Noteworthy Topics

Environmental DNA:
Poised to Transform How We Track Fish Populations

Environmental DNA (eDNA) can provide single-species and community level information that could be used in fisheries assessments and management. While eDNA cannot replace some of the biological data collected from traditional survey methods, there are numerous opportunities to expand eDNA collections and leverage eDNA data for fisheries research and management. Current and on-going collaborations are addressing gadid populations in the Arctic, groundfish communities in the EBS, northern fur seal and Steller sea lion diet studies in the Aleutian Islands, and ice seal surveys along the ice edge during spring break-up.

Alaska Department of Fish & Game Nearshore Survey

In September 2024, ADF&G surveyed nearshore marine waters of the southeastern Bering Sea. The aim of the survey was to study the early marine life stage of salmon originating from southwestern Alaska. This survey is intended to be the start of a long-term project to assess the early marine ecology of southwestern Alaska stocks, to understand factors that influence population dynamics, and to make progress towards developing a forecasting tool for Kuskokwim River salmon.

A Borealization Index for the Southeastern Bering Sea

Borealization is the transition from an Arctic physical state supporting a cold-adapted species assemblage to a subarctic (boreal) physical state supporting a warm-adapted assemblage. An index of borealization was developed that includes nine time series that reflect the difference between Arctic and boreal conditions in the southeastern Bering Sea. The borealization index has reverted to the timeseries mean from 2022–2024.

Future Projections

Looking ahead, the expected transition to La Niña is projected to bring continued cooler conditions to the EBS shelf with SST anomalies within 0.25°C of average. Relatively cool SSTs during the early ice season may contribute to earlier formation of sea ice. However, recent storms (e.g., October 20–22, 2024) in the NBS and Bering Strait region may now entrain relatively warmer water into the surface layer and delay sea ice formation.

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

Management Uses

Ecosystem and stock assessment scientists worked together to account for the influence of environmental conditions on commercially-important fish stocks. They considered ecosystem information in 17 operational assessments for the Bering Sea and Aleutian Islands stocks plus the Alaska-wide sablefish stock in 2024. One of these assessments classified ecosystem dynamics at risk level 2 (Increased Concern; out of 3 levels ranging from level 1: Normal to level 3: Extreme Concern) in the Bering Sea, noting adverse signals related to biological status of prey and competitors for the eastern Bering Sea Pacific cod stock. The Aleutian Islands Pacific cod and Atka mackerel assessments also classified ecosystem dynamics at a risk level 2 (see AI In Brief for details).

Following review of ecosystem information and the stock assessment, the Scientific and Statistical Committee (SSC) set the acceptable biological catch (ABC) for eastern Bering Sea Pacific cod under Tier 3b at the maximum permissible (max ABC).

Two additional BSAI stocks had recommended reductions from max ABC for 2024. Greenland turbot had a recommended reduction of 25% based on assessment-related concerns, population dynamics considerations, and fishery-informed stock considerations. No increased ecosystem concerns were noted for this stock. The shark complex had a full assessment in 2022 that was updated in 2024. A recommended reduction from max ABC of 13% in 2022 was carried forward for 2024.

The Alaska-wide sablefish stock's ABC was reduced from maximum permissible by 5% due to elevated concern in the stock assessment and fishery-informed stock considerations

For the remaining stocks managed in the eastern Bering Sea, including eastern Bering Sea pollock and yellowfin sole, no ecosystem-related reductions from max ABC were recommended for 2024, as precautionary measures already incorporated into setting catch levels were considered sufficient to address uncertainty about ecosystem dynamics.

Reference: Siddon, E. 2024. Ecosystem Status Report 2024: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501.

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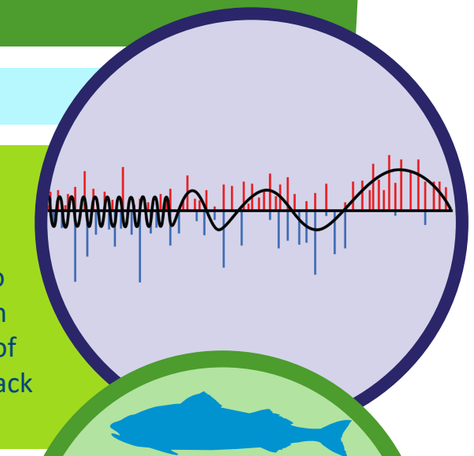
2024 Eastern Bering Sea Ecosystem Status Report:

IN BRIEF

Current Conditions

The eastern Bering Sea (EBS) transitioned from year-to-year variability (1982–2000), to multi-year stanzas of warm (above-average temperatures) and cold (below-average temperatures) conditions (2000-2013), to a warm period unprecedented in magnitude and duration (2014-2021). This warm period included a near-absence of sea ice in the winters of 2017/2018 and 2018/2019 and lack of a cold pool in the summers of 2018 and 2019.



During the extended warm period, some stocks had large recruitment events, like Togiak herring and Bristol Bay sockeye salmon. Conversely, some stocks experienced declines, like snow crab and multiple Western Alaska salmon runs.

Since 2021, the EBS has returned to average thermal conditions based on metrics such as sea ice extent, sea surface temperatures, and bottom temperatures. This has resulted in different ecosystem responses in the southeastern and northern Bering Sea. Over the southeastern shelf, zooplankton quality has remained low. For pelagic foragers like pollock, this has led to reduced fish size. However, overall biomass increased 74% in the bottom trawl survey as the 2018 year class continues to grow. Over the northern shelf, zooplankton quality has improved, yet juvenile salmon condition declined and overall biomass trends of forage fish were mixed in 2024.

NOAA FISHERIES
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Ecosystem Impacts

The southeastern and northern Bering Sea (divided at 60°N) have different oceanographic and zoogeographic characteristics. An assessment of the ecosystem response to the average thermal conditions (since 2021) and current 2024 status in the ecoregions is provided.

Southeastern Bering Sea

Over the past year (August 2023–August 2024) sea surface temperature (SST), wintertime sea ice extent, and summer cool pool extent continued to be near historical averages. **Persistent storms** through summer 2024 mixed the upper water column deeper than usual. This brought cooler water from depth and kept SSTs cooler. The fall phytoplankton bloom started unusually early in 2024. A large storm in late August caused water column mixing, which introduced nutrients to the surface, and initiated the bloom.

At the seafloor, the biomass of echinoderms, including **sea stars, brittle stars, and sea cucumbers**, remained above-average in 2024. **Crab** populations remained low, although tanner crab and snow crab had some relative increases. The biomass of small-mouthed flatfishes remained below-average with some species, like **yellowfin sole**, increasing and other species, like **Alaska plaice**, decreasing. The condition of small-mouthed flatfishes has been mixed since the return to average thermal conditions in 2021. The biomass of **arrowtooth flounder**, a large-mouthed apex predator, increased 26% from 2023 to 2024.

Alaska Fisheries Science Center's spring Rapid Zooplankton Assessment was dominated by **small copepods**, with low abundance of **large copepods and euphausiids**. Summer and fall zooplankton patterns were similar, with some increased euphausiid abundance to the north. Euphausiid density during the summer acoustic survey was the second-lowest in the time series. The revised Oscillating Control Hypothesis would predict large, lipid-rich copepods under cool conditions. However, it is important to note that thermal conditions have returned to average, not cool.

In spring 2024, **larval pollock** abundance was the highest of years sampled (2012, 2014, 2016, 2018, 2024). By late summer, **age-0 pollock** abundance estimates were low. The energy density of age-0 pollock has remained below-average since 2014 and the condition of small (100-250 mm) and large (>250 mm) pollock has decreased and/or remained below-average since ~2021. While individual fish condition has declined, the overall biomass of **pollock** increased 74% in the bottom trawl survey. Adult pollock were distributed over the northwest outer domain where large oceanic copepods occur. This was reflected in their diets in 2024. Also, rates of cannibalism were low between 2021–2024.

Seabirds are indicators of zooplankton and forage fish availability. Seabird condition may serve as a proxy for what prey is available to commercial fish, since they feed on the same prey. Seabird species that experienced recent population losses, like least auklets, have not rebounded.

Overall, **seabird reproductive success** was mixed for both plankton-eating and fish-eating species. Seabird reproductive success was generally higher on St. George Island than on St. Paul Island, similar to 2023. No major seabird die-off events were observed in 2024.

Metrics of **ocean acidification** (OA; pH and Ωarag) continued a multi-decadal decline, indicating more corrosive bottom-water conditions for marine calcifiers. At this time, there is no evidence that OA is linked to recent declines in crab populations. It is worth noting that Ωarag is approaching the threshold value for pteropod shell dissolution that could have biological significance throughout the food web.

Northern Bering Sea

The extent of **sea ice** has been steadily increasing in the northern Bering Sea (NBS) since 2018 and ice thickness has increased dramatically to above-average in the Bering Strait region since 2021. Ice thickness may be a proxy for ice residency over the shelf, which may be related to the abundance of ice algae that contributes to the productivity of the NBS ecosystem. In fact, the abundance of **large copepods** in fall over the NBS shelf has increased to average since 2021. The lipid content of large copepods was significantly higher in 2024 compared to 2023. **Jellyfish** biomass increased in 2023 and remained high in 2024. Taken together, these indicators show that pelagic forage has increased in the NBS since 2021.

Measures of pelagic productivity in the NBS include age-0 pollock, herring, capelin, and juvenile salmonids. **Age-0 pollock** abundance has remained low compared to the southern shelf, fish weights have been below-average in 2022–2024, and energy density was below-average while % lipid was average in 2024. **Herring** also remained low in the NBS, but **capelin** increased dramatically from 2023 to 2024. Juvenile pink, chum, and coho salmon condition decreased from positive in 2023 to average in 2024. Juvenile Chinook salmon condition increased from average to positive in 2024, yet the abundance estimate of **juvenile Chinook salmon** was at a record low in 2024.

In the NBS, we track **harmful algal blooms** (HABs) as an emerging stressor to the ecosystem as well as people's nutritional, cultural, and economic needs. Recent oceanographic changes have made conditions more favorable for HAB species, particularly the dinoflagellate *Alexandrium catenella* and diatoms in the genus *Pseudo-nitzschia*. To date, higher prevalence of saxitoxin (produced by *Alexandrium catenella*) has been detected in Arctic food webs, including in the Bering Strait region.

What do the indicators tell us this year?

Salmon have unique life histories that can extend throughout the Bering Sea ecosystem and into the Gulf of Alaska. Species have shown contrasting responses to the return to average thermal conditions since 2021. Western Alaska chum salmon occupy the EBS in summer as juveniles before overwintering in the Gulf of Alaska, therefore their dynamics as juveniles are reflective of the pelagic environment in the EBS. These stocks collapsed during the warm period, driven by changes in prey and energetic condition. In the southeastern Bering Sea (SEBS), juvenile chum salmon fish condition has remained below-average in 2022 and 2024. In the NBS, condition has improved since 2021 and the 2024 **juvenile chum salmon** abundance estimate was the highest on record. These divergent trends indicate better pelagic foraging conditions for juvenile chum salmon in the NBS than the SEBS.