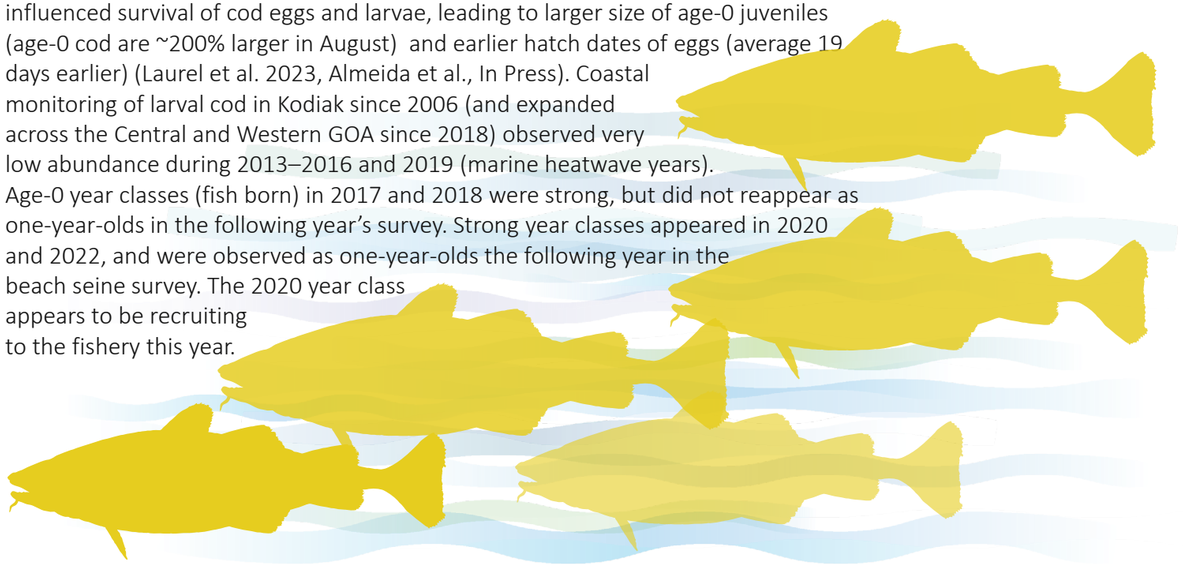
## Noteworthy

### Gulf of Alaska Pacific Cod Recruitment (2017–2023)

The Gulf of Alaska stock of Pacific cod experienced a 70% decline in population abundance in 2017, and has remained at reduced levels through 2023 (although the population is showing signs of growth in 2023). Warm ocean temperatures have influenced survival of cod eggs and larvae, leading to larger size of age-0 juveniles (age-0 cod are ~200% larger in August) and earlier hatch dates of eggs (average 19 days earlier) (Laurel et al. 2023, Almeida et al., In Press). Coastal monitoring of larval cod in Kodiak since 2006 (and expanded across the Central and Western GOA since 2018) observed very low abundance during 2013–2016 and 2019 (marine heatwave years). Age-0 year classes (fish born) in 2017 and 2018 were strong, but did not reappear as one-year-olds in the following year's survey. Strong year classes appeared in 2020 and 2022, and were observed as one-year-olds the following year in the beach seine survey. The 2020 year class appears to be recruiting to the fishery this year.



## Management Uses

*Section to be updated after the December North Pacific Fishery Management Council meeting*

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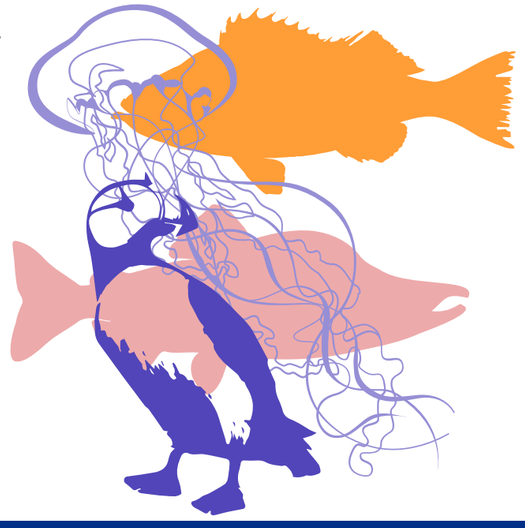

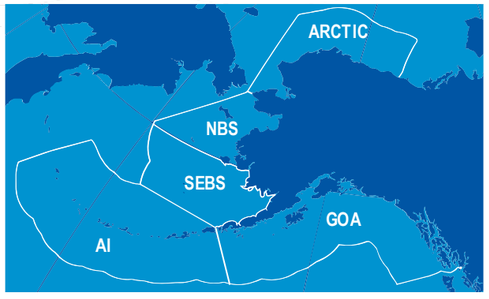


*More information on these and other topics can be found on the Ecosystem Status Report website.*

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

Reference: Ferriss, B.E. 2023. Ecosystem Status Report 2023: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, AK 99501.

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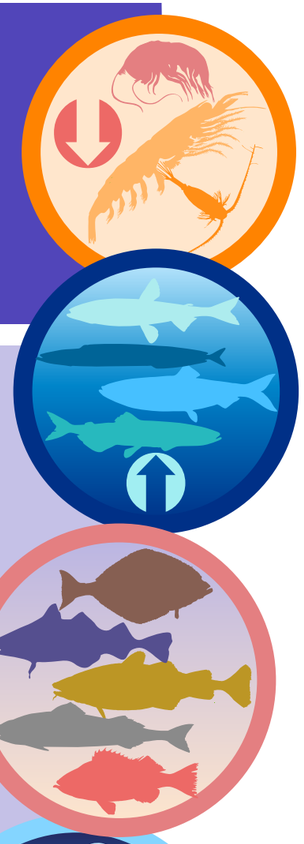
# 2023 Gulf of Alaska Ecosystem Status Report:

## IN BRIEF

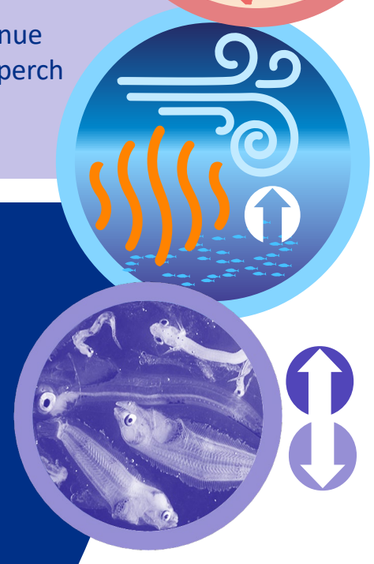


## Overview

- The Gulf of Alaska shelf marine ecosystem had an average year of productivity in 2023, continuing a multi-year trend that is expected to change in 2024.
- Zooplankton were less available in 2023 (prey for adult walleye pollock, Pacific ocean perch, dusky rockfish, northern rockfish and juvenile groundfish) but nutritious large copepods were more abundant across the GOA.
- Forage fish (prey for Pacific cod, sablefish, arrowtooth flounder, yelloweye rockfish) varied across the GOA, and included increased capelin.
- The predominant GOA groundfish species, by biomass, continue to be characterized by increased sablefish and Pacific ocean perch populations and reduced populations of Pacific cod, Pacific halibut, and arrowtooth flounder

## Multi-Year Trends

Given our current El Niño status and the associated warming surface waters predicted in winter/spring of 2024, the reduction in zooplankton availability and quality may persist into the coming year. Vulnerable groundfish in 2024 (due to warm surface waters and reduced zooplankton quality) potentially include the larval and age-0 juveniles of Pacific cod, walleye pollock, and northern rock sole. Warm surface waters can be favorable for larval rockfish and sablefish. Zooplankton-eating adult groundfish may have reduced prey availability (walleye pollock, Pacific ocean perch, dusky & northern rockfish) but the deeper adult habitat is not predicted to warm unless El Niño-related warming continues long enough to be mixed to depth.



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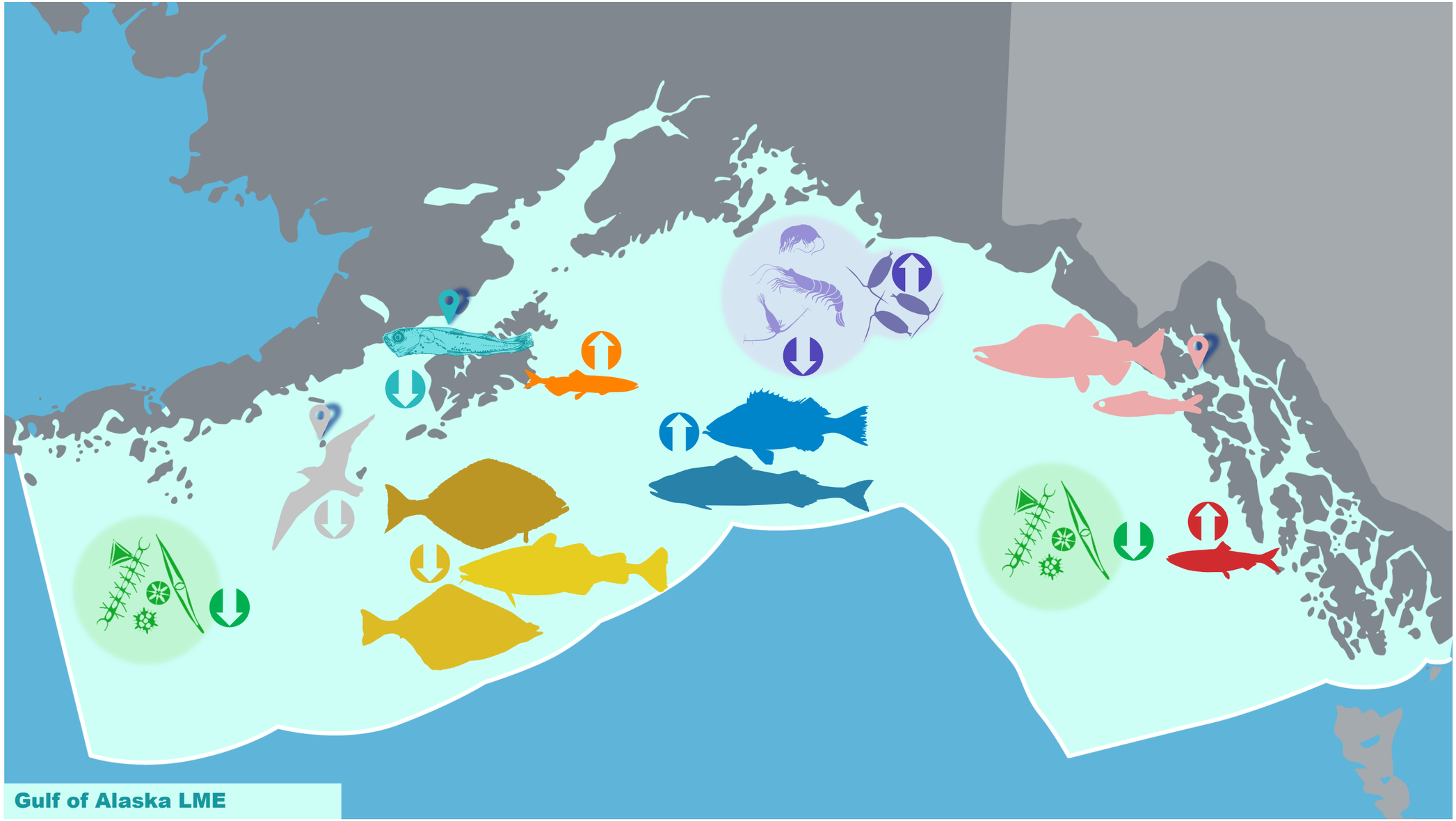
## Ecosystem Assessment

**Ocean temperatures were approximately average to cooler than average** in the winter and spring (surface and depth) and above average in the late summer, ranging from 5.8°C (WGOA Bottom Trawl Survey) to 10.5°C (Icy Strait, southeast Alaska). The cool early spring surface temperatures were favorable for walleye pollock, Pacific cod, northern rock sole egg and larval survival. The warm late spring/early summer surface temperatures may have been favorable for rockfish larval feeding and survival.

**The spring chlorophyll-*a* concentration (an indicator of primary production) continued a multiyear below average trend, and peak bloom timing was considerably late** (western GOA) to average (eastern GOA) across the regions. While late peak spring blooms can be driven by colder springs, this event may also be explained by a deeper mixed layer in the winter/spring. Weaker stratification of the water column and a deeper mixed layer depth can reduce the opportunity for wind mixing to bring plankton and nutrients to the surface to promote spring blooms.



Gulf of Alaska LME

**Prey availability for zooplankton-eating adult groundfish (e.g., walleye pollock, Pacific Ocean perch, dusky and northern rockfish), and larval/juvenile groundfish, was below average to average across the GOA shelf.** Total **zooplankton biomass** progressed from below average in the spring to improved conditions in the summer, although higher biomass of large copepods and euphausiid biomass were higher in many areas. **Biomass of larval walleye pollock and Pacific cod** in spring and summer surveys were low, suggesting less productive feeding conditions in the nearshore for both those larvae and the predators that feed upon them. Signs of a restricted zooplankton prey base include a decline from above average to average reproductive success for zooplankton-eating seabirds, skinnier adult pollock, below average energy density of juvenile salmon, and **juvenile pink salmon** diet dominated by jellyfish, tunicates, and other gelatinous prey (less nutritious zooplankton). Predictions for 2024 returns of **pink salmon** are less favorable based on juvenile CPUE, length, and energy density in 2023.

**Prey availability for fish-eating groundfish (e.g., Pacific cod, sablefish, arrowtooth flounder, yelloweye rockfish) was approximately average with signs of reduced abundance.** **Capelin** populations are rebounding for the first year since their decline during the 2014-2016 marine heatwave. **Herring** population biomass remains elevated, but is decreasing due to a declining 2016 strong year class (as assessed in eastern GOA but assumed GOA-wide trends). **Age-0 pollock**, a common prey in western GOA, had very low abundance. Fish-eating, diving seabirds (common murres and tufted puffins), had fewer to average number of chicks across the GOA, indicating less than sufficient to adequate prey to meet their needs. In particular, black legged **kittiwakes** experience reproductive failure on Chowiet Isl. (Alaska Peninsula), potentially due to lack of age-0 pollock and Pacific sandlance in that area.

**The predominant GOA groundfish species, by biomass, continue to be characterized by reduced populations of Pacific cod, Pacific halibut, and arrowtooth flounder, and increased sablefish and Pacific ocean perch populations.** While the implications of the Pacific ocean perch population expansion (numerically and spatially) are not well understood, the biomass has grown large enough for this longer-lived, zooplankton-eating species to influence trends in various GOA groundfish community metrics (e.g., groundfish community stability and average groundfish lifespan).