**BSAI Flathead sole-Bering flounder**

Risk Table information for *Environmental/Ecosystem considerations*

**Environmental processes:** Following two years of physical oceanographic perturbations, the eastern Bering Sea experienced a return to near-normal climatic conditions in 2020. Summer bottom temperatures and spatial extent of the cold pool were average based on the ROMS hindcast model and observations from the 2020 Dyson cruise. However, summer sea surface temperatures through August were above average in the southern and northern Bering Sea, similar to those observed in 2019 (Siddon, 2020).

Based on the OSCURS model, the 2020 springtime drift pattern was mixed, with an early period of favorable winds consistent with eastward drift followed by a period of unfavorable winds consistent with westward drift (Cooper and Wilderbuer, 2020). This drift pattern appears consistent with years when below-average recruitment occurred for flathead sole (FHS).

**Prey:** The 2020 springtime drift pattern likely retained FHS larvae over the southern middle domain (Cooper and Widerbuer, 2020). In that region, the 2020 spring bloom timing occurred about a week earlier than the long-term mean while production was below the long-term mean (Nielsen et al., 2020). Depending on the spatial and temporal overlap between larvae and available primary production, this can result in a match or mismatch with favorable feeding conditions. Prey resources for adult FHS and Bering flounder include brittle stars (echinoderms), polychaetes, and crustaceans as well as juvenile walleye pollock. Trends in the abundance of motile epifauna remained above the long-term mean in 2019, although decreased 10% from 2018 (Whitehouse, 2019). This indicates sufficient prey availability for adult FHS over the southern Bering Sea shelf. Recent years of pollock recruitment were low, but the 2018 year class appears strong (as age-1 in 2019 assessment; Ianelli et al., 2019), therefore juvenile pollock may have been an available prey resource for FHS and Bering flounder.

In 2019, FHS condition (as measured by weighted length-weight residuals [updated method]) was near the historical average over the SEBS shelf with positive residuals over the southern portion of the bottom trawl survey area (strata 10, 30, and 50) and negative residuals over the northwest region (strata 40 and 40) (Rohan and Laman, 2020).

**Predators:** Predators of FHS include Pacific Cod, pollock, Arrowtooth flounder, Greenland turbot, and halibut. In terms of predation pressure on FHS, we focus on biomass trends over the southern Bering Sea shelf. The biomass within the apex predator guild (including Pacific cod, Arrowtooth flounder, Greenland turbot, and halibut) increased slightly (2%) from 2018 to 2019 and remains at the long term mean (Whitehouse, 2019). Pacific cod and Arrowtooth flounder are the biomass-dominant components of the guild. Pacific cod biomass has decreased since 2015 and is below its long term mean. In 2019, the biomass of Pacific cod in the standard bottom trawl survey area increased slightly (2%) while the abundance increased dramatically (112%) from 2018. This indicates strong recruitment of age-1 fish. Depending on the eventual year class strength of the 2018 Pacific cod cohort, this could present increased predation risk to FHS in the future. Arrowtooth flounder biomass increased 13% from 2018 to 2019.

The biomass of pelagic foragers, dominated by pollock, increased from 2018 to 2019, but remains below the long term mean (Whitehouse, 2019). However, the biomass of pollock increased 75% from 2018 and indicates movement of adult pollock into the region that could present predation risk to FHS (Ianelli et al., 2019).

**Competitors** for FHS prey resources include other benthic foragers, like northern rock sole and yellowfin sole. The trend in biomass of the benthic foragers guild has been declining since approximately 2010 and remained below the long term mean in 2019 (Whitehouse, 2019), suggesting a reduction in prey competition that is supported by the positive length-weight residuals over the southern shelf (strata 10, 30, and 50).

Summary for *Environmental/Ecosystem considerations*:

* Summer bottom temperatures and spatial extent of the cold pool were average, indicating a cooler thermal experience for Flathead sole and Bering flounder;
* Based on the OSCURS model, the 2020 springtime drift pattern appears consistent with years when below-average recruitment occurred for flathead sole;
* The 2020 spring bloom occurred about a week earlier than the long-term mean while production was below the long-term mean;
* Prey abundance remained above the long-term mean in 2019, although decreased 10% from 2018, indicating sufficient prey availability;
* The 2018 pollock year class appears strong, therefore juvenile pollock in 2018 and 2019 may have been an available prey resource;
* In 2019, FHS condition was near the historical average over the SEBS shelf with positive residuals in strata 10, 30, and 50 indicating favorable prey conditions over the southern portion of the standard survey grid;
* Pacific cod abundance trends indicate relatively strong recruitment of the 2018 year class. Depending on the eventual cohort strength, this could present increased predation risk to FHS in the future;
* Arrowtooth flounder biomass increased 13% from 2018 to 2019;
* The biomass of pollock increased 75% from 2018 to 2019 and indicates movement of adult pollock into the region that could present predation risk to FHS;
* Competitors for prey resources include other benthic foragers. The biomass trend of the benthic foragers guild has been declining since approximately 2010, suggesting a reduction in prey competition.

Together, the most recent data available suggest there are no apparent ecosystem concerns, although predation pressure may be rising--level 1.

**References:**

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