

2022 Gulf of Alaska Ecosystem Status Report:

IN BRIEF

Key Findings

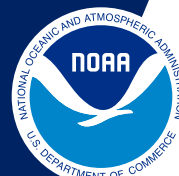
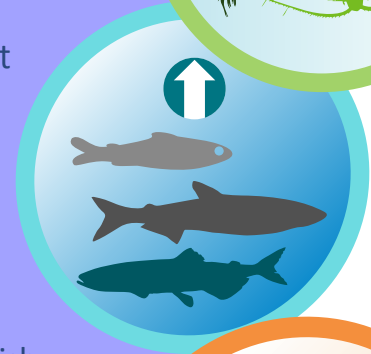
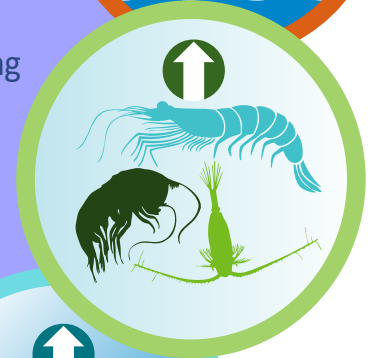
- A generally productive year in the Gulf of Alaska (GOA), with species continuing trends from the marine heatwave years (2014-2016, 2019) including recovery, increases, and decreases.
- Cooler ocean temperatures in the winter/spring and warmer temperatures in the summer/fall, including warmer deeper waters in summer
- Generally enough zooplankton and forage fish to eat for most groundfish on the GOA shelf (except fewer zooplankton available in western GOA)
- Longer-lived marine mammals (Steller sea lions and humpback whales) are potentially still impacted by the 2014-2016 and 2019 marine heatwaves
- Some concerns about the habitat quality for adult rockfish and flatfish that live along the shelf edge/upper slope

GOA Multi-Year Trends

The GOA is still transitioning to a community shaped by marine heatwave perturbations and cooler productive waters. The upcoming winter is predicted to be a third consecutive La Niña. This, coupled with a negative Pacific Decadal Oscillation (PDO) and non-persistent marine heatwave conditions, coincides with a three year period of cooling ocean temperatures and increased pelagic productivity on the GOA shelf. The current triple La Niña started in 2020 with residual heat throughout the water column and a marine community responding to the preceding marine heatwave years (2014-2016, 2019). GOA groundfish biomass remains dominated by arrowtooth flounder, walleye pollock, Pacific Ocean perch, and increasingly sablefish, but their relative composition is changing.

- Pacific cod has not recovered from the decline during the 2014-2016 marine heatwave,
- Arrowtooth flounder has been declining since 2008,
- Pacific ocean perch has steadily increased over many years, and
- Sablefish has been increasing since 2016.

Another year (2023) of predicted similar ocean conditions would be informative as to the relative persistence of these trends.



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This year was a generally productive year in the GOA, with a continuation of trends from the marine heatwave years (2014-2016, 2019).

Some species continue to recover from negative impacts of the warm conditions (e.g., **sea stars**). Other species have been increasing due to a preference for warm conditions and other indirect effects such as fewer predators (e.g., **Tanner crab**, **sablefish**, **Pacific herring**). A few have not yet recovered or show continued lagged responses, including **Pacific cod**, **Steller sea lions**, and **humpback whales**.

3rd consecutive non-marine heatwave year with a cooler winter/spring and warmer summer and fall, including warmth at depth

Cooler **winter and early spring surface temperatures** coincided with a productive start to the year. **Summer and fall temperatures** (as of November 1) were warmer than average, at surface and at depth. Cooler conditions are considered beneficial to late winter/early spring shelf spawners and spring larval conditions (e.g., Pacific cod, walleye pollock, northern rock sole). Warming in the second half of the year has the potential to negatively impact the survival of juveniles entering their first winter. Surface temperatures are predicted to be cooler than average in the upcoming winter, consistent with a predicted third consecutive La Niña winter and negative Pacific Decadal Oscillation. **Harmful algal blooms** were at relatively low levels in the GOA this year, despite the warmer summer temperatures.

Enough forage fish and zooplankton for groundfish, seabirds, and other predators to eat

Zooplankton biomass ranged from below average southwest of Kodiak to average in the northern GOA to above average in the eastern GOA. This is evident in zooplankton surveys (calanoid copepods and euphausiids) in northern and eastern GOA. It is also supported by the reproductive success of zooplankton-eating seabirds (higher proportion of chicks fledged indicates greater prey availability).

Forage fish appeared relatively abundant across the GOA, based on surveys and above-average reproductive success in fish-eating seabirds. Some key forage fish found in seabird chicks on Middleton Island included herring, sand lance, age-0 sablefish. Some exceptions include **capelin** (a cold-water associated species), which remains at low abundance (since the 2014-2016 marine heatwave), **juvenile salmon** abundance that appears to be either average or below average in Icy Strait, and **eulachon**, which had low returning spawning biomass in southeast Alaska. **Herring** populations remain elevated in southeast Alaska and are increasing in Prince William Sound (but remain relatively low biomass). While data on benthic/demersal prey are limited, Tanner crab and shrimp around Kodiak continue to increase.



What do the indicators tell us this year?

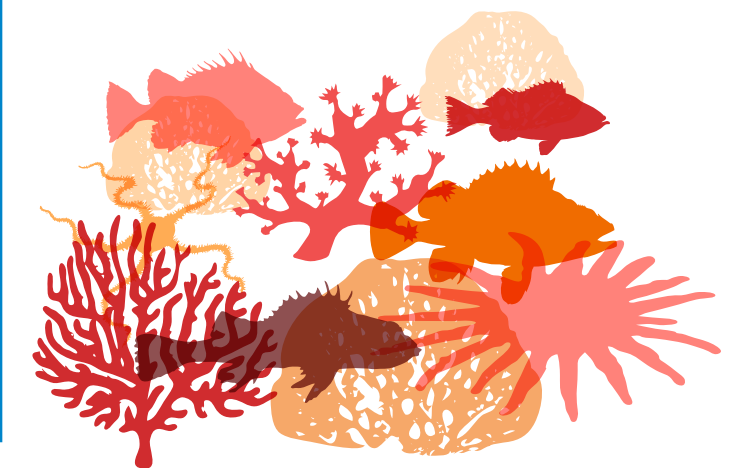
Longer lived marine mammals (Steller sea lions and humpback whales) are potentially still impacted by the 2014-2016 and 2019 marine heatwaves

The western and eastern populations of **Steller sea lions** have been increasing since about 2000, but have either declined or plateaued from 2017 - 2021. The change in population trends could be related to reduced Pacific cod and walleye pollock as prey (Pacific cod has not yet recovered from marine heatwave impacts). A reduced number of **humpback whale** calves were observed in Glacier Bay/Icy Strait in 2022. Calve observations have not yet returned to pre-2014 (marine heatwave) levels. Humpback whale encounters in Prince William Sound have also not yet returned to pre-2014 levels despite the increase of herring, a key prey species.

Shelf edge/upper slope habitat concerns

The GOA shelf edge and upper slope demersal/benthic habitat is an area characterized by limited ecosystem data. However, there are a few indicators of increased concern: (1) **temperatures** around 250 m depth, along the shelf edge, have been consistently above average since 2016, and (2) **structural epifauna (primarily sponges)**, which are important habitat for rockfish, have experienced a multi-year decline in the western GOA. Adult female sablefish were also skinnier than average. This may indicate that they experienced challenging forage conditions, even though they can eat a variety of prey. This is habitat for adults of numerous managed **groundfish species**, including **sablefish**, rockfish (e.g., shortraker rockfish, rougheye/blackspotted rockfish, thornyhead rockfish, **Pacific Ocean perch**), and **flatfish** (deepwater flatfish complex, including Dover sole). A number of these species migrate onto the shelf to spawn (e.g., sablefish, POP) and others are capable

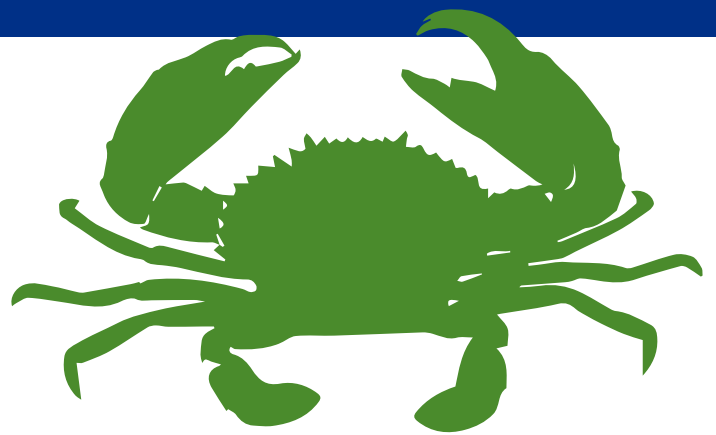
of changing depths in response to environmental conditions. As a result, their ability to mitigate unfavorable habitat and forage conditions may be greater than some shelf groundfish.



Noteworthy

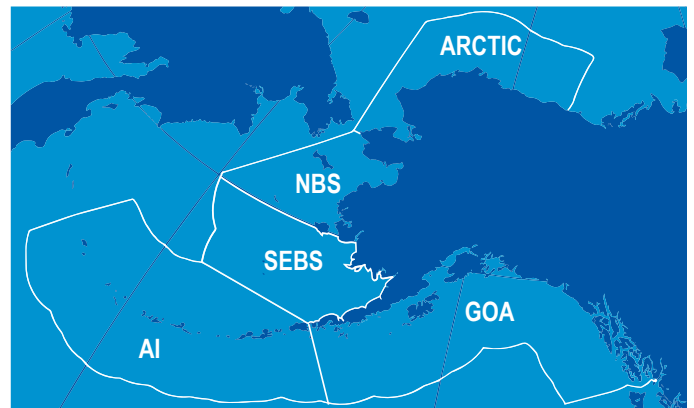
Green Crab

Invasive European **green crab** (*Carcinus maenas*) were observed in Alaska for the first time, on Annette Island in Southeast Alaska. As a new invasive species in the Gulf of Alaska, the potential impact of invasive green crabs on fish and shellfish populations is still negligible. However, they have the potential to disrupt local, intertidal systems. The primary ecological impacts of invasive green crab are through shellfish predation and uprooting eelgrass beds, important habitat for juvenile fish.



Management Uses

Ecosystem information was formally considered in eight full groundfish stock assessments for Gulf of Alaska (GOA), and one state-wide stock (sablefish) in 2022. Given the relatively productive conditions in the GOA, there were no ecosystem-related reductions from the maximum acceptable biological catch (ABC) for GOA groundfish stocks (similar to 2021). Precautionary measures already incorporated into setting catch levels were considered sufficient to address uncertainty where there is a lack of a mechanistic understanding for the direct and indirect effects of environmental change on stock productivity. The total allowable catch for 2023 across GOA groundfish stocks (including sablefish) amounts to 468,796 metric tons, which is below the optimal yield cap of 800,000 metric tons.



Links to full reports from Large Marine Ecosystems are available here: <https://www.fisheries.noaa.gov/alaska/ecosystems/ecosystem-status-reports-gulf-alaska-bering-sea-and-aleutian-islands>

Reference: Ferriss, B.E. and S. Zador 2022. Ecosystem Status Report for the 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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