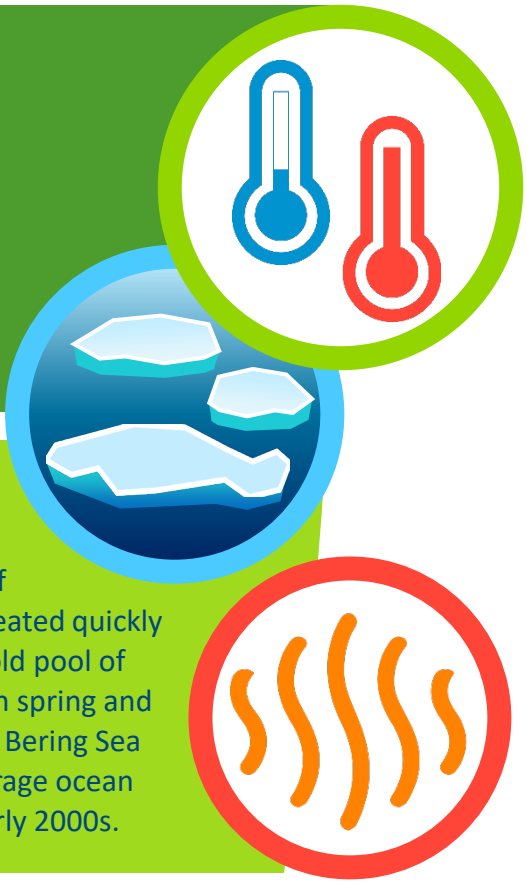
2020 Eastern Bering Sea Ecosystem Status Report:

IN BRIEF

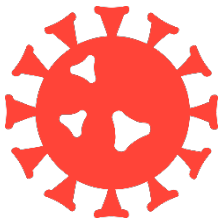


Current Conditions

Considerable cooling began in late December 2019 and allowed for rapid build-up of sea ice, exceeding the median (1981-2010) ice extent in parts of February and March 2020. However, ice thickness was low and the ice retreated quickly with warm winds in spring. This seasonal sea ice was sufficient to form a cold pool of average spatial extent. Above-average sea surface temperatures returned in spring and remained above average through fall 2020. The southeastern and northern Bering Sea are experiencing a persistent warm stanza (consecutive years of above average ocean temperatures), greater in both magnitude and duration than that of the early 2000s.

COVID-19 Impacts

During 2020, several key research surveys were canceled in the eastern Bering Sea due to COVID-19. While data gaps still exist, NOAA scientists, state/university partners, tribal governments, and coastal community members provided new and innovative contributions to inform our understanding of the current ecosystem state. Some examples include information from local communities on seabird conditions (see 2020 Integrated Seabird Information), satellite-derived indicators including new marine heatwave information, and the use of a model (Bering 10K Regional Ocean Modeling System [ROMS]) to hindcast ocean bottom temperatures and better understand ocean carbonate chemistry (see Hot Topic on Ocean Acidification).



The Defining Role of Sea Ice

Tracking the seasonal progression and retreat of sea ice over the shelf highlights the interactive roles of water temperature and winds. Late arrival of sea ice is more common over the past 40 years. Delayed freeze-up leads to shortened ice seasons that have impacts on ice thickness, ice algae, and cooling effects. Shorter ice seasons and thinner sea ice also affect transportation and subsistence activities. After two years of little to no sea ice over the Bering Sea shelf, 2020 represented a return to near-normal ice extent. However, these conditions appeared to have only minimal mitigating effects on the warmth in the upper water column, even though the cold pool extent was average. The vertical separation of warm surface waters and cooler bottom waters is more typical of shelf conditions and plays a key role in predator/prey dynamics.

NOAA FISHERIES

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What did we see in 2020?

Sea surface temperatures (SSTs) over the eastern Bering Sea cooled to average temperatures during March 2020. However, SSTs increased again through spring and summer 2020. As of November 18, 2020, the northern Bering Sea region had exceeded the **marine heatwave** threshold (heatwaves occur when daily SST exceeds the 90th percentile of normal for 5 consecutive days). The frequency and duration of marine heatwaves in the Bering Sea have increased over the past several decades, especially in the northern Bering Sea.

Phytoplankton are primary producers, the base of the marine food chain, and provide fundamental energy and nutrients for zooplankton grazers (e.g., small animals, larval fish, crabs) and higher trophic level species.

Chlorophyll-a concentrations were lower in 2020 than 2019 in most regions of the shelf. Over the southeastern shelf, chl-a biomass has been below average since at least 2016, except on the outer continental shelf where it was above average in 2020. Low chl-a biomass could indicate reduced production and/or increased grazing by zooplankton.

The timing of the 2020 spring bloom peak over the southern shelf was about a week earlier than average (ice cover in spring limits satellite data coverage for estimating peak bloom timing in the northern regions). This contrasts with both 2017 and 2018. The year 2017 had one of the earliest spring bloom peaks, while 2018 had among the latest.

The **coccolithophore** bloom index increased, particularly on the middle shelf, in 2020. Coccolithophores may be a less desirable food source and their small size results in longer trophic chains. The striking milky aquamarine color of the water during a coccolithophore bloom can also reduce foraging success for visual predators.

Combined, these indicators of primary producers suggest limited and/or poor quality of the prey base to support trophic energy transfer (e.g., juvenile fish, seabirds) in 2020.

Seabirds are upper trophic level predators and are indicators of changes in their prey availability. Seabird trends observed this year highlight regional differences in prey availability of both zooplankton and forage fish.

In the southeastern Bering Sea, colony attendance (estimates of abundance) and reproductive success suggest that **fish-eating species** were able to find sufficient food while **plankton-eating species** were not.

In the northern Bering Sea, at St. Lawrence Island, least auklet (plankton-eating) reproductive success was higher in 2020. However, there was a rare mass die-off of **auklet fledglings** (usually associated with starvation) during late chick-rearing. This indicates potential issues with zooplankton availability during August 2020. Conversely, in the Bering Strait region, the majority of **seabird** carcasses reported during this time were fish-eating species, although some plankton-eating birds were also affected.

Additional indirect evidence of poor feeding conditions in the northern Bering Sea comes from the continuation of the Unusual Mortality Event (UME) for **gray whales**. Gray whales feed in the northern Bering and Chukchi seas and are typically benthic feeders (e.g., amphipods). However, under warm conditions, they may shift from foraging on the bottom to feeding on zooplankton in the water column. The 2020 continued mortality events may reflect cumulative impacts of changes in food web structure and carrying capacity of the northern Bering Sea.

The 2020 Bristol Bay **sockeye salmon** inshore run was the fifth largest on record and higher than the long-term average. These fish experienced positive ocean conditions in summers of 2017 and 2018 and winters of 2017/2018 and 2018/2019. Juvenile sockeye salmon feed on zooplankton and age-0 pollock in warm years; adults feed on zooplankton, including krill.

Juvenile sockeye salmon may have exerted increased predation pressure on **age-0 pollock** in recent years. However, low recruitment success of pollock in recent years may have resulted in lower rates of cannibalism. The climate-enhanced multispecies model (CEATTLE) estimates that age-1 predation mortality for pollock has declined since 2016 and is at the long-term mean. This suggests that declines in total predator biomass are contributing to reduced predation rates and mortality.

2020 Integrated Seabird Information

During 2020, the U.S. Fish and Wildlife Service was unable to conduct field research in the Bering Sea due to COVID-19 travel restrictions. Coastal community members, tribal governments, and state/university partners provided information on seabird dynamics from the region. The U.S. Fish and Wildlife Service biologists helped to synthesize the information and provide ecosystem implications.

At the Pribilof Islands, seabird attendance appeared average, to slightly below average, for black-legged kittiwakes and **common murres** (fish-eating species). However, least auklets (plankton-eating) continued to decline. There was a complete lack of **parakeet auklets**, a plankton-eating species known for eating jellyfish, from St. Paul Island. Previously this had been the most abundant auklet species since monitoring began in the late 1970s.

At St. Lawrence Island, colony attendance and reproductive success differed among fish-eating and plankton-eating seabirds. This suggests foraging impacts across trophic levels. Seabird mortality events in the northern Bering Sea were unusual due to the magnitude, geographic range, and duration. Bird carcasses of several species were observed on beaches on both the eastern and western sides of the Bering Strait.

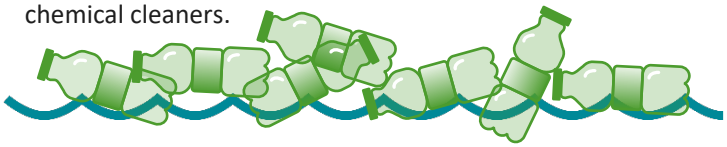
What do the indicators tell us this year?

Hot Topics

Ocean Acidification. To track and forecast the spatial extent of acidified waters in the Bering Sea, the Bering 10K Regional Ocean Modeling System (ROMS) model provides critical information on bottom water conditions over the shelf. The acidified waters are caused by both natural processes and oceanic uptake of anthropogenic CO_2, which decreases pH and reduces the availability of carbonate for shell building organisms. The anthropogenic process is called Ocean Acidification. Changes in pH pose threats to marine organisms and changes in carbonate availability affect shell building organisms.

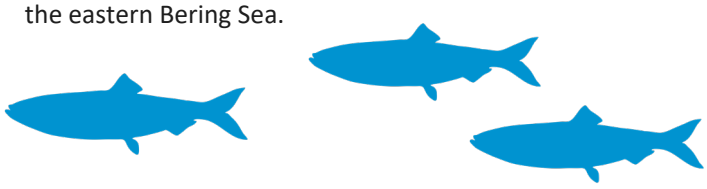
In 2020, scientists used the model to track ocean conditions that could be corrosive to marine life that depend on aragonite (e.g. coral, bivalves). Future indices related to ocean acidification will be developed for calcite saturation, which is important for crab species.

Marine Debris. In July 2020, communities in the Bering Strait region began reporting an increased amount of marine debris that continued through at least October 2020. The debris was predominantly foreign in manufacture, with Russian and Korean labeling. Debris types varied by location, but included beverage bottles, food containers, personal product containers, household aerosol cans, and chemical cleaners.



This debris event added to existing concerns in the Bering Strait region about food security and economic impacts due to increased commercial fishing/processing activities and other marine industrial vessel traffic.

Incidental Catch of Herring. Pacific herring are identified as Prohibited Species Catch (PSC) in the Bering Sea and Aleutian Islands Groundfish Fisheries Management Plan. The PSC limit is set at 1% of the eastern Bering Sea herring biomass. The incidental catch of herring in the 2020 directed pollock fishery exceeded the PSC limit, which was unusual because it occurred in the winter 'A' season (i.e., early in the year) and during a period of relatively high CPUE for pollock fishing. Several hypotheses related to changes in the herring or pollock populations that could explain the high PSC catch in 2020 are explored in the full Ecosystem Status Report along with areas of research that could inform the hypotheses and further the understanding of herring population dynamics in the eastern Bering Sea.



Future Projections

A continuation of warm conditions is projected through the end of 2020 across the entire Bering Sea and north of Bering Strait. Peak temperatures will occur in the Chukchi Sea and are expected to delay sea ice formation in winter 2020/2021.

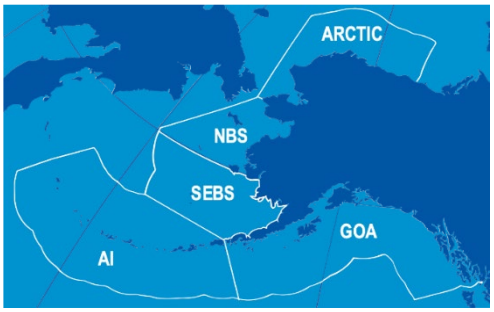
Modestly warm conditions over the Bering Sea shelf are predicted to result in a light sea ice year. Sea surface temperature projections in the tropical Pacific indicate a weak to moderate La Niña. This is predicted to bring some cooling to the eastern Bering Sea shelf into spring 2021.

Management Uses

Ecosystem and stock assessment scientists worked together to account for the influence of exceptional environmental conditions in the Bering Sea on commercially-important fish stocks. They considered ecosystem information in 21 full assessments for eastern Bering Sea and Aleutian Islands stocks and the Alaska-wide sablefish stock. Five of these assessments classified ecosystem dynamics at risk level 2 (out of 4), noting substantially increased concerns: EBS pollock, EBS and AI Pacific cod, Greenland turbot, and sablefish.

For two stocks, EBS pollock and sablefish, the acceptable biological catch (ABC) level was reduced. The ABC for EBS pollock was reduced 30% from Tier 1 to Tier 3 maximum permissible noting both ecosystem and fisheries performance concerns. The ABC for Alaska-wide sablefish was reduced 44% in part due to a trend of increasing trawl catch of sablefish, a fishery performance concern, primarily in the Bering Sea, and statewide assessment and population dynamics concerns.

For the remaining 19 stocks, precautionary measures already incorporated into setting catch levels were considered sufficient to address uncertainty about current ecosystem dynamics.



More information on these and other topics can be found on the Ecosystem Status Report website:

https://www.fisheries.noaa.gov/alaska/ecosystems/ecosystem-status-reports-gulf-alaska-bering-sea-and-aleutian-islands

Reference: Siddon, E. 2020. Ecosystem Status Report for the Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, AK 99501.

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