

# 2019 Eastern Bering Sea Ecosystem Status Report:

## IN BRIEF

### Current Conditions

The eastern Bering Sea experienced the second year of low sea ice conditions during winter 2018/2019 due to (1) residual heat in the Chukchi Sea in fall of 2018 and (2) anomalous winds from the south in February 2019 causing ice retreat. The 2018-2019 mean sea ice extent was the second lowest of record (only 2017-2018 was lower).

Over the southern shelf, summer surface and bottom water temperatures increased from 2018 and were significantly warmer than their long-term means. No cold pool (footprint of winter sea ice the following summer) was present over the southern shelf and unprecedentedly warm bottom temperatures occurred in coastal waters. A small cold pool was located over a portion of the northern shelf in summer 2019.



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## How did the system respond?

The current eastern Bering Sea ecosystem has been shaped by environmental and biological conditions (1) that occurred in 2018, (2) that were observed in 2019, and (3) that reflect cumulative impacts delivering a ‘double whammy’ to the ecosystem.

### How did conditions in 2018 influence 2019?

Lagged (delayed) impacts of poor feeding conditions experienced during 2018 may partially explain the **gray whale** Unusual Mortality Event (UME) and **short-tailed shearwater** die-off in 2019. Both species feed in the Bering Sea during summer; gray whales feed in the northern Bering and Chukchi seas and are benthic feeders (e.g., amphipods, crab larvae) while shearwaters are planktivorous (e.g., euphausiids). Both species embark on long migrations south for breeding. The 2019 mortality events may reflect 2018 feeding conditions in the Bering Sea, conditions experienced during the breeding season, or lack of available prey to complete the migration to the Bering Sea in 2019.

### What did 2019 look like?

This was the second year of little winter sea ice (winter 2018/2019) and a reduced cold pool extent (summer 2019). However, the 2018/2019 winter sea ice accumulation differed from winter 2017/2018. Residual heat delayed freeze up until mid-December (similar to 2017/2018). Nevertheless, accumulation approached the long-term mean sea ice extent through January 2019 (whereas 2018 sea ice never approached normal levels). But then persistent southerly winds during February reduced **sea ice** (similar between years). The impact and subsequent ecosystem effects of early sea ice are not fully understood, although it is hypothesized that the small, retracted cold pool (i.e., thermal barrier) may have contributed to the increased biomass of adult **Walleye pollock** over the southern shelf in 2019.

The timing of the peak spring bloom in 2019, estimated from satellite data, was earlier than the long-term average (by approximately 9 days) and earlier than 2018. The spring bloom fuels secondary production of the zooplankton prey community that forms the base of the marine food web (energy transfer for upper trophic levels of fish, seabirds, and mammals). In 2019, the zooplankton community was dominated by small copepods, which is typical of warm-year conditions over the shelf, while **large copepod** and **euphausiid** abundances were low. Warm temperatures increased copepod secondary production rates. This, combined with an earlier bloom, may have resulted in sustained production and energy transfer into summer 2019. **Jellyfish**, which are pelagic consumers of zooplankton and small fishes, showed a sharp increase in biomass in 2019 relative to 2018 and their long-term mean.

On the Pribilof Islands, reproductive success of several seabird species improved in 2019. This suggests that birds were able to find sufficient food resources to support reproductive efforts during 2019. Successful breeding events occurred for fish-eating species (i.e., **murre**s at St. George Island and red-faced cormorants at St. Paul Island) and mixed fish/plankton-eating species (both species of **kittiwakes** on both islands). However, oceanographic surveys showed that the zooplankton community was made up of primarily small copepods. Several possible explanations include: (i)

seabirds may have been successful at finding lipid-rich (higher fat) copepods and euphausiids, even though abundances were low; (ii) competition for available prey was reduced as a result of shearwater mortalities and/or poor recruitment events for fish species; and (iii) colonies at the Pribilof Islands may have benefited from northward shifts in fish populations. Evidence supporting these hypotheses include the below-average coccolithophore bloom index for 2019 and the high abundance of **age-0 pollock** collected on the Arctic Integrated Ecosystem surface trawl survey.

**Unprecedented warmth** in coastal waters during summer 2019 likely resulted in increased metabolic demands. Under these conditions fish tend to eat more and move more, which may have impacted fish distributions. For example, the increased warmth may have pushed **juvenile Pacific cod** away from warm coastal waters and made them more available to the bottom trawl survey, contributing to the large increase in abundance of young cod in 2019. In Bristol Bay, **sockeye salmon** returns remained high. The large inshore run in 2019 suggests these stocks experienced positive conditions at entry into the eastern Bering Sea in the summers of 2016 and 2017, and winters of 2016/2017 and 2017/2018.

### Cumulative impacts

Adult groundfish condition over the southern shelf increased in 2019 relative to 2018 and was positive for several key species sampled during the bottom trawl survey. Large increases were shown for adult pollock, Yellowfin sole, and Arrowtooth flounder, suggesting a possible shift to a benthic-dominated system. **Arrowtooth flounder** biomass continued an increasing trend since 2017. Groundfish condition reflects ecosystem productivity, especially when viewed across stocks, and population dynamics within a stock. However, the biomasses of many crab stocks remain below their long-term means, such as Bristol Bay **red king crab**.

The **2018 pollock year class** showed strong overwinter survival to age-1. However, several indicators of survival measured in 2018 (e.g., food availability, energy content) predicted below-average recruitment to age-1. The occurrence of strong recruitment in light of low sea ice, above-average water temperatures, and poor prey quality/quantity challenges our current understanding of recruitment processes for pollock. One hypothesis stems from the anomalous February winds from the southwest. Winds brought warm, moist air from the south over the shelf, but may have also increased on-shelf flow and upwelling conditions. Upwelling of productivity during winter may have subsidized energy transfer (food availability) and contributed to increased survival of age-0 pollock. In combination with greater overwinter survival, the 2018 year class may have experienced reduced predation pressure from cannibalism because recruitment of recent year classes has been low. Pollock age-1 natural mortality peaked in 2016. It has declined in recent years. The 2019 estimate was at the long-term mean, also demonstrating reduced predation pressure for the 2018 year class. That said, this year’s bottom trawl survey showed a 75% increase in pollock biomass over the southern shelf from 2018 to 2019. This suggests that adult fish moved into the region (recruitment of small fish could not account for such a large increase in biomass). Therefore, the 2019 year class may

## What do the indicators tell us this year?



experience increased predation pressure from cannibalism (from the 2018 and older age classes).

The declaration of an Unusual Mortality Event for **ice seals** reflects cumulative impacts of conditions in 2018 and 2019. The increased mortality of seals and the apparent decline in pup condition demonstrate immediate and delayed impacts of the loss of sea ice habitat for pupping and nursing in both years.

They could also demonstrate broader ecosystem effects, such as competition for prey from northward shifts of fish populations. At the Pribilof Islands, community members reported unusually high numbers of male fur seals overwintering at St. Paul (i.e., they never left from the 2018 season), reflective of the continuous warmth throughout the year.

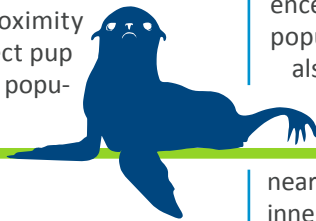


## Northern Fur Seal Foraging Effort

Since 1998, Northern fur seal pup production on the Pribilof Islands has declined 51%. In contrast, pup production on Bogoslof Island has increased at an annual rate of 10% since 1997. The population decline at St. Paul Island may be attributed to low pup growth rates due, in part, to extended foraging trips required for nursing females to provision pups. On Bogoslof Island, nursing females make shorter foraging trips and spend a higher proportion of their time on shore nursing their pups. This contributes to greater pup growth rates. Females from St. Paul Island make extended foraging trips and compensate by spending longer periods on shore but are unable to make up for pup mass loss during these longer trips.

Preliminary data from the Alaska Fisheries Science Center's Marine Mammal Laboratory show that the contrasting trend in foraging effort between St. Paul and Bogoslof islands continues. Average foraging trip duration of fur seals from St. Paul Island is ~8 days, whereas trips are significantly shorter (average ~4 days) for fur seals on Bogoslof Island. A study to examine the energetic expenditure of females found that lactating females from the Pribilof Islands appear to have reached a metabolic ceiling. In other words, they are working hard to find food and have very limited flexibility to adjust to changes in prey resources without extending trip durations.

Collectively, the results of the foraging effort and bioenergetic studies suggest that lactating females on St. Paul Island are having difficulty finding food in close proximity to the rookery, which could adversely affect pup growth rates and contribute to the ongoing population decline on St. Paul Island.



## Future Projections

A continuation of warm conditions is projected across virtually all of the North Pacific through December 2019 with reduced positive anomalies over the southern Bering Sea shelf. The forecast for the upcoming winter indicates a 50-55% chance of neutral conditions and a 30% chance of El Niño.

## Management Uses

Ecosystem and stock assessment scientists were able to work together to account for the influence of exceptional environmental conditions in the Bering Sea on several commercially-important fish stocks. Specifically, stock assessment scientists considered ecosystem information in 6 full assessments for eastern Bering Sea (EBS) and Bering Sea/Aleutian Islands fish stocks. For three of these assessments there was an elevated risk associated with ecosystem dynamics. For two stocks, EBS Walleye pollock and Pacific cod, the biological catch level was reduced noting ecosystem concerns. For pollock, scientists and managers noted the potential negative impacts on survival and recruitment success due to the

## Integrating Knowledge: Seabirds

In this year's Eastern Bering Sea Ecosystem Status Report, information was collected from a number of sources to derive regional seabird summaries in the southeastern and northern Bering Sea. The synthesized information provides an overview of environmental impacts on seabirds, which are indicative of ecosystem productivity.

Reproductive success (or failure) can be a reflection of feeding conditions and prey availability in the environment for breeding birds. This also has implications on subsistence egg practices, harvest of adult birds (e.g., kittiwakes), food security, and human health. Timing of seabird reproductive stages (phenology) at colonies can reflect ecosystem conditions encountered by birds during the months preceding the breeding season. Specifically, long-lived seabirds may delay or defer breeding if foraging conditions limit their ability to build up their energy reserves to support energy demands during the breeding season. Reproductive failure during the breeding season, such as abandonment of nest sites, may indicate (i) that foraging conditions were poor during the non-breeding season and birds did not return to the colony in good condition, (ii) that foraging conditions deteriorated rapidly, or (iii) the presence of disturbance at the colony such as from land-based predators. Reproductive success within a season can differ among planktivorous (primarily zooplankton-feeding), piscivorous (primarily forage fish-feeding), and mixed planktivorous/piscivorous species, reflecting potential differences among those different prey resources. Large impacts to populations, such as in the case of seabird die-off events, may also indicate broader ecosystem concerns (e.g., harmful algal blooms, broad-scale lack of prey).

near absence of a "cold pool" and very warm conditions on the inner part of the EBS shelf. For Pacific cod, both assessment and ecosystem concerns lead to a reduction in the biological catch level. Scientists and managers considered the potential impacts of shifts in the food web dynamics in the northern Bering Sea in their analysis and decision-making.

Because of anomalously high numbers of young sablefish in the Alaska-wide population, there was an extreme amount of incidental catch in the EBS trawl fishery. This contribution to the total catch nearly caused the Overfishing Limit to be exceeded.



Links to full reports from Large Marine Ecosystems are available here: <https://access.afsc.noaa.gov/reem/ecoweb/Index.php>

**Reference:** Siddon, E., and Zador, S., 2019. Ecosystem Status Report 2019: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, AK 99501

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