The Black Guillemots of Cooper Island

Identification

1. Description

This regional feature examines how the number of breeding pairs of a colony of black guillemots (*Cepphus grylle mandtii*) has changed over time in northern Alaska. Tracking the population of breeding adults of this colony through annual studies on the island is key to understanding the implications of temperature and sea ice changes in this coastal marine ecosystem. Recent major declines in summer Arctic sea ice extent can affect the distributions and life histories, such as patterns of survival and reproduction, of Arctic marine species adapted to living near sea ice (Divoky et al., 2015). For example, the effects of ice reductions and associated increasing ocean sea surface temperatures could impact the abundance of forage fish in the Arctic, such as the Arctic cod (*Boreogadus saida*), which is the primary prey for the region's upper trophic level marine predators. Specifically, black guillemots are ice-obligate sea diving birds that depend on the local availability of sea ice for their method in hunting prey, as well as on the prey itself.

Since the 1970s, certain environmental factors have been associated with changing suitability for black guillemots on Cooper Island, including earlier local spring ice-out and earlier laying of the first egg (Cox et al., 2017). Overall, when looking at record-setting monthly measurements, the entire Arctic region has seen consistent declines in sea ice extent, with only new low extent records measured since 1986 (Parkinson & DiGirolamo, 2016). Of particular note, the distance from Alaska's northern coast to the edge of the summer ice pack began to increase noticeably during the 1990s (Parkinson & DiGirolamo, 2016). The numbers of breeding pairs of this colony are important as an indicator of climate change because they reflect both physical changes in sea ice and associated implications for the marine ecosystem species of the region.

This feature consists of the following data series:

- The number of breeding pairs in the black guillemot colony that inhabit Cooper Island along the north coast of Alaska, starting in 1975 (Figure 1).

2. Revision History

April 2021: Published feature.
June 2024: Feature updated with data through 2023.

Data Sources

3. Data Sources

This data set was compiled and used for an analysis that appeared as part of a larger assessment of the Cooper Island area that was published in a journal article (Divoky et al., 2015).

A collaboration of scientists helped form the Cooper Island Black Guillemot study, which has since become part of the recently initiated project, Sentinels of the Sea Ice (SENSEI). Comprising 13 teams of researchers from six countries, the project aims to assess recent and ongoing responses of ice-associated seabirds and seals to changes in Arctic and Antarctic sea ice.

4. Data Availability

EPA obtained these data in spreadsheet format directly from Dr. George Divoky of Friends of Cooper Island. The data set is publicly available upon request at: https://cooperisland.org.

Methodology

5. Data Collection

This feature provides information on the number of breeding pairs of black guillemot at a specific location in northern Alaska. A black guillemot colony has been studied annually since 1975 at Cooper Island, a sand and gravel bar 35 kilometers southeast of Point Barrow (Nuvuk), Alaska. Guillemots are cavity-nesting alcids (an alcid is a bird of the family *Alcidae*, which includes the murres, guillemots, auklets, puffins, and murrelets), typically breeding in cavities in scree and talus on rocky shorelines (Cairns, 1980; Harris & Birkhead, 1985), but all nests used on Cooper Island are in human-made cavities, thereby giving investigators access to all nests. Creation of nest sites by investigators from 1972 to 1984 allowed the colony to grow from 10 breeding pairs in 1972 to 220 in 1988 (Divoky et al., 2015). Breeding pairs exceeded sites in some years as some sites housed more than one pair during the period of maximum occupancy. Thus, the colony peaked at 220 pairs in 1988. In 2011, all the original sites were replaced with bear-proof plastic nest cases. The nest cases were provided before the start of egg laying and were subsequently adopted by the birds.

The number of breeding pairs is determined by counting the number of active nests (nests with eggs). Starting in 1980, black guillemot adults were also identified through banding during the breeding season. Birds were banded with a metal band and each received a unique combination of three plastic color bands allowing for identification of individuals with binoculars. However, because all nests are in human-made nest sites, it is possible to examine all places where guillemots would be breeding and determine the number of breeding pairs.

6. Derivation

Researchers used direct counts of the number of nest sites where egg laying and subsequent incubation occurred to determine the number of breeding pairs for the colony. This count of breeding pairs occurred at the peak of the breeding season each year (June, July, and August).

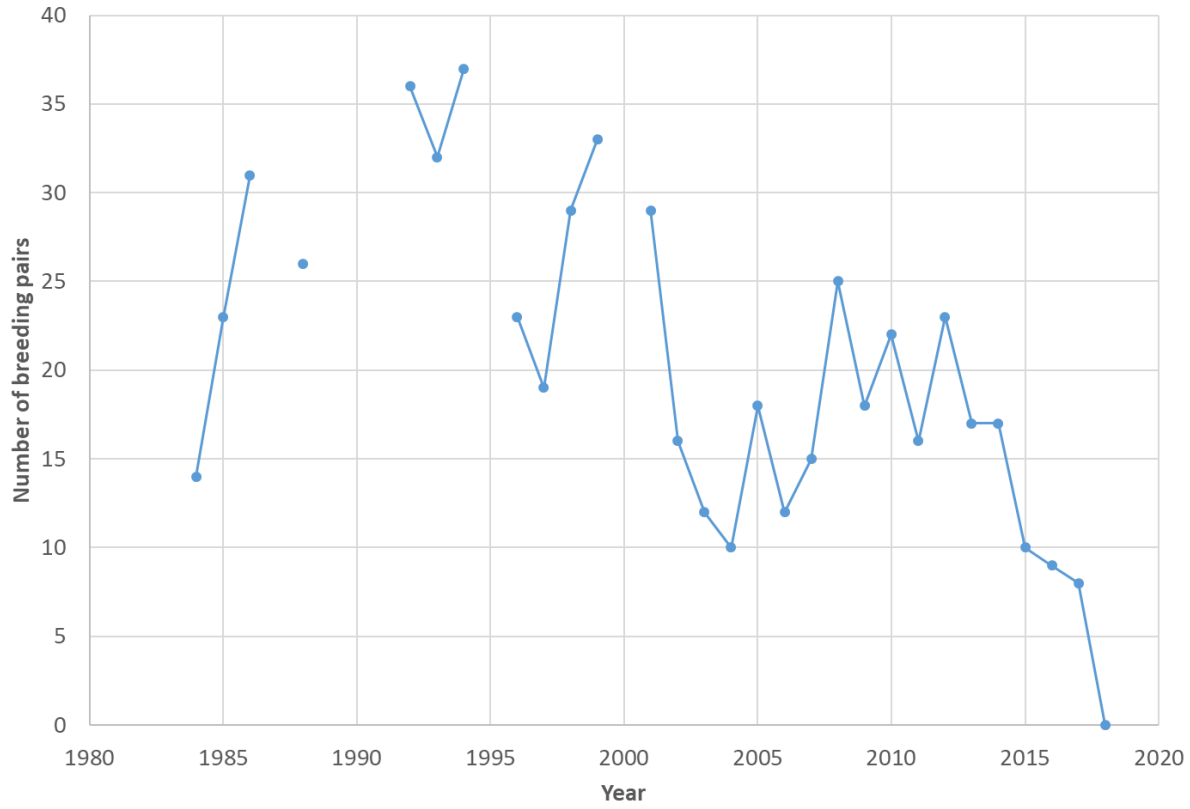
The count of nest sites reflects the number of nests created by investigators that were available each year, including the original nests on the island when the colony was first discovered.

Scientists observed 85 breeding pairs on Cooper Island in the summer of 2019. Of the 128 chicks that hatched, 32 fledged. This fledgling success is one-third the rate necessary to maintain the colony, according to the lead author of this ongoing study, Dr. George Divoky. In 2023, only 24 breeding pairs were observed.

Although no causal link has been established, the precipitous decline in the breeding health of the Cooper Island colony and the Herschel Islands colony (see Section 8) coincides with extreme conditions in the wintering habitat for black guillemots. During the winter of 2017–2018, the Bering Sea experienced record low sea ice conditions from early December through April (Divoky et al., 2018).

To supplement the observations shown in this feature, Figure TD-1 shows a similar analysis from another long-studied black guillemot colony on Herschel Island, Canada. This additional analysis offers corroborating context for the overall breeding health of the black guillemot population in the western Arctic region (Kuyt et al., 1976).

Figure TD-1. Black Guillemot Breeding Pairs on Herschel Island, Canada, 1984–2018



Data source: Eckert (2018)

7. Quality Assurance and Quality Control

Quality assurance and quality control involved review by several scientists involved in the annual studies and familiar with this colony of birds.

Analysis

8. Comparability Over Time and Space

Annual studies over the 40+ years since the colony was first discovered have used consistent census methods for identifying and counting breeding pairs of the birds. The number of breeding pairs is simply the number of active nests (nests with eggs). As all nests are in human-made nest sites, it is possible to

consistently examine all places where guillemots would be breeding and determine the number of breeding pairs. In 2011, all of the original sites were replaced with bear-proof plastic nest cases. The nest cases were provided before the start of egg laying and were adopted by the birds. No known breeding pairs have used natural nest sites. Beyond nesting cavity installations and nest cases, no further human interventions have influenced the birds during the breeding season. The observations have been consistently collected during summer months (June–August).

Cooper Island had more breeding pairs than nest sites in the late 1980s, when some of the larger nesting sites were occupied by more than one pair. Many additional birds were present but unable to breed due to the limited number of nest cavities. In some years, the colony had 200+ nonbreeding birds in addition to about 400 breeding birds. Most of the nonbreeding birds were banded, and many died without entering the breeding population.

9. Data Limitations

Factors that may impact the confidence, application, or conclusions drawn from this feature are as follows:

1. Nests used on Cooper Island are in human-made cavities, thereby giving researchers access to all nest contents for study. The creation of nest sites by the researchers from 1972 to 1984 allowed the colony to grow from 10 breeding pairs in 1972 to nearly 200 in 1984; therefore, it influences the numbers of breeding pairs in the early part of the record.

2. Changes in the timing and duration of the breeding season significantly influence the likelihood of successful reproduction. Successful reproduction can also be influenced by competition from other bird species, the activity of predators such as polar bears, and the success of and immigration from other black guillemot colonies in the Arctic. The timing and duration of the breeding season can also change in response to changing temperatures and snow and ice conditions.

10. Sources of Uncertainty

While visual field observations and counts of bird species have inherent uncertainties, the Cooper Island colony—with nesting opportunities only in human-made sites—allows an accurate census of the number of breeding pairs annually. Uncertainties in this data set are associated with bird tagging errors (e.g., lost tags) or count recording error. These uncertainties have been identified and minimized, though not explicitly quantified. More than 95 percent of the guillemots that survive the nonbreeding season return to the same nest sites, so there is little or no loss of established breeders to other colonies. Additionally, with the exception of a few individually breeding pairs, the closest guillemot colonies are more than 400 kilometers away. This means that the birds present on the island are those that inhabit the island; they are not visitors from nesting colonies elsewhere in the region. For reference, the two closest guillemot colonies are at Cape Lisburne in Alaska and Herschel Island in Canada.

11. Sources of Variability

While the availability of suitable habitat and prey are critical to thriving guillemot populations, many factors could contribute to the variability of the number of breeding pairs. Shifts in range, overwinter

survival, temperature and snow cover conditions, the availability of more preferable nesting sites, and species gender balance are some of the potential sources of variability. In addition, as the count of breeding pairs depends on the observation of successful egg laying, changes in fertility or nest predation could influence annual totals.

Immigration from other colonies in the region has contributed to colony growth and also maintenance. As all birds fledging from the colony are banded, the annual number of immigrants per year has been known since 1978. A decrease in immigration rates to the island had contributed to the increasing number of vacant nest sites. The decrease in immigration may be due to a decrease in productivity at source colonies or to Cooper Island being an undesirable location for recruitment for nonbreeding prospecting birds.

12. Statistical/Trend Analysis

This feature does not report on the slope or average rate of change in the figure, nor does it calculate the statistical significance of these trends or provide confidence bounds. This is primarily due to the limited, discrete temporal nature of these data.

References

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