Hot Topics

Spawning Market Squid

Market squid (*Doryteuthis opalescens*) are a small squid species that usually inhabits nearshore waters along the west coast from Baja California to southeast Alaska. They are an important prey species for many predators, including fish, marine mammals and seabirds. They are also an important commercial species, particularly in California. It had been presumed that water temperatures north of southern British Columbia are too cold for them to spawn.

However, during the 2014–2016 heatwave, **market squid** spawning was observed further north than in the past. Spawning on nets at Little Port Walter on southern Baranof Island in southeast Alaska was first observed in 2015. It was then observed again in 2016, 2018, and 2019. Spawning on crab pots was observed in Kodiak in 2016–2018. These observations of market squid spawning in multiple years during and after the 2014–2016 heatwave suggest that increasing sea temperatures may have contributed to a spawning range expansion for this species.

Gray Whale Unusual Mortality Event

An Unusual Mortality Event was declared for gray whales (*Eschrichtius robustus*) in May 2019. Higher than normal gray whale mortalities were observed along the Pacific coast of North America from January through October. By October 30th, 213 dead gray whales had been observed, with 48 of these in Alaska, of which 22 were in the Gulf of Alaska. Preliminary results from examinations of whale carcasses show evidence of starvation.

Gray whales spend summer and fall on their primary feeding grounds in the Northern Bering and Chukchi seas eating benthic amphipods, mysids, and crab larvae. They undertake a very long migration to overwinter and give birth to calves in waters off Baja California. Recent changes in the northern Bering Sea may have negatively impacted their food supply during summer 2018. One suggestion is that the whales were unable to feed enough in the north to sustain them through their migration to and from their wintering grounds, resulting in deaths along the way as they travelled back north in 2019. So, although there were many dead whales observed in the Gulf of Alaska, their deaths are more likely due to changes in the Northern Bering and Chukchi seas.

Future Projections

Warmer than average sea surface temperatures are predicted for the Gulf of Alaska through spring 2020. Sea surface temperature projections from the National Multi-Model Ensemble from NOAA's Climate Prediction Center are for the continuation of the warm patterns that were seen in the past year, but at a reduced magnitude. Neutral ENSO (El Niño) is forecasted through spring 2020.

Management Uses

Results from the December Council meeting will be added here.

Links to full reports from Large Marine Ecosystems are available here: https://access.afsc.noaa. gov/reem/ecoweb/Index.php

Reference: Zador, S., et al., 2019. Ecosystem Status Report 2019: Gulf of Alaska, North Pacific Fishery Management Council, 605 West 4th, Suite 306, Anchorage, Alaska 99501

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2019 Gulf of Alaska Ecosystem Status Report:

IN BRIEF

Current Conditions

The Gulf of Alaska experienced unusually warm conditions in 2019. This followed the extreme marine heatwave of 2014–2016 (known popularly as "The Blob") and a return to more typical temperatures during 2017 and 2018. In September 2018, sea surface temperatures in the western Gulf of Alaska shelf area crossed a temperature threshold to become a marine heatwave and have largely remained in heatwave status since then.

Sea level pressure patterns from late 2018 through summer 2019 resulted in high pressure over the Gulf of Alaska, which suppressed storminess and contributed to the development of warm sea surface temperatures, particularly during the summer. Sea surface temperatures were similar to those during the previous 2014–2016 "Blob" heatwave. While the total number of days in heatwave status during 2019 was similar to that during 2015, there was proportionally more heat during this past summer. These warm temperatures extended down into the water column, especially in the western Gulf of Alaska. The weather in the coastal Gulf of Alaska also featured warmer than normal air temperatures and lower than usual precipitation, leading to drought conditions in areas accustomed to summer rain.

NOAA FISHERIES

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How did the system respond?

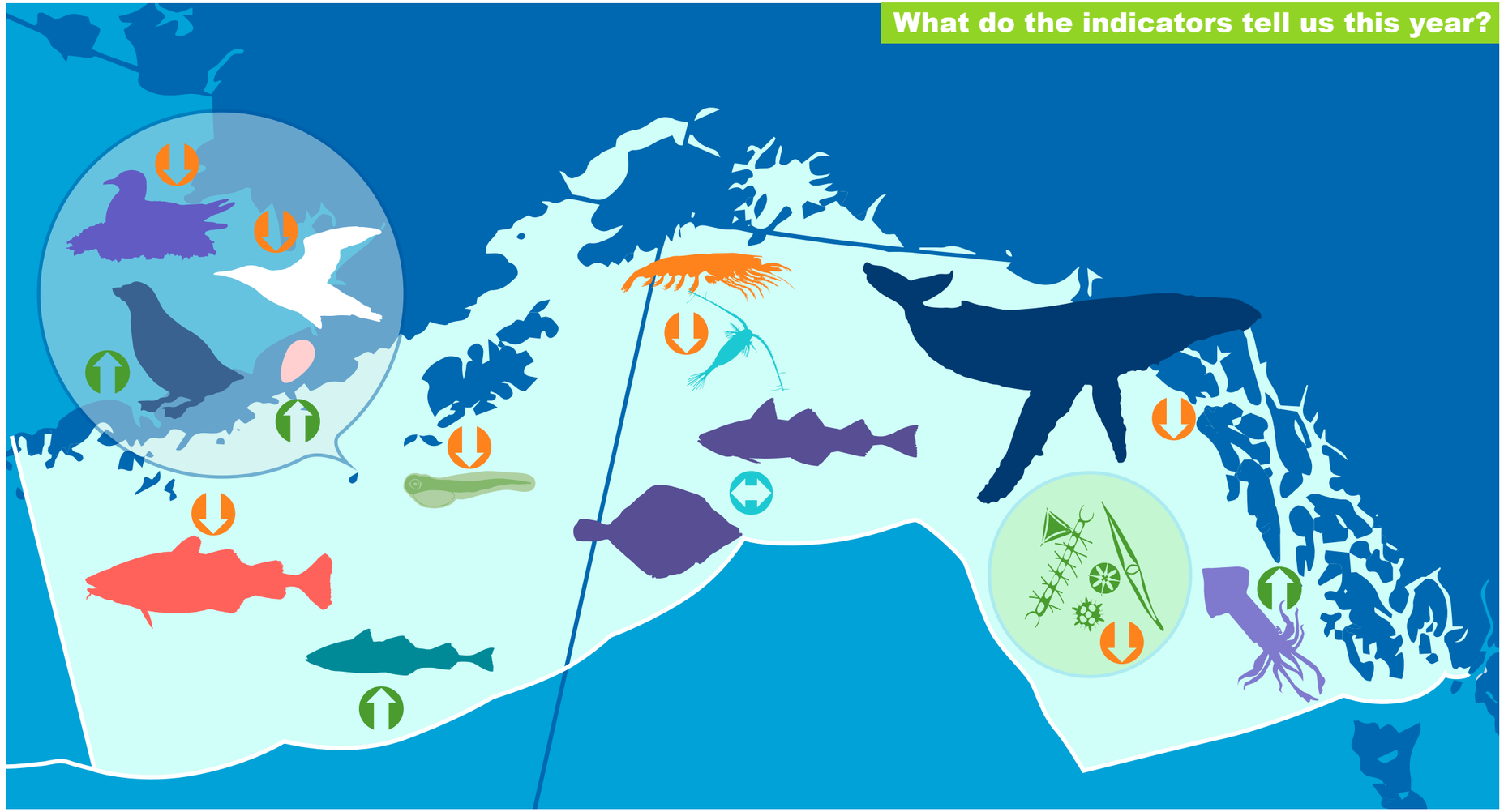
Given the recent history of extreme marine heatwaves in the Gulf of Alaska, it is challenging to disentangle the ecosystem responses to the current heatwave. For example, in the winters of 2014/2015 and 2015/2016, warm temperatures had extensive impacts on populations of piscivorous predators such as **Pacific cod** and **murres**. In 2018/2019, the winter temperatures were not quite as warm, so the ecosystem impacts may be less severe. It is also possible given the declines in the Pacific cod stock and murre populations that the ecosystem structure may have changed since 2014–2016, resulting in different ecosystem impacts of elevated sea temperatures.

Chlorophyll concentrations during 2019 in the Gulf of Alaska indicated: (1) a late phytoplankton bloom that did not show up until June, and (2) low early season **phytoplankton** biomass. This may affect phytoplankton predators such as zooplankton and some larval fish populations, depending on their timing and location. Zooplantkon indicators suggested that only moderate to low abundances were available to predators in 2019. During spring, both large calanoid **copepod** and **euphausiid** biomasses were below average on the Seward Line. During the summer acoustic survey, euphausiid biomass was estimated to be slightly below average in this 7-year time series. Planktivorous **parakeet auklets** nesting at the Semidi Islands had above average reproductive success. This suggests that there were sufficient euphausiid or larval fish prey available to successfully rear chicks. However, planktivorous fork-tailed storm petrels nesting at the Barren Islands at the mouth of the Cook Inlet did not fare well reproductively. Zooplankton may not have been as available to them. Also, record abundances of **jellyfish** were caught during the bottom trawl survey, across all regions. As jellyfish such as *Chrysaora melanaster* feed on zooplankton and small fish, high numbers could represent significant predation pressure on their prey.

Larval fish surveys during spring found few to no age-0 gadids, and their near-absence was confirmed during surveys at the end of summer. No **age-0 pollock** were found to the south and east of Kodiak Island, or near the Shumagin Islands in the southwest at the end of summer. The majority of age-0 pollock found were in Shelikof Strait and near the Semidi Islands. Patterns in age-0 pollock abundance may be inferred from seabirds. **Black-legged kittiwakes**, which have a mixed fish/invertebrate diet, failed reproductively at the Semidi Islands during the chick-rearing stage. The timing of failure suggests that they arrived in good condition in early summer but failed to find sufficient prey for their chicks. Kittiwakes are known to feed on age-1 pollock through late winter and early spring. Indeed, surveys confirmed that there were abundant **age-1 pollock** (the 2018 year class). However, kittiwakes switch to age-0 pollock during summer, because age-1 pollock are too big to feed to chicks. So, kittiwakes may have had sufficient prey available to them at the surface prior to the breeding season, including age-1 pollock, but then suffered from the lack of age-0 pollock during the chick-rearing stage, when they had to abandon chicks. Other piscivorous seabirds at the Semidi Islands did well reproductively. However, anecdotal data suggest that the birds were bringing in more diverse prey than the typical sand lance and age-0 gadids. On Middleton Island, the occurrence of herring and other coastal species in seabird diets may reflect more use of nearshore/inner shelf habitat because of reduced availability of key offshore prey such as capelin. In fact, GPS-tracking of foraging seabirds conducted during chick-rearing revealed that birds from Middleton Island were flying a considerable distance to forage primarily in nearshore waters. Overall, these patterns suggest that forage fish were not abundant in 2019.

Groundfish condition, as measured by average weight-per-lengths, was once again below average for all groundfish in the bottom trawl survey except for Pacific cod, indicating that fish were skinnier than usual. This was the same overall pattern that was seen during the last survey in 2017, and indicates that foraging conditions were not sufficient for optimal growth for most species of groundfish. However, when fish condition is analyzed at finer spatial scales, a few patterns are discernible. There appeared to be an east-to-west trend in condition, with heavier age-2+ pollock and **southern rock sole** per length in the eastern areas of the Gulf of Alaska compared to the western areas. **Pollock** in the western Gulf of Alaska may be experiencing more limitations in prey than those in the east. Further supporting evidence of below average foraging conditions is the poor condition (or skinniness) of Pacific Ocean perch, which have similarly planktivorous diets to pollock. **Pacific cod** biomass is currently at an extremely low level. Fewer cod may have resulted in less competition for prey (i.e, density-dependent competitive effects), which, in combination with their large growth potential, may have enabled cod to build up their weight in spite of other species remaining skinny.

What do the indicators tell us this year?



Seabirds and marine mammals continue to show lagged effects of the 2014–2016 heatwave. Generally high **reproductive success of murres** indicated favorable foraging conditions in 2019. However, the numbers of birds on breeding cliffs at the Semidi Islands was still only a little more than half the number that was counted, on average, in years before the 2014–2016 heatwave. Even though murres may defer breeding in some years due to poor foraging conditions, the continued low numbers at colonies may indicate population-level impacts of the 2015/2016 murre die-off, which included almost 1 million murres. Slightly more humpback whales were observed during September 2019 in Prince William Sound than had been observed in 2017 and 2018. However, numbers remain well below 2008–2014 numbers. **Humpback whale** calving and juvenile return rates in Glacier Bay also remained low in 2019. Mothers appeared to be in suboptimal condition, suggesting poor foraging conditions and continued negative impacts of the 2014–2016 heatwave.