present (at the time of listing, 12 sites were considered to have Poweshiek skipperling present). Researchers have studied host plant relations, and have found Poweshiek skipperlings ovipositing in Michigan on 4 different plant species (*Muhlenbergia richardsonis* [muhly grass], *M. glomerata* [marsh muhly], *C. sterilis* [dioecious sedge], and *Dasiphora fruticosa* [shrubby cinquefoil]), the latter three of which had no observed Poweshiek oviposition at the time of listing and had not previously been suggested as potential host plants (Belitz et al. 2019, p. 646). A recent observational study in Manitoba showed that Poweshiek skipperlings were observed ovipositing and then feeding on big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), prairie

dropseed, and mat muhly grasses (and moving between these nearby host plant species as larvae; Westwood and Henault 2019).

Of the various threats to Poweshiek skipperling habitat, conversion, invasive species, secondary succession, and reduction in the diversity of native prairie plant communities have moderate- to high-level impacts to populations throughout the range of the Poweshiek skipperling. An array of other factors including non-agricultural development, chemical contaminants, pesticides, and intensive grazing are also current and ongoing threats to the Poweshiek skipperling and its habitat (USFWS 2014). Within the remaining native-prairie patches, degradation of habitat quality is now the primary threat to the Poweshiek skipperling. Habitat loss and degradation have impacted the Poweshiek skipperling, curtailing their ranges. Extensive historical conversion of prairie and associated habitats, nearly complete in some areas, has isolated many Poweshiek skipperling populations. These small and isolated populations are subject to loss of genetic diversity through genetic drift and are susceptible to a variety of stochastic (e.g., wildfires, droughts, and floods) and deterministic (e.g., overgrazing, invasive species) factors that may kill all or a substantial proportion of a population. Although much of the habitat conversion occurred in the past, the effects of the dramatic reduction and fragmentation of habitat have persistent and ongoing effects on the viability of populations; furthermore, conversion of native prairies to agriculture or other uses is still occurring today. Native tallgrass prairies have been reduced by 85 to 99.9% of their former area, and native mixed-grass prairies have been reduced by 72 to 99% of their former area in North Dakota, Manitoba, and Saskatchewan.

Pesticide sampling has been done at both occupied and previously occupied (but now unoccupied) sites in Michigan, Manitoba, Minnesota, and South Dakota (Warner and Grantham 2019,; Runquist 2019). Researchers sampled for a suite of 214 pesticides in sedge leaves, grass leaves, duff, and floral nectar sources. Certain pesticides were detected at both Michigan and Manitoba sites at low concentration levels. In Michigan, a greater number of pesticides were detected at the now unoccupied sites than at the currently occupied sites. It is difficult to ascertain the impact of these low level pesticides on Poweshiek skipperlings because of limited research on Poweshiek skipperling or similar species. There are additional results pending. Landscape GIS analyses of Michigan Poweshiek skipperling sites and the areas upwind revealed that unoccupied sites were surrounded by more agriculture than currently occupied sites (52% agricultural foot print vs. 17%), although this trend was reversed at Manitoba sites (7% vs. 13%; Warner and Grantham 2019).

EB/CE Sources: U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling. Federal Register 79(206):63671-63748.

U.S. Fish and Wildlife Service. 2019. Poweshiek skipperling (*Oarisma poweshiek*) 5-Year Review: Summary and Evaluation. Minnesota-Wisconsin Ecological Services Field Office, Bloomington. 17 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Poweshiek skipperling butterflies exposed to malathion at maximum use rates is 1-31% for developed, pasture, wheat, open space developed, and corn, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 41.3% |
| Spray drift areas – mortality | Up to 57.9% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 5% of use sites could affect plants (decline in growth) |
| MOSQUITO CONTROL | |
| Direct - mortality | 32.9% |
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

Poweshiek skipperling butterflies are obligate residents of untilled high-quality prairie, ranging from wet-mesic tallgrass prairie to dry-mesic mixed-grass prairie to prairie fens.

The Poweshiek skipperling larvae enter diapause near the end of September. Over winter as larvae at the base of a host plant. Adults lay eggs near the tips of leaf blades, and larvae hatch after around nine days. After hatching, larvae crawl to the base of grasses. Past the 7th instar, there follows the chrysalis (pupa). The annual single generation of adults emerges in mid-June to early July, and the flight period lasts two to four weeks, where mating occurs. Eggs are laid on the tips of leaf blades. Therefore, the Poweshiek skipperling butterfly is vulnerable to the effects

of malathion throughout its entire lifecycle, especially vulnerable are the larval and adult stages if applications are made from Spring through September.

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 3,868,381 | 32.87 | 36,300 | 0.31 |
| Corn | D,I | 3,666,801 | 31.16 | 77,826 | 0.66 |
| Open Space Developed | D,I | 508,743 | 4.32 | 25,437 | 0.22 |
| Wheat | D,I | 320,244 | 2.72 | 197,485 | 1.68 |
| Pasture | D,I | 170,149 | 1.45 | 79,893 | 0.68 |
| Developed | D,I | 107,716 | 0.92 | 5,386 | 0.05 |
| Other Row Crops | D,I | 53,599 | 0.46 | 34,471 | 0.29 |
| Other Grains | D,I | 50,462 | 0.43 | 26,158 | 0.22 |
| Other Crops | D,I | 27,623 | 0.23 | 0 | 0 |
| Vegetables and Ground Fruit | D,I | 13,164 | 0.11 | 13,164 | 0.11 |
| Nurseries | D,I | 480 | <0.01 | 480 | <0.01 |
| Orchards and vineyards | D,I | 13 | <0.01 | 3 | <0.01 |
| Christmas trees | D,I | 12 | <0.01 | 9 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 4,919,004 | 41.83 | 460,312 | 3.93 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 4,919,004 | 41.83 | 460,312 | 3.93 |
| TOTAL⁴: | | 8,787,385 | 74.7 | 496,611 | 4.22 |

acres in species range: 11,769,103 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 159,521 acres, 1.36%

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Poweshiek skipperling, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Bloom restrictions: New restrictions on orchards and vineyards, pasture, and the other crops will prohibit application of malathion within three days prior to tree bloom, during bloom, and until petal fall is complete on certain crops. This measure is anticipated to further limit the exposure of pollinators to malathion in this use area where it occurs in or around the range of the Poweshiek skipperling, reducing the risk of direct mortality.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service’s biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Poweshiek skipperling. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above

is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Poweshiek skipperling has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 41.3% mortality of individuals, up to 57.9% mortality from spray drift. In addition, there could be up to 32.9% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects. Where exposure occurs and all individuals of a population are lost, or large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will likely not be recolonized due to the isolated and fragmented nature of the butterfly populations limited flight capability between habitat patches.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year. We anticipate that usage will occur in up to 4.22% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the general conservation measures described above, including reductions in application rates and number of applications for specific crops, new restrictions for residential use, and bloom restrictions, will further reduce the risk of exposure to malathion. For example, the Poweshiek skipperling is found in remnant prairies mainly in small areas of Michigan and Wisconsin, where agricultural crops are prevalent. The conservation measure reducing application number and rate on various crops, including some of those occurring within the species' range, such corn and pasture, is anticipated to decrease exposure and the resultant mortality of individuals.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals), we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Poweshiek skipperling in the wild.

Conclusion: Not likely to jeopardize

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-----------------------|--------------------------|------------|
| <i>Bombus affinis</i> | Rusty patched bumble bee | 10383 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Declining population(s) – one or more populations declining

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

Since the late 1990s, *B. affinis* distribution and abundance has declined. Five percent of the historical locations (grids) are currently (the last 2 decades) occupied by *B. affinis*, and the relative abundance of *B. affinis* declined from 8% historically to 1% currently. Although we could not assess the health of all existing populations, analyzing data from 25 of the 69 current grid occurrences suggests that many of the persisting populations are affected by at least one stressor (many with high severity) over a broad extent of the population. Along with the loss of populations, the spatial extent is currently 8% of its historical extent. This reduction has likely led to loss of spatial heterogeneity and adaptive diversity. Similarly, the loss of occurrences has increased the risk of ecoregion-wide extirpations due to catastrophic events (i.e., severe drought and prolonged, high temperatures). Rusty patched bumble bee is a colonial species with an annual cycle that starts in early spring when colonies are initiated by solitary queens emerging from overwintering sites, progresses with the production of workers throughout the summer, and ends with the production of males and new queens in late summer and early fall. Survival and successful recruitment require floral resources (for food) from early spring through fall, undisturbed nest sites in proximity to foraging resources, and overwintering sites for the next year's queens. Populations consist of tens to hundreds of colonies, and the health (long-term productivity) of populations is affected by the quantity and quality (a diversity of floral resources) of nectar and pollen available and the proximity of these resources to nesting habitat.

Prior to listing (in 2017), the species experienced a widespread and precipitous decline. The cause of the decline is unknown, but evidence suggests a synergistic interaction between an introduced pathogen and exposure to pesticides (specifically, insecticides and fungicides; USFWS 2016). Many of the existing populations continue to face the effects of past and ongoing stressors, including pathogens, pesticides, habitat loss and degradation, climate change, and small population dynamics. It is likely that several of these risk factors are acting synergistically on the species, and the combination of multiple stressors is likely more harmful than a single stressor acting alone. The abundance of *B. affinis* is forecasted to decline over time under all three risk scenarios evaluated, with extinction predicted in all but one ecoregion within 5 years;

Ecoregion 220 is forecasted to be extinct by Year 30. These projections, however, are likely optimistic due to continued loss of spatial heterogeneity and the consequent increased risk of population extirpation due to environmental stochasticity. As fewer and fewer populations persist, the ability to withstand normal environmental stochasticity is diminished, and thus the decline to extinction is accelerated. Furthermore, as fewer populations persist and the spatial extent of the species declines, the species' ability to withstand catastrophic events and changes in its environment is likely to be greatly reduced.

EB/CE Sources: U.S. Fish and Wildlife Service. 2016. Rusty Patched Bumblebee (*Bombus affinis*) Species Status Assessment. Minnesota-Wisconsin Ecological Services Field Office, Bloomington. 100 pp.

U.S. Fish and Wildlife Service. 2019. Draft Recovery Plan for Rusty Patched Bumble Bee (*Bombus affinis*). Minnesota-Wisconsin Ecological Services Field Office, Bloomington. 12 pp.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for the Rusty-patched bumble bee exposed to malathion at maximum use rates is 3-17% for pasture, open space developed, developed, and corn, and <1% for all other use sites. The table below summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 43.7% |
| Spray drift areas – mortality | Up to 58.6% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | NA |
| Spray drift areas – effects to dietary items | NA |
| Plants affected – decline in growth | 23% |
| MOSQUITO CONTROL | |
| Direct - mortality | 36.4% |

| | |
|-----------|----|
| Sublethal | NA |
| Indirect | NA |

Risk modifiers:

New queens go into diapause (a form of hibernation) over winter. The following spring, the queen, or foundress, searches for suitable nest sites and collects nectar and pollen from flowers to support the production of her eggs, which are fertilized by sperm she has stored since mating the previous fall (USFWS, 2016).

The rusty patched bumble bee's annual cycle begins in early spring and ending with the production of reproductive individuals (males and potential queens) in mid- to late summer and early fall (Macfarlane et al. 1994, p. 4; Colla and Dumes 2010, p. 45; Plath 1922, p. 192).

The rusty patched bumble bee has been observed and collected in a variety of habitats, including prairies, woodlands, marshes, agricultural landscapes, and residential parks and gardens (Colla and Packer 2008, p. 1381; Colla and Dumes 2010, p. 46; USFWS rusty patched bumble bee unpublished geodatabase 2016).

The environmental specificity is broad; this was a widespread rather common bumblebee that occurred in a variety of habitats including urban areas, which could possibly be refugia now (NatureServe, 2015).

Overall Risk: ☒ High ☐ Medium ☐ Low

USAGE

(Anticipated usage within the range based on past usage data)

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|-----------------------------|------------------------------|------------------------|-------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 3,850,400 | 36.44 | 13,228 | 0.34 |
| Corn | D,I | 1,755,042 | 16.61 | 15,232 | 0.87 |
| Developed | D,I | 1,642,547 | 15.55 | 82,127 | 0.78 |
| Open Space Developed | D,I | 808,961 | 7.66 | 40,448 | 0.38 |
| Pasture | D,I | 279,487 | 2.65 | 2,426 | 0.87 |
| Wheat | D,I | 53,594 | 0.51 | 69 | 0.13 |
| Vegetables and Ground Fruit | D,I | 37,316 | 0.35 | 42 | 0.11 |

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)

² Estimated usage in the range is based on information about annual past usage.

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|---|------------------------------|------------------------|-------|---------------------------------------|-------|
| | | Acres | % | Acres | % |
| Other Grains | D,I | 20,833 | 0.2 | 23 | 0.11 |
| Other Crops | D,I | 9,139 | 0.09 | 0 | <0.01 |
| Nurseries | D,I | 7,144 | 0.07 | 4 | 0.07 |
| Other Row Crops | D,I | 396 | <0.01 | 0 | <0.01 |
| Christmas Trees | D,I | 396 | <0.01 | 0 | <0.01 |
| Orchards and Vineyards | D,I | 334 | <0.01 | 0 | <0.01 |
| Rice | D,I | <1 | <0.01 | 0 | <0.01 |
| Sub-TOTAL (D): <i>Other uses with direct effects only</i> ³ | | 4,615,189 | 43.73 | 140,371 | 3.37 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only</i> ³ | | 4,615,189 | 43.73 | 140,371 | 3.37 |
| TOTAL⁴: | | 8,465,589 | 80.17 | 153,599 | 3.71 |

acres in species range: 10,565,912 acres

% of range in California (i.e., where CalPUR data is available): 0%

Range overlap with Federal lands: 420,878 acres, 3.98%

Overall Usage: ☐ High ☐ Medium ☒ Low

CONSERVATION MEASURES

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Rusty patched

³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.

⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

bumble bee, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and groundfruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 applications per year, depending on the specific crop), as described in the *Description of the Action* of this Opinion.. This is anticipated to reduce the amount of malathion used and decrease exposure to the species, thus decreasing mortality of individuals.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, is not likely to jeopardize the continued existence of the Rusty patched bumble bee. As discussed below, even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low, and the implementation of the general conservation measures described above is expected to further reduce the likelihood of exposure. We do not expect species-level effects to occur.

The Rusty patched bumble bee has a high vulnerability based on its status, distribution, and trends. The risk to the species posed by labeled uses across the range is high. The estimated usage within the non-Federal portion of the species range is low based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion.

We estimated that across the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 43.7% mortality of individuals, up to 58.6% mortality from spray drift. In addition, there could be up to 36.4% mortality of individuals from malathion use in mosquito control efforts. Use sites where the application rate exceeds the threshold for plants would be expected to cause a decrease in growth of food sources for this species. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

However, we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year; we anticipate that usage will occur in up to 3.71% of the non-Federal portion of the species range annually based on standard past usage data. Even though the vulnerability and risk are high for this species, the likelihood of exposure to malathion is low because past malathion usage overlaps a small portion of the non-Federal species range. Additionally, the conservation measures described above, including reductions in application

rates and number of applications for specific crops, new restrictions for residential use, and timing restrictions for mosquito control applications, will further reduce the risk of exposure to malathion. For example, the Rusty patched bumblebee can occur in residential gardens and other developed areas. Residential uses of malathion are now limited to two applications per year (reduced from as many as necessary), to spot treatments only, thereby reducing the application footprint and likelihood of spray drift within and around residential areas and reducing the likelihood of exposure to this species.

While we anticipate that small numbers of individuals may be affected over the duration of the proposed action (in the form of the loss of a small number of individuals) , we do not expect species-level effects to occur. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Rusty patched bumble bee in the wild.

Conclusion: Not likely to jeopardize

REFERENCES

Integration and Synthesis Summary: Insects

| Scientific Name: | Common Name: | Entity ID: |
|-------------------------------|--------------------|------------|
| <i>Cicindelidia floridana</i> | Miami tiger beetle | 10909 |

VULNERABILITY

(Summary of status, environmental baseline and cumulative effects)

Status: Endangered

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of Populations: Multiple populations (few)

Species Trends: Unknown population trends

Pesticides noted ☒

Environmental Baseline/Cumulative Effects (EB/CE) Summary:

It is likely that the Miami tiger beetle historically occurred throughout pine rockland habitat on the Miami Rock Ridge. The Miami tiger beetle was thought to be extinct until 2007, when a population was discovered at the Richmond Heights area of south Miami, Florida, known as the Richmond Pine Rocklands (Brzoska et al. 2011, p. 2; Knisley 2011a, p. 26). The Richmond Pine Rocklands is a mixture of publicly and privately owned lands that retain the largest area of contiguous pine rockland habitat within the urbanized areas of Miami-Dade County and outside of the boundaries of Everglades National Park (ENP). At this time, the Miami tiger beetle is known to occur in only two separate locations within pine rockland habitat in Miami-Dade County. The Richmond population occurs on four contiguous parcels within the Richmond Pine Rocklands: (1) Zoo Miami Pine Rockland Preserve (Zoo Miami) (293 ha; 723 ac), (2) Larry and Penny Thompson Park (121 ha; 300 ac), (3) U.S. Coast Guard property (USCG) (96 ha; 237 ac), and (4) University of Miami's Center for Southeastern Tropical Advanced Remote Sensing property (CSTARS) (31 ha; 76 ac). The second population, which was identified in September 2015, is within approximately 5.0 km (3.1 mi) of the Richmond population and separated by urban development (D. Cook, 2015a, pers. comm.). Based on historical records, current occurrences, and habitat needs of the species, the current range of the species is considered to be any pine rockland habitat (natural or disturbed) within the Miami Rock Ridge (Knisley 2015a, p. 7; CBD et al. 2014, pp. 13–16, 31–32). Miami tiger beetles within the four contiguous occupied parcels in the Richmond population are within close proximity to each other. There are apparent connecting patches of habitat and few or no barriers between parcels. Given the contiguous habitat with few barriers to dispersal, frequent adult movement among individuals is likely, and the occupied Richmond parcels probably represent a single population (Knisley 2015a, p. 10). Information regarding Miami tiger beetles at the new location is limited, but beetles here are within approximately 5.0 km (3.1 mi) of the Richmond population and separated by ample urban development, which likely represents a significant barrier to dispersal. Miami tiger beetles at the new location are currently considered a second population. The Richmond population occurs within an approximate 2- km² (494-ac) block, but currently much of the habitat is overgrown with vegetation, leaving few remaining open patches for the beetle. Survey data documented a

decline in the number of open habitat patches, and Knisley (2015a, pp. 9–10) estimated that less than 10% of the mostly pine rockland habitat within this area supports the species in its current condition.

The threat of habitat loss is continuing from development, inadequate habitat management resulting in vegetation encroachment, and environmental effects resulting from climatic change. Due to the restricted range, small population size, few populations, and relative isolation, collection is a significant threat to the species and could potentially occur at any time. Additionally, the species is currently threatened by a wide array of natural and anthropogenic factors.

Pesticides used in and around pine rockland habitat are a potential threat to the Miami tiger beetle through direct exposure to adults and larvae, secondary exposure from insect prey, overall reduction in availability of adult and larval prey, or any combination of these factors. The use of pesticides for agriculture and mosquito control presents potential risks to nontarget insects, especially imperiled insects (EPA 2002, p. 32; 2006a, p. 58; 2006b, p. 44). The negative effect of insecticides on several tiger beetle species was suggested by Nagano (1982, p. 34) and Stamatov (1972, p. 78), although impacts from pesticides do not appear to be well studied in tiger beetles. Efforts to control mosquitoes and other insect pests in Florida have increased as human activity and population size have increased. To control mosquito populations, organophosphate (naled) and pyrethroid (permethrin) adulticides are applied by mosquito control districts throughout south Florida, including Miami-Dade County. These compounds have been characterized as being highly toxic to nontarget insects by the U.S. Environmental Protection Agency (2002, p. 32; 2006a, p. 58; 2006b, p. 44). The use of such pesticides (applied using both aerial and ground-based methods) for mosquito control presents a potential risk to the Miami tiger beetle, and this risk may increase with the spread of any mosquito-borne disease, such as the Zika virus, as current guidelines to incorporate no-spray buffers around butterfly critical habitat are not necessarily adhered to if there is a public health concern (Florida Administrative Code 5E–13.036; Service 2015, entire).

In order for mosquito control pesticides to be effective, they must make direct contact with mosquitoes. For this to happen, pesticides are applied using methods to promote drift through the air, so as to increase the potential for contact with their intended target organism. Truck-based permethrin application methods are expected to produce a swath of suspended pesticides approximately 91 m (300 ft) wide (Prentiss 2007, p. 4). The extent of pesticide drift from this swath is dependent on several factors, including wind speed, wind direction, and vegetation density. Hennessey and Habeck (1989, pp. 1–22; 1991, pp. 1–68) and Hennessey et al. (1992, pp. 715–721) illustrated the presence of mosquito spray residues long after application in habitat of several butterfly species. Residues of aerially applied naled were found 6 hours after application in a pineland area that was 750 m (2,460 ft) from the target area; residues of fenthion (an adulticide previously used in the Florida Keys) applied via truck were found up to 50 m (160 ft) downwind in a hammock area 15 minutes after application in adjacent target areas (Hennessey et al. 1992, pp. 715–721).

More recently, Pierce (2009, pp. 1–17) monitored naled and permethrin deposition following mosquito control application. Permethrin, applied by truck, was found to drift considerable distances from target areas, with residues that persisted for weeks. Permethrin was detected at concentrations lethal to three butterfly species at a distance of approximately 227 m (745 ft) away from targeted truck routes. Naled, applied by plane, was also found to drift into nontarget areas, but was much less persistent, exhibiting a half-life (time for half of the naled applied to chemically break down) of approximately 6 hours. To expand this work, Pierce (2011, pp. 6–11) conducted an additional deposition study in 2010, focusing on permethrin drift from truck spraying, and again documented low but measurable amounts of permethrin in nontarget areas. In 2009, Bargar (2012, p. 3) conducted two field trials that detected significant naled residues at locations within nontarget areas up to 366 m (1,200 ft) from the edge of zones targeted for aerial applications. After this discovery, the Florida Keys Mosquito Control District recalibrated the on-board model (Wingman, which provides flight guidance and flow rates). Naled deposition was reduced in some of the nontarget zones following recalibration (Bargar 2012, p. 3). In addition to mosquito control chemicals entering nontarget areas, the toxic effects of such chemicals to nontarget organisms have also been documented. Lethal effects on nontarget moths and butterflies have been attributed to fenthion and naled in both south Florida and the Florida Keys (Emmel 1991, pp. 12–13; Eliazar and Emmel 1991, pp. 18–19; Eliazar 1992, pp. 29–30). Based on these studies, it can be concluded that mosquito control activities that involve the use of both aerial and ground-based spraying methods have the potential to deliver pesticides in quantities sufficient to cause adverse effects to nontarget species in both target and nontarget areas. Based on Miami-Dade Mosquito Control's implementation of spray buffers, mosquito control pesticides were not considered a major threat for the Miami tiger beetle at the time of listing (2016).

EB/CE Source: U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Miami Tiger Beetle (*Cicindelia floridana*). Federal Register 81(193):68985-69007.

Overall Vulnerability: ☒ High ☐ Medium ☐ Low

RISK

(Risk is based on species exposure and response from labeled uses across the range)

Risk to individuals if exposed: We anticipate that, for most uses, individuals exposed to malathion would be at high risk of mortality. We expect individuals to be at greater risk of lethal effects than sublethal effects.

Risk to the species from labeled uses across the range: Mortality for Miami tiger beetles exposed to malathion at maximum use rates is 1-7% for other grains, orchards and vineyards, open spaced developed, and developed, and <1% for all other use sites. The table below

summarizes the risk to the species from labeled uses across the range based on range overlaps with use sites and anticipated effects associated with the particular uses.

| | |
|---|---------------------------------------|
| DIRECT (all uses except mosquito control) | |
| Use areas – mortality | 64% |
| Spray drift areas – mortality | Up to 24.2% |
| Sublethal – growth (G), reproduction (R) and behavior (B) | NA |
| Direct spray or contact with contaminated media | NA |
| Volatilization | Not an appreciable source of exposure |
| INDIRECT (all uses except mosquito control) | |
| Use areas – effects to dietary items | 64% |
| Spray drift areas – effects to dietary items | Up to 24.2% |
| Plants affected – decline in growth | NA |
| MOSQUITO CONTROL | |
| Direct - mortality | 122% |
| Sublethal | NA |
| Indirect - mortality | 100% arthropods |

Risk modifiers:

The Miami tiger beetle is found exclusively in bare or sparsely vegetated sandy areas in pine rockland habitat. In Florida pine rocklands they are found along the Miami Rock Ridge, within the Florida Keys, and in Big Cypress National Preserve.

As is typical of other tiger beetles, adult Miami tiger beetles are active diurnal predators that use their keen vision to detect movement of small arthropods and run quickly to capture prey with their well-developed jaws (mandibles). Observations indicate small arthropods, especially ants, are the most common prey for tiger beetles. Larvae are sedentary sit-and-wait predators occurring in permanent burrows flush with the ground surface (USFWS, 2015).

Breeding season is from May-October when females oviposit (lay eggs) in open sandy patches (Knisley 2015a, p. 8). Females will often touch the soil with the antennae, bite it, and even dig trial holes, possibly to determine suitable soil characteristics (Willis 1967, p. 194) before placing a single egg into a shallow oviposition burrow dug into the soil with the ovipositor. The egg hatches, apparently after sufficient soil wetting, and the first instar larvae digs a burrow at the site of oviposition. Adults emerging in May and June will mate, oviposit, and produce larvae that can develop and emerge as a second cohort of adults in late July and August as the earlier cohort of adults were dying off. Larvae from these later active adults would develop through fall and winter, emerging as adults the following May (USFWS, 2015).

The Miami tiger beetle is extremely rare and only known to occur in two separate locations within pine rockland habitat in Miami-Dade County.

Overall Risk: ☒ **High** ☐ **Medium** ☐ **Low**

USAGE*(Anticipated usage within the range based on past usage data)*

| Use type | Risk to species ¹ | Use overlap with range | | Estimated usage in range ² | |
|--|------------------------------|------------------------|------|---------------------------------------|------|
| | | Acres | % | Acres | % |
| Mosquito Control | D | 4,909 ^{##} | 122* | 4,000 | 99.4 |
| Developed | D,I | 540 | 13.4 | 27 | 0.67 |
| Open Space Developed | D,I | 1,199 | 30 | 60 | 1.49 |
| Orchards and Vineyards | D,I | 501 | 12.5 | 501 | 12.5 |
| Other grains | D,I | 29 | 0.73 | 29 | 0.73 |
| Other crops | D,I | 154 | 3.8 | 0 | 0.59 |
| Corn | D,I | 0.48 | 0.01 | 0.48 | 0.01 |
| Vegetables and Ground Fruit | D,I | 137 | 3.4 | 138 | 3.42 |
| Nurseries | D,I | 23 | 0.57 | 23 | 0.57 |
| Sub-TOTAL (D): <i>Other uses with direct effects only³</i> | | 7,492 | 100 | 4,779 | 20 |
| Sub- TOTAL (I): <i>Other uses with indirect effects only³</i> | | 2,583 | 64 | 778 | 20 |
| TOTAL⁴: | | 7,492 ^{##} | 100* | 4,779 | 100 |

*Use overlaps with range are additive and cannot be greater than 100%.

^{##}Overlap acreage greater than acres in species range.**Number of acres in species range:** 4,022 acres**% of range in California (i.e., where CalPUR data is available):** 0%**Range overlap with Federal lands:** 22 acres, 0.56%**Overall Usage:** ☐ High ☒ Medium ☐ Low**CONSERVATION MEASURES**

All measures are anticipated to limit the exposure of individuals of this species to malathion in the described use area where it occurs in or around the range of the species, thus reducing the risk of mortality to the species.

¹ Direct effects (D), Indirect effects (I), No effects expected (N), Use site not utilized by the species (*)² Estimated usage in the range is based on information about annual past usage.³ Mosquito control has the potential to overlap with other uses. It is not included in the Sub-TOTALs.⁴ TOTAL includes usage on all use sites with effects, including mosquito control.

General Conservation Measures

Residential use label changes: New restrictions to the method and frequency of application for residential use of malathion are expected to substantially reduce exposure to species that overlap with developed and open space developed areas. Label changes will ensure that residential use is limited to spot treatments only (rendering spray drift offsite unlikely) and reducing the extent of area which can be treated in the developed and open space developed areas by as much as 75% or more from modeled values. In addition, we expect the frequency of exposure to decrease as the number of allowable applications is reduced from “repeat as necessary” to a maximum of 2–4 applications per year (depending on the specific residential use). Retreatment intervals of 7-10 days between any repeated applications are expected to reduce environmental concentrations by allowing initial residues to degrade prior to the next application.

Mosquito adulticide timing restrictions: Conservation measures for mosquito adulticide use will prohibit application during most daylight hours (from two hours after dawn until two hours before sunset). This period is when many vulnerable diurnal insects, such as the Miami tiger beetle, are most active. This further limits the anticipated exposure of insect species to malathion when used as a mosquito adulticide, reducing the risk of direct effects.

Reduced application number and rate: New restrictions on corn, cotton, orchards and vineyards, pasture, other crops, and vegetables and ground fruit lower the maximum allowable number of applications to 2-4 per year (previously ranging from 3-13 per year, depending on the specific crop). This will reduce the amount of malathion used and decrease potential exposure to the species, thus decreasing the risk of mortality to individuals of this species.

Reduced citrus application rate: The reduction in the maximum application rate for citrus is expected to reduce potential environmental concentrations to one-third of modeled values, reducing the effects to species, prey, host fish, and pollinators on and adjacent to these use areas.

Species-specific Conservation Measures:

In addition to the above general label changes that would apply to all uses specified on the label, which would be protective of a wide range of species, additional species-specific conservation measures will be implemented as outlined below. The following species-specific measures are now part of the Action and will be included in *BulletinsLive! Two*.

Measure for mosquito control use:

Applicators of mosquito control products, where feasible, must not apply malathion within the species range, plus a 200 foot buffer to prevent spray drift from adjacent applicators from entering the range. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, coordinate with the local FWS Ecological Services field office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species (FWS points of contact and maps of designated critical habitat are available through the Information, Planning, and Consultation (IPaC) website <https://ecos.fws.gov/ipac/>). The applicator must retain documentation of the technical assistance and the agreed upon species-specific measures that were implemented.

Measures for agricultural uses:

Within the species range (plus a 200 foot buffer) agricultural applicators must follow one of these measures: 1. Apply malathion only when wind is blowing away from pine rockland habitat or 2. Use a 50-foot ground buffer from pine rockland habitat, and an aerial buffer from pine rockland habitat according to application rate:

- (1) 50 feet for <0.5 lbs ai/A
- (2) 75 feet for 0.5 to <1 lb ai/A
- (3) 150 feet for 1-2.5 lbs ai/A
- (4) 200 feet for >2.5 lbs ai/A

Buffer sizes may be reduced by 25 feet for application rates (1) and (2) if a full swath displacement upwind is used during aerial application. Buffer sizes may be reduced by 50 feet for application rates (3) and (4) if a full swath displacement upwind is used during aerial application.

The amount of spray drift entering off site locations is, in part, determined by wind speed and direction. Thus, adjusting application patterns based on current wind conditions can effectively reduce the amount of spray drift entering a habitat, which would decrease the likelihood of exposure. When wind conditions are favorable, this wind restriction could potentially eliminate exposure from spray drift. Even when winds are not blowing away from the species' habitat, extended no-spray buffers, whose distance vary depending on the application method and rate, can still substantially decrease the amount of spray drift entering the species' habitat and reduce the likelihood of exposure.

Application buffers are designed to reduce spray drift from entering sensitive non-target areas, even in unfavorable wind conditions, thereby providing protection to species. While the exact amount of spray drift reduction will vary depending on environmental conditions as well as the application method, AgDRIFT modeling indicates that we can expect spray drift reductions ranging from 82 to 90%.

Given the different factors influencing spray drift, applicators can modify the buffer distances for agricultural applications needed to protect the species from spray drift based on the application method and rate, with shorter buffer distances required for ground application and lower application rates. While these buffers may not eliminate exposure completely, they can substantially reduce the amount of spray drift entering off site locations when wind conditions are less favorable and result in similar decreases in the likelihood of exposure.

Swath displacement is a typical practice in the aerial applications of pesticides where applicators adjust the position of spray to account for pesticide that may drift into adjacent areas. For example, applicators may skip an outer row of trees or avoid spraying to the edge of the field. In our conservation measure for (this species), we allow applicators to reduce the required buffer size by 25-50 feet if using a full swath displacement, which we anticipate will generally be roughly equivalent to this distance. The full swath displacement effectively acts as a buffer and the resultant distance from species habitat is expected to be the same size whether swath displacement is used or not.

CONCLUSION

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed registration of malathion, and the cumulative effects, it is the Service's biological opinion that the registration of malathion, as proposed, including the general and species-specific conservation measures described above, is not likely to jeopardize the continued existence of the Miami tiger beetle.

The Miami tiger beetle has a high vulnerability based on its status, distribution, and trends. At the time of listing (2016), one population of Miami tiger beetle was known from pine rockland habitat on four contiguous parcels within the Richmond Pine Rocklands, each of which are protected to some capacity (Zoo Miami Pine Rockland Preserve, Larry and Penny Thompson Park, U.S. Coast Guard property, and University of Miami's Center for Southeastern Tropical Advanced Remote Sensing property), but they are not necessarily protected for the conservation of this particular species. The only other known population was recently identified (September 2015) within 5.0 km (3.1 mi) of the Richmond population, is separated by urban development (D. Cook, 2015a, pers. comm.), and protection of the newly discovered population is unknown. As described above, pesticides used in and around pine rockland habitat are a threat to the Miami tiger beetle through direct exposure to adults and larvae, secondary exposure from dietary items, overall reduction in availability of adult and larval prey, and any combination of these factors.

The risk to the species posed by labeled uses across the range is high. We estimated that across the non-Federal portion of the species range, annual malathion uses pursuant to the labels for purposes other than mosquito control would result in about 64% mortality of individuals, up to 24% mortality from spray drift, a loss of about 64% of dietary items in use areas, and an additional loss of up to 24% of dietary items through spray drift. In addition, there could be 100% mortality of individuals from malathion use in mosquito control efforts. We anticipate effects of malathion on insects to be lethal, therefore sublethal effects from spray drift are considered not applicable for insects.

The estimated usage within the non-Federal portion of the range is medium based on standard usage data. For the portion of the species range that is on Federal lands, we did not quantitatively evaluate use or usage, but we assume only low levels of usage per the rationale related to usage on Federal lands as described in the Biological Opinion. A small portion of the species range overlaps Federal lands (0.56%).

While we do not expect usage on all use sites nor at the maximum rates allowed by the labels wherever used each year, we anticipate that usage will occur in up to 100% of the non-Federal portion of the species range annually based on standard past usage data, and we anticipate similar levels of usage in the future. A small portion of the species range occurs on Federal lands. The species occurs in small, isolated areas surrounded by heavy urbanization, where we expect mosquito control to occur. Where exposure occurs and all individuals of a population are lost, or

large proportions of those populations are lost, in any given year or due to incremental losses over time, the area of suitable habitat will not be recolonized due to the isolated and fragmented nature of the Miami tiger beetle populations and the limited flight capability of this species and existing barriers to recolonization. Additionally, dietary items will be lost from malathion use, which will likely reduce the survivability and reproduction of individual Miami tiger beetles that are not directly exposed to malathion.

However, implementation of the general and species-specific measures described above are expected to appreciably reduce the likelihood of exposure and resultant mortality of the species and its prey items. The main use driver for this species is mosquito control, and to a lesser extent, agricultural use on orchards and vineyards and other crops (see table, above). To reduce anticipated exposure from these use types, conservation measures will be implemented that restrict use within and adjacent to the range of the species.

More specifically, for agricultural applications, within the range plus 200 feet, applicators can choose to either apply malathion when winds are blowing away from pine rockland habitat, or if winds are blowing towards this habitat, use a buffer based on application rate, as described above. These buffers are anticipated to limit spray drift exposure by up to 90%, thus appreciably diminishing the anticipated effects to individual beetles and their prey items from use on agricultural crops within and adjacent to the range of the Miami tiger beetle.

Similarly, for mosquito control, where feasible, applicators are prohibited from spraying in or within 200 feet of the range of the beetle. If avoidance is not feasible or impairs the ability of the mosquito control district or agency to protect the public's health and welfare, applicators must coordinate with the local FWS Ecological Services field office to determine appropriate measures to ensure the proposed application is likely to have no more than minor effects on the species. Discussions at the local level may allow for greater flexibility and less restrictive measures based on site- or species-specific considerations, such as specific timing, species life history, and geographic or habitat factors. Coordination with the Service on measures to minimize exposure to listed species, including avoidance, is a recognized practice by mosquito control professionals. In its 2021 Best Practices for Integrated Mosquito Management, the American Mosquito Control Association (AMCA) instructs applicators with listed species in their treatment area to coordinate with the Service prior to application and maintain records of interactions. Discussions with the AMCA and anecdotal reports from FWS field offices indicate that this type of coordination is presently occurring to varying degrees for mosquito control applications in general. Applicators subject to this conservation measure will be required to maintain records of their interactions with FWS offices, allowing us to better track this coordination and its outcomes moving forward.

For the Miami tiger beetle specifically, there is already ongoing coordination between the Service and the Miami-Dade Mosquito Control District, the entity responsible for mosquito control within the range of the beetle. As discussed in the proposed rule for designation of critical habitat for the Miami tiger beetle, pesticides are not considered a current threat for the species given the mosquito control spray buffers put in place by Miami-Dade around pine

rocklands occupied by this species (USFWS 2021). This measure will expand upon that ongoing coordination to all pine rockland habitat within the range of the species (plus a 200 foot buffer). Furthermore, both agricultural and mosquito control conservation measures will be implemented year-round to be protective of the various life stages active throughout the year. As a result, we anticipate the conservation measures will appreciably limit mortality of individuals and their dietary items.

We anticipate the conservation measures will appreciably limit mortality of individuals and their dietary items, though small numbers of individuals may be adversely affected over the duration of the action (in the form of loss of a small number of individuals and small reductions in fitness for a small number of individuals due to loss of dietary items). However we do not anticipate malathion usage will result in species-level effects. Therefore, we do not anticipate that the proposed action would appreciably reduce survival and recovery of the Miami tiger beetle in the wild.

Conclusion: Not likely to jeopardize

USFWS 2021. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Miami Tiger Beetle (*Cicindelidia floridana*). Federal Register Vol. 86, No. 170, pp. 48845 – 49985.