

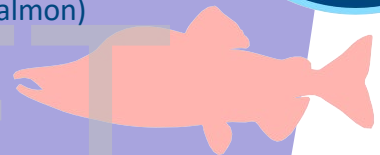
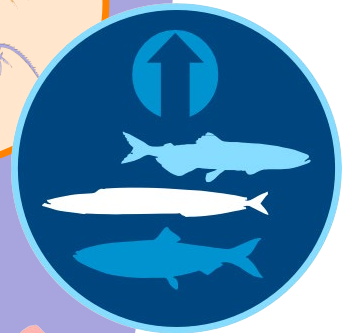
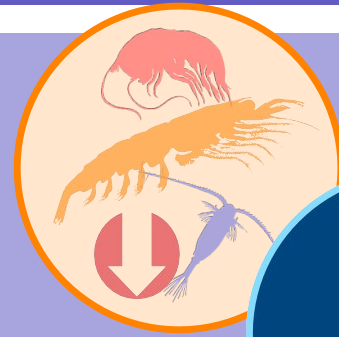
2021 Gulf of Alaska Ecosystem Status Report:

IN BRIEF



Overview

- 2nd consecutive non-marine heatwave year, with average ocean temperatures at surface and depth
- Mixed trends in prey abundance
 - Zooplankton — below-average to average (spatially-variable)
 - Forage fish — above-average
- Reduced abundance of groundfish apex predators (Pacific cod, arrowtooth flounder, Pacific halibut)
- Adult salmon returns improved from the lows of 2020 (abundant pink salmon)
- Biological community experiencing continued impacts from the 2014-2016 and 2019 marine heatwave periods



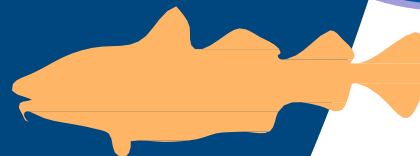
Multi-Year Trends

The Gulf of Alaska biological community is still in transition from the 2014-2016 and 2019 marine heatwave periods, even though ocean temperatures have returned to pre-heatwave conditions.

Examples of species populations that remain reduced include **capelin**, **common murre**s, Prince William Sound **humpback whales**, and some groundfish species (e.g., **Pacific cod**). Some groundfish species continue to be skinnier than average. Potential explanations for these trends include:

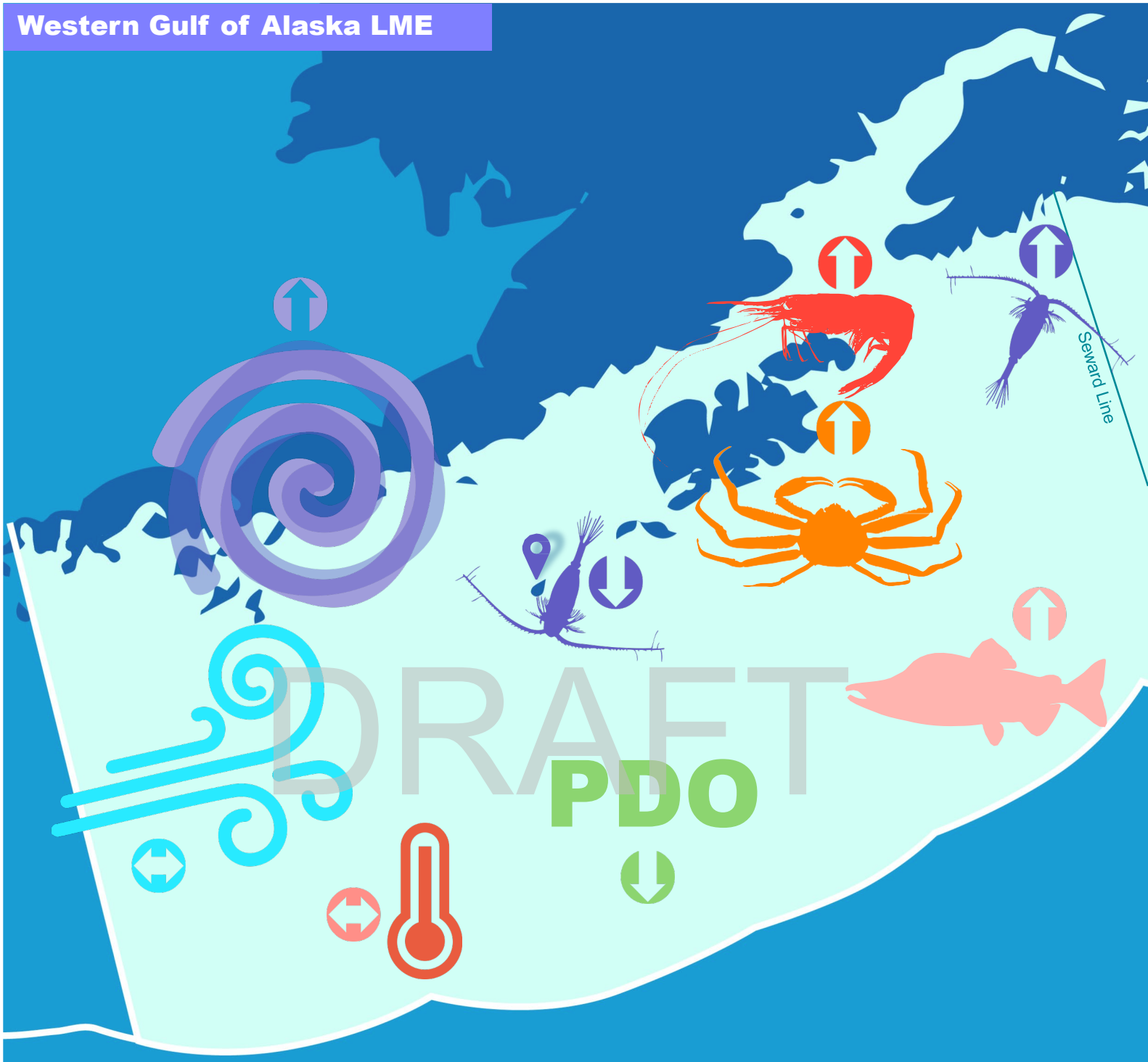
- (1) Cumulative effects of and variable recovery times from the warm period across species at different stages of development; and
- (2) Continued lower productivity of the marine ecosystem at the base of the food web (e.g., lower primary production and a shift in species composition of zooplankton communities).

A predicted cool phase in 2022 might shed light on how persistent the impacts of previous heatwaves will continue to be.



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A second consecutive non-marine heatwave year.

The Gulf of Alaska (GOA) **temperatures at the surface and depth** generally hovered around long-term means, cooling from 2019. These temperatures are within the range for moderate growth and physiological conditions of commercially important groundfish species. Surface temperatures are predicted to continue cooling into 2022. This is consistent with a second **La Niña** winter and potentially continued negative **Pacific Decadal Oscillation**. Strong, persistent **eddies** were located along the shelf edge off Seward and Kodiak in the winter and spring. This indicated greater movement of nutrients across the shelf.

Zooplankton (e.g., large calanoid copepods) had mixed trends across the GOA.

Around Kodiak Island there was a lower abundance of large copepods. This is similar to lower productive, warmer years (e.g., 2019). Closer to the central GOA, the Seward Line survey observed average to above-average spring abundance of large calanoid copepods in association with a large spring phytoplankton bloom. This productivity was not reflected in higher trophic levels as planktivorous seabirds had below-average reproductive success in this region (East Amatuli fork-tailed storm petrels). Above-average **copepod** abundance was observed in southeast Alaska inside waters. However, eastern GOA shelf conditions may have been less productive, given the below-average reproductive success of planktivorous seabirds in that area. So while we saw average to cooler ocean temperatures, that didn't translate into predicted higher abundance of large copepods.



Higher observed forage fish abundance.

However, the community composition was supplemented by a more diverse suite of species. **Herring** spawning stock biomass continues to increase, which supports fish-eating groundfish (e.g., sablefish), the increasing population of **humpback whales** in Glacier Bay, and fish-eating seabirds (e.g., murrens and gulls). **Juvenile pollock** (age-1; a common prey species) were seen in high abundance. **Sand lance** (a warm-water associated species) was observed in moderate amounts while **capelin** (a cold-water associated species) remain at low abundance since the 2014-2016 marine heatwave. **Juvenile salmon** in Icy Strait were, on average, observed at lower abundance. While not considered forage fish, other prey species including **Tanner crab** and **shrimp** around Kodiak continue to increase.

There remains lower predation pressure from major **groundfish predators** in the system (reduced populations of Pacific cod, Pacific halibut, arrowtooth flounder, and lower but increasing sablefish). This may enable other species to increase in abundance. Low abundance of predators may also reflect lower system productivity and prey availability.

Salmon returns increased in 2021, driven by abundant **pink salmon**. There was some evidence of the large population of pink salmon impacting the food web in the western GOA. This was apparent through reduced abundance of large copepods (pink salmon prey), increased biomass of large diatoms (fewer eaten by copepod predators), and reduced reproductive success of black-legged kittiwakes (competitors of pink salmon for large copepods).

Paralytic shellfish toxins in shellfish (harmful **algal blooms**) were observed in reduced frequency and concentrations in 2021 (from 2020 and 2019). Fewer shellfish samples exceeded the regulatory limit for human consumption. This is likely due to cooler ocean conditions.

Noteworthy



Seabird Die-off: A seabird mortality event of at least 250 kittiwakes, plus other species, occurred in July 2021 on Middleton Island, in the central GOA. The primary suspect driving this event is an outbreak of locally-contracted botulism toxin type C. Botulism type C is a natural toxin produced by the bacterium *Clostridium botulinum*. Birds are exposed by feeding on invertebrates often found in stagnant/ brackish waters. As a result, this mortality event seems to be an isolated event on Middleton Island and less connected to the general health of the GOA marine ecosystem (e.g., prey availability or ocean temperature).



North Pacific Right whales sighted: Four endangered North Pacific right whales were observed around Albatross Bank, out of an estimated total population of 30 whales. These observations occurred on the first dedicated large whale survey in the GOA since 2015. Other whales observed include humpback whales, fin whales, killer whales and sperm whales. Survey results are being analyzed to better understand the distribution, population dynamics, and habitat use of these whales.

Management Uses

Ecosystem information was formally considered in 14 full stock assessments for Gulf of Alaska groundfish stocks in 2021.

The remainder of this section will be completed following the December 2021 North Pacific Fishery Council Meeting.



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).

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Reference: Ferriss, B.E. and S. Zador 2021. 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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