Meeting objectives:
1. To identify areas of concern or unusual conditions that may be relevant to ecosystem and stock assessments.
2. To inform upcoming surveys and the Council process.

- **Bering Sea**
  - 2nd winter of low sea ice in the NBS.
  - Gray whale Unusual Mortality Event (UME).

- **Gulf of Alaska**
  - Marine heatwave since Sept 2018.
  - Low abundance of larval fish.
2019 climate and oceanography
2019 early warnings for the Bering Sea and Gulf of Alaska
2020 sea surface temperature forecasts
Sea Surface Temperature Anomalies

Winter 2018/19

From NOAA's Optimum Interpolation SST analysis

Warmth in the north delayed sea ice formation

Modulation of temperatures; weak El Niño

Increased warming in the EBS/GOA and PNW; beginning positive PDO pattern

Autumn 2018

Spring 2019

Summer 2019
Suppressed storminess in the GOA related to development of warm SSTs

Continuation of warm air flow from the south over the EBS and WGOA

Highly unusual pattern with El Niño. Strong southern winds across the Bering (2\textsuperscript{nd} winter)

Suppressed storminess in the EBS/GOA contributing to warmth

From the NCEP/NCAR Reanalysis project
Bering Sea sea ice extent
Thoman, Bond

A double whammy!
2nd winter of low sea ice in the Bering Sea.
Early winter ice, but southerly winds in Feb caused retreat.

Data source: NSIDC Sea Ice Index, Version 3
Graphic by Rick Thoman, @AlaskaWx
Updated through May 11, 2019
EBS cold pool and temperatures
Ladd, Britt

- Second smallest cold pool
- Warmest bottom temperature
- 2nd warmest surface temperature
Western Gulf of Alaska heatwave
Barbeaux

A. Hobday algorithm, through Sept 10, 2019
Western Gulf of Alaska heatwave
Barbeaux

New heatwave

- Similar sustained warmth as 2014.
- Number of heatwave days in 2019 already similar to 2015 (through Sept 10).
Sea Surface Temperature Departure From Normal

June 2019

Graphic by @AlaskaWx

OISSTv2 courtesy of NOAA/PSD/ESRL

Ecosystem ‘red flags’
Seabirds

Saxitoxin linked to Arctic Tern mortality in southeast Alaska (EGOA).

Mainly short-tailed shearwaters.

Most birds were emaciated.
Gray Whale Strandings in 2019

<table>
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<tr>
<th>Location</th>
<th>Count</th>
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<tbody>
<tr>
<td>Canada</td>
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<td>US Total</td>
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<td>Mexico</td>
<td>81</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>215</strong></td>
</tr>
</tbody>
</table>

Brent Pristas
Kodiak Is.
July 3, 2019
Preliminary necropsy results show evidence of emaciation.

Annual migration of up to 20,000 km.

- Summer and fall in the Bering and Chukchi Seas feeding.
- Feed on amphipods, mysids, crab larvae.
- Overwinter (mating, calving) along the west coast of southern Baja California Peninsula.
2018 had no cold pool, but inner domain temperatures were not as warm as 2019.

2019 had a small cold pool up north and the inner domain was very warm.
Spring SEBS
- Small copepod abundance higher compared to historical average.
- Large copepod abundance low; north/south gradient.

Fall NBS
- Small copepod abundance high.
- Large copepod abundance low.
BT survey: Walleye pollock

SEBS (movement)
- Biomass +75% from 2018 (at 5.46 mmt). Just above the long-term mean.
- Abundance +53%.

NBS (recruitment)
- Biomass -11% from 2017 (at 1.17 mmt).
- Abundance +59%
BT survey: Pacific cod

**SEBS (recruitment)**

- Biomass +2% from 2018 (at 517K mt). Below the long-term mean.
- Abundance +112%.

**NBS**

- Biomass +30% from 2017 (at 368K mt).
- Abundance +52%.
Die-off events have occurred in 2017-2019.

Shearwater die-off extended north in August.

Also other species (murres and kittiwakes).

Extremely large die-off event in 2019 of shearwaters.

But, seabirds at colonies appear to have done fairly well.
In 2018 & 2019, 282 ice seal carcasses were reported from the Bering and Chukchi seas. 

- Mainly young and emaciated.
- Approximately 5-7 times the 2000-2017 annual average.
- Dramatic loss of sea ice habitat and competition for prey with shifts in fish distributions.
2\textsuperscript{nd} winter of low sea ice in NBS; unprecedented warm inner domain. Impacts to fish distribution.

Zooplankton prey base dominated by small, lipid-poor copepods; low abundances of large copepods and euphausiids. Impacts to carrying capacity throughout the system.

Pollock increase represents movement of adult fish into SEBS; PCod biomass continues to increase in the NBS.

Seabird die-off (mainly short-tailed shearwaters) attributed to starvation. Concerns about food security in NBS. Seabirds at colonies did better than expected.

Gray whale UME; ice seal UME. Indicates cumulative impacts of changes in food web structure and carrying capacity of the NBS.
Gulf of Alaska
- Few larval fish in spring
- 3rd lowest pollock catch
- 2nd lowest Pacific cod catch
- Few rockfish
Summer

2019 pollock year class
Laurel, Duffy-Anderson

Beach seines and surface trawls saw few 2019 pollock
GOA bottom trawl survey: pollock

Palsson

walleye pollock (Gadus chalcogrammus)

Preliminary Estimates-Survey
Biomass does not necessarily reflect stock assessment results
GOA bottom trawl survey: Pacific cod

Preliminary Estimates-Survey
Biomass does not necessarily reflect stock assessment results.
Warm temperatures through winter, similar to the beginning of the 2014-2016 heat wave.

Few pollock and Pacific cod young of year.

Adult pollock and cod biomass remains low.

Seabirds at colonies did well, foraging more nearshore; saxitoxin linked to localized tern die-off.

Gray whale UME likely indicates cumulative impacts of changes in food web structure in the NBS.

Few humpback calves indicates minor, lagged improvement from previous heatwave.
2020 Sea Surface Temperature Forecasts
SST Projections from the National Multi-Model Ensemble Bond

- Projected continuation of warmth but reduced magnitude
- Previous projections were warm, but not warm enough
- Warmest north of Kuroshio Extension
- Neutral ENSO projected