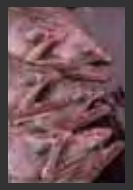
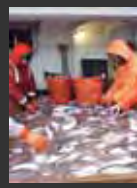
A Recent Indicator-Based Assessment of the Eastern Bering Sea

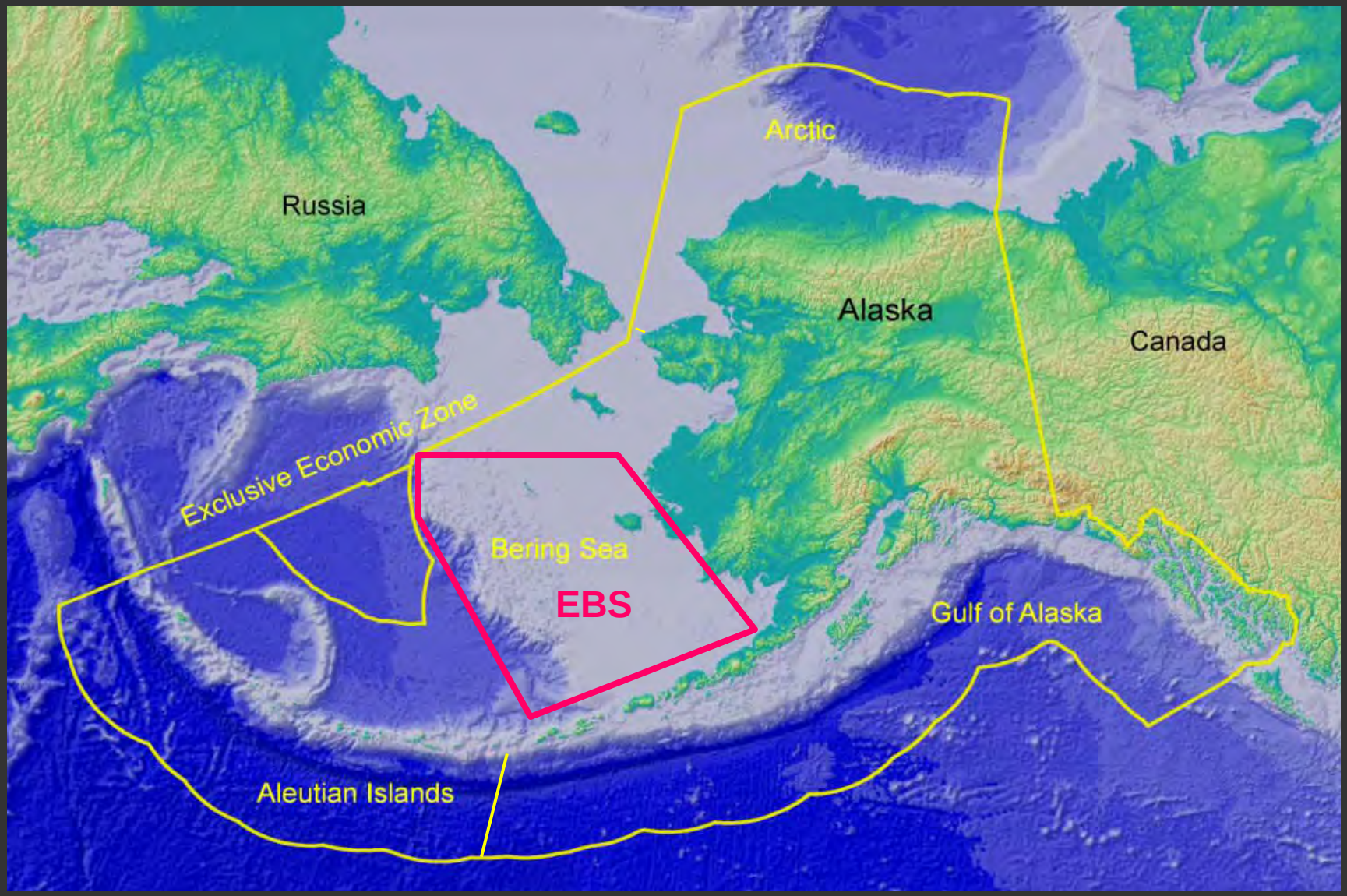
Stephani Zador, Sarah Gaichas, and Kerim Aydin

NOAA Alaska Fisheries Science Center

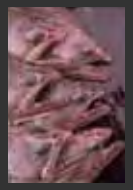
Alaska Fishery Management Areas







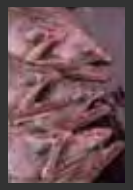
Ecosystem Assessments at the Alaska Fisheries Science Center

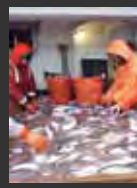


- **Goal**: to provide current and relevant scientific advice for fisheries managers
- Part of the **annual** Stock Assessment and Fishery Evaluation report
- In 2010, initiated a regional approach and presented an entirely new assessment for the eastern Bering Sea

http://access.afsc.noaa.gov/reem/ecoweb/index.cfm

Methods

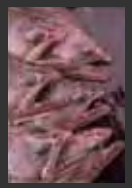


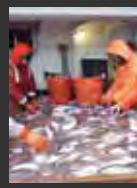


- Assembled a team of Eastern Bering Sea experts
- Met in September and October 2010
- Developed list of hot topics and 10 indicators
- Focused on **broad, community-level indicators** of ecosystem-wide productivity, and those most informative for managers

- Stock-specific indicators discussed in workshop early April 2011

Eastern Bering Sea Ecosystem Synthesis Team





Sarah Gaichas[1], Phyllis Stabeno[2], Jeff Napp[3], Lisa Guy[4], Kerim Aydin[1], Anne Hollowed[1], Patrick Ressler[3], Nick Bond[4], Troy Buckley[1], Jerry Hoff[3], Jim Ianelli[1], Tom Wilderbuer[1], Lowell Fritz[5], Diana Evans[6], Martin Dorn[1], Pat Livingston[1], Franz Mueter[7], Robert Foy[3], Ed Farley[8], Sue Moore[2], Stephani Zador[4]

[1] **NOAA** Resource Ecology and Fisheries Management Division

[2] **NOAA** Pacific Marine Environmental Lab

[3] **NOAA** Resource Assessment and Conservation Engineering Division

[4] **University of Washington** Joint Institute for the Study of the Atmosphere and Ocean

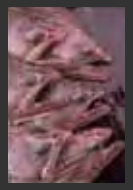
[5] **NOAA** National Marine Mammal Laboratory

[6] **North Pacific Fisheries Management Council**

[7] **University of Alaska** Fairbanks

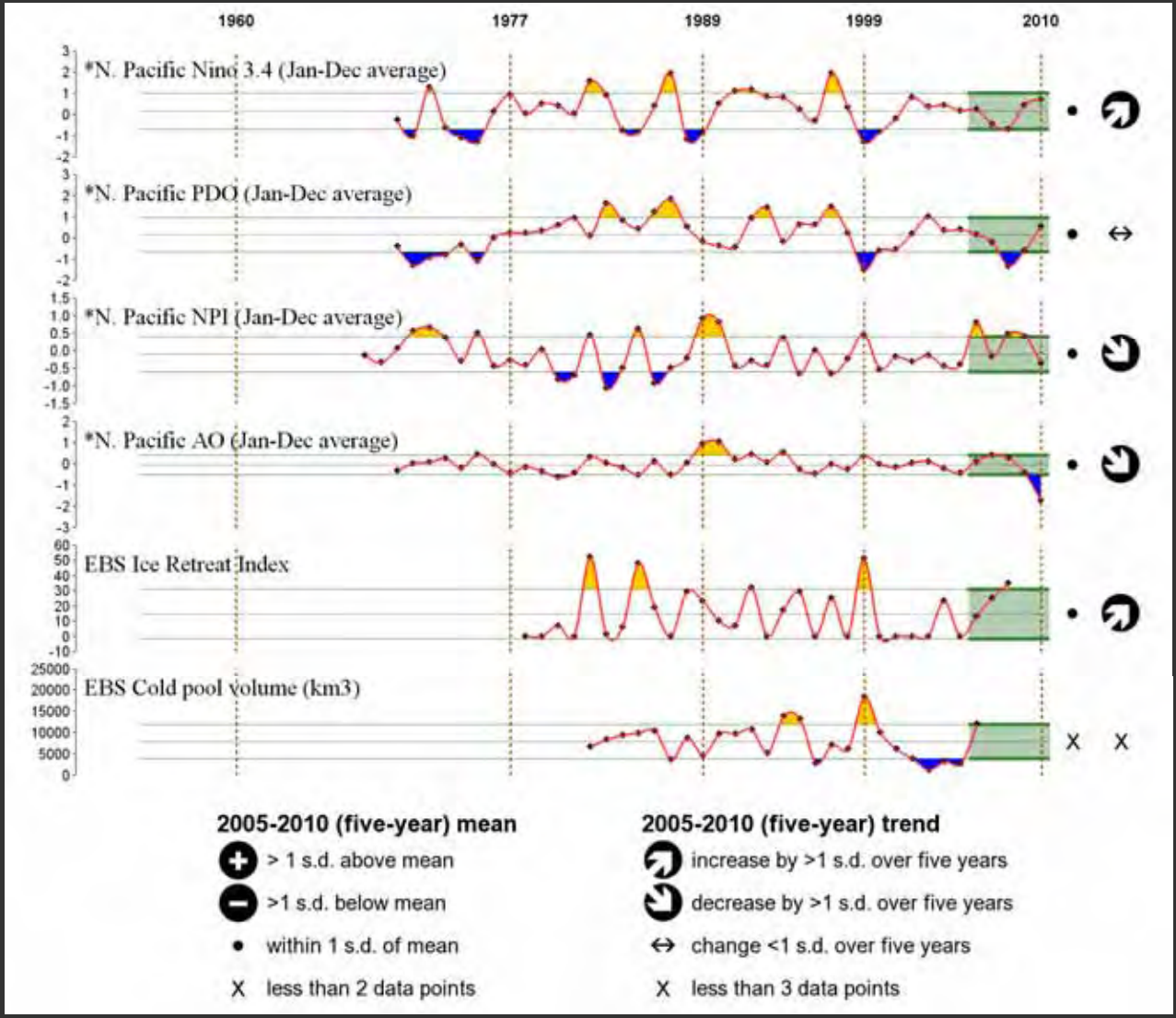
[8] **NOAA** Auke Bay Laboratory

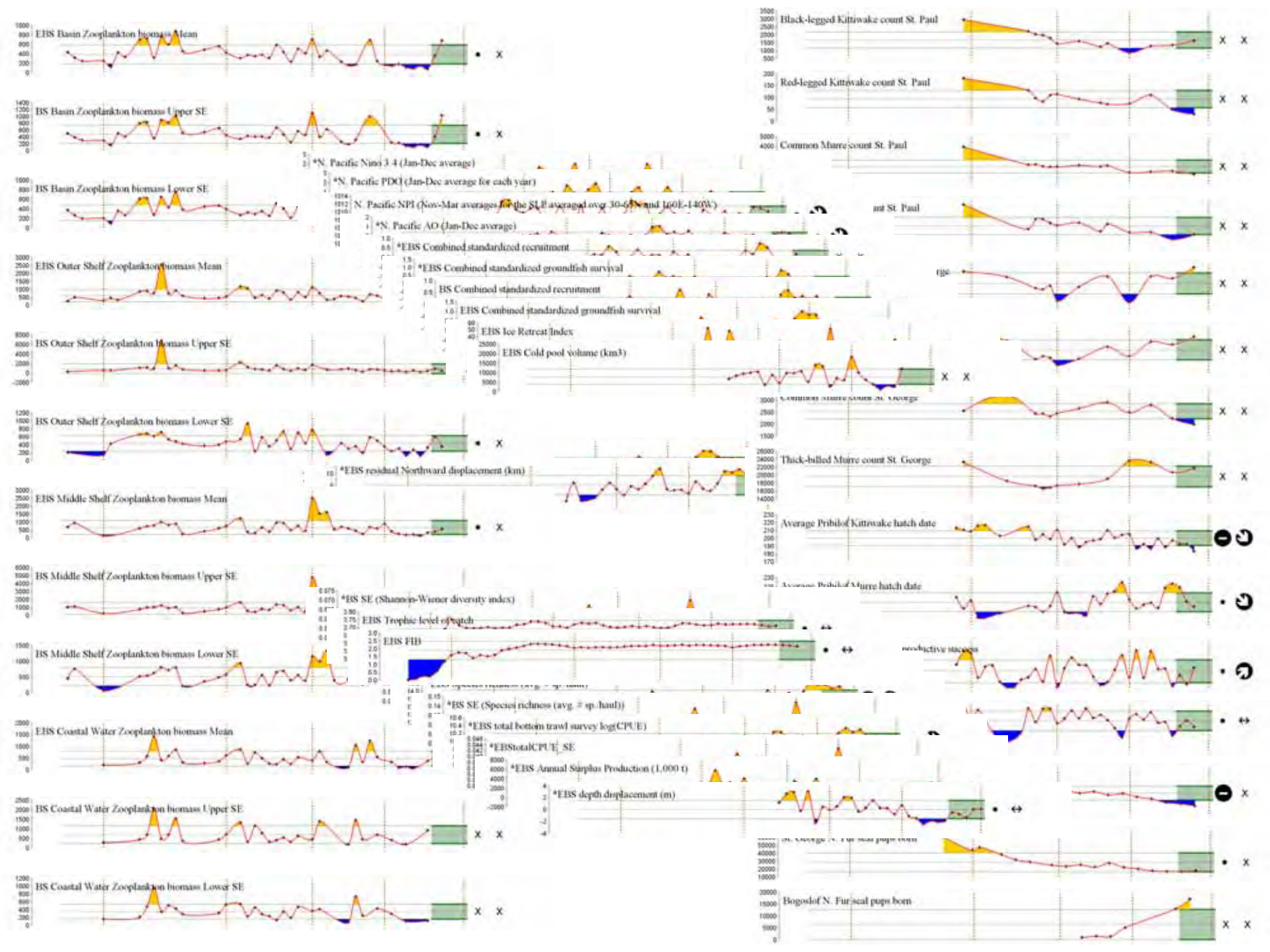
Raw materials for the assessment



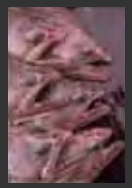
The annual Ecosystem Considerations SAFE (1995-2009):

1. Executive summary
2. Ecosystem Assessment
3. Contributed data/indices




EBS Basin Zooplankton biomass Mean
BS Basin Zooplankton biomass Upper SE
BS Basin Zooplankton biomass Lower SE
EBS Outer Shelf Zooplankton biomass Mean
BS Outer Shelf Zooplankton biomass Upper SE
BS Outer Shelf Zooplankton biomass Lower SE
EBS Middle Shelf Zooplankton biomass Mean
BS Middle Shelf Zooplankton biomass Upper SE
BS Middle Shelf Zooplankton biomass Lower SE
EBS Coastal Water Zooplankton biomass Mean
BS Coastal Water Zooplankton biomass Upper SE
BS Coastal Water Zooplankton biomass Lower SE
*N. Pacific Nino 3 4 (Jan-Dec average)
*N. Pacific PDO (Jan-Dec average for each year)
N. Pacific NPI (Nov-Mar averages for the SLP averaged over 30-65N and 160E-140W)
*N. Pacific AO (Jan-Dec average)
*EBS Combined standardized recruitment
*EBS Combined standardized groundfish survival
BS Combined standardized recruitment
EBS Combined standardized groundfish survival
EBS Ice Retreat Index
EBS Cold pool volume (km3)
*EBS residual Northward displacement (km)
*BS SE (Shannon-Wiener diversity index)
EBS Trophic level of catch
EBS FIB
*BS SE (Species richness (avg. # sp. haul))
*EBS total bottom trawl survey log(CPUE)
*EBStotalCPUE_SE
*EBS Annual Surplus Production (1,000 t)
*EBS depth displacement (m)
Black-legged Kittiwake count St. Paul
Red-legged Kittiwake count St. Paul
Common Murre count St. Paul
Thick-billed Murre count St. George
Average Pribilof Kittiwake hatch date
Bogoslof N. Fur seal pups born

Assessment Sections



I. ***Hot Topics*** – potential concerns for fishery management, endangered species issues

II. ***Eastern Bering Sea****
   - **Summary**
   - **Indicators**
   - **Gaps and Needs**

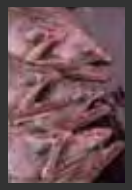
III. Gulf of Alaska

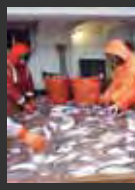
IV. Aleutians

V. Indicators common to all ecosystems

* new

Hot Topics for 2010



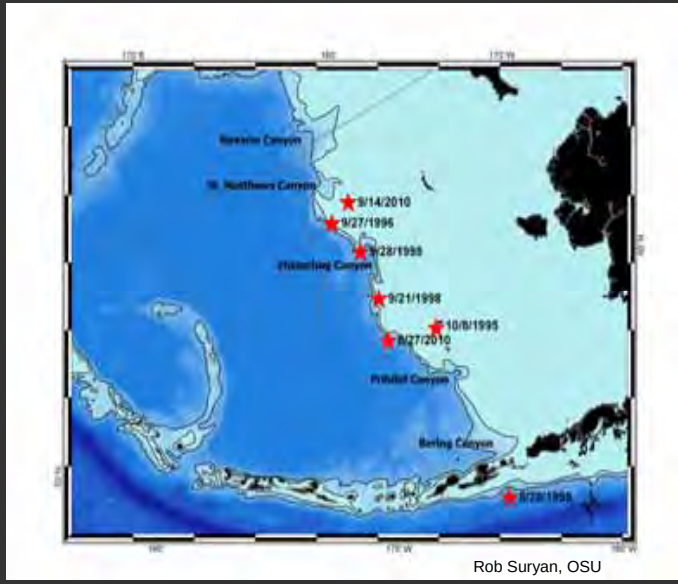


Endangered species information critical to fishery management

- Short-tailed albatross bycatch
- Steller sea lions

Early warnings: potential future fishery management interest

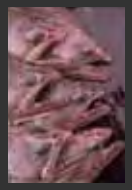
- Rare species observed in the Bering Sea
  - Longnose skate, spiny dogfish, big skate, pacific hake
  - Common in GOA

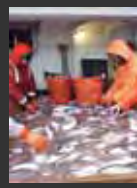


Rob Suryan, OSU


AFSC

Selected Indicators





1. **North Pacific Index**
   - Strength of Aleutian Low relates to wintertime temps
2. **Eastern Bering Sea ice retreat**
   - Influences timing of spring bloom, cold pool extent, and summer surface temps
3. **Zooplankton - euphausiid hydroacoustic data and copepod index**
   - Index of forage for planktivorous fish, seabirds, marine mammals
4. **Motile epifauna aggregate biomass**
5. **Benthic foragers aggregate biomass**
6. **Pelagic foragers aggregate biomass**
7. **Fish apex predators aggregate biomass**
8. **St. Paul fur seal pup production**
   - Females foraging ranges on the shelf
9. **Thick-billed murre reproductive success on St. George**
   - Central place foragers, not migrate far outside EBS during winter
10. **Maximum potential trawl area disturbed**
    - Index of habitat disturbance

Report Card

Contributions

⬇

Assessment

⬇

Summary

⬇

Report Card

⬇

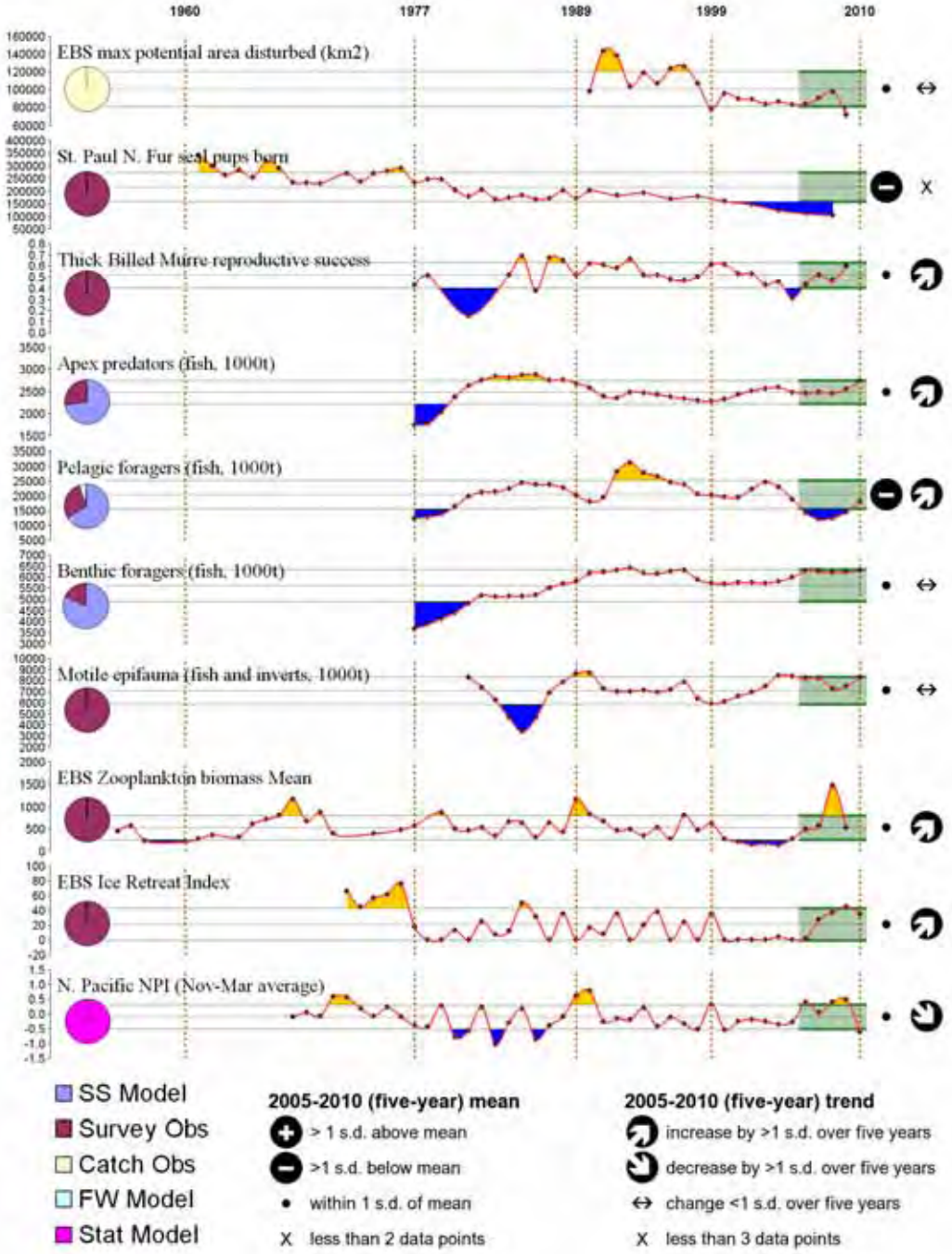
Highlights

EBS Report Card

- A strong la Niña has formed on the equator as reflected in the recent downward trend in NPI. The prediction for the Bering Sea is above average sea-ice extent and duration in winter and spring 2011. This would result in a fifth year of extensive ice over the southern Bering Sea shelf.
- The euphausiid biomass index increased more than three fold from 2004 to 2009 and then decreased in 2010 by ca. 30%. Large copepod biomass increased 10 fold from very low values during the recent 2002-2005 warm period to 2009. This suggests that overall food availability for planktivorous species is high. Age-0 pollock and other planktivorous species may be dependent on the availability of sufficient prey to generate enough depot lipids to survive their first winter. Thus, we predict that the survival of this particular year class of fishes might be better than average.
- Current (2005-2010) mean biomass, catch, and exploitation rates of motile benthic epifauna and benthic foraging fish have been within ±one standard deviation of 1977-2010 levels. No trend is apparent in recent years for these foraging guilds.
- There is a concern with two of the commercial crab stocks in the mobile benthic epifauna guild which are overfished. However, this guild appears stable because the guild is dominated by non-target fish and invertebrate biomass.
- There are no apparent trends in benthic forager catch and exploitation rate. The benthic foragers guild appears stable and may not require further management action.
- Pelagic foragers have biomass below mean and exploitation rate above mean, but increasing trends in biomass and decreasing trends in catch and exploitation rates. The pelagic foragers guild biomass has been at a historic low, which has been a recent management concern. However, there are signs of recovery within the guild, as well as increased forage and positive physical conditions to support recovery. Continued caution with the management of species in this guild and continued monitoring may be necessary, but the outlook is improved from last year.
- The recent increasing trend in the apex predator guild biomass is driven largely by a decrease in Pacific cod biomass being offset by an increase in arrowtooth flounder biomass. The fish apex predators guild appears stable and may not require additional management action.
- Thick-billed murre reproductive success has increased during the past five years, concurrent with a colder Bering Sea, later ice retreat, and increased biomass of zooplankton on the outer shelf. Continued cold conditions in the Bering Sea will likely lead to favorable conditions for thick-billed murres nesting on St. George Island and a continued trend of higher reproductive success in 2011.
- Northern fur seal pup production on St Paul Island has been declining since the mid-1990s, while it has been relatively stable on St George since 2002. Estimated pup production on both Pribilof Islands in 2008 was similar to the level observed in 1916; however the population trends are different. In 1916, the northern fur seal population was increasing at approximately 8% per year following the cessation of extensive pelagic sealing, while currently (1998 through 2008), northern fur seal pup production on both Pribilof Islands is decreasing at approximately 6% per year.

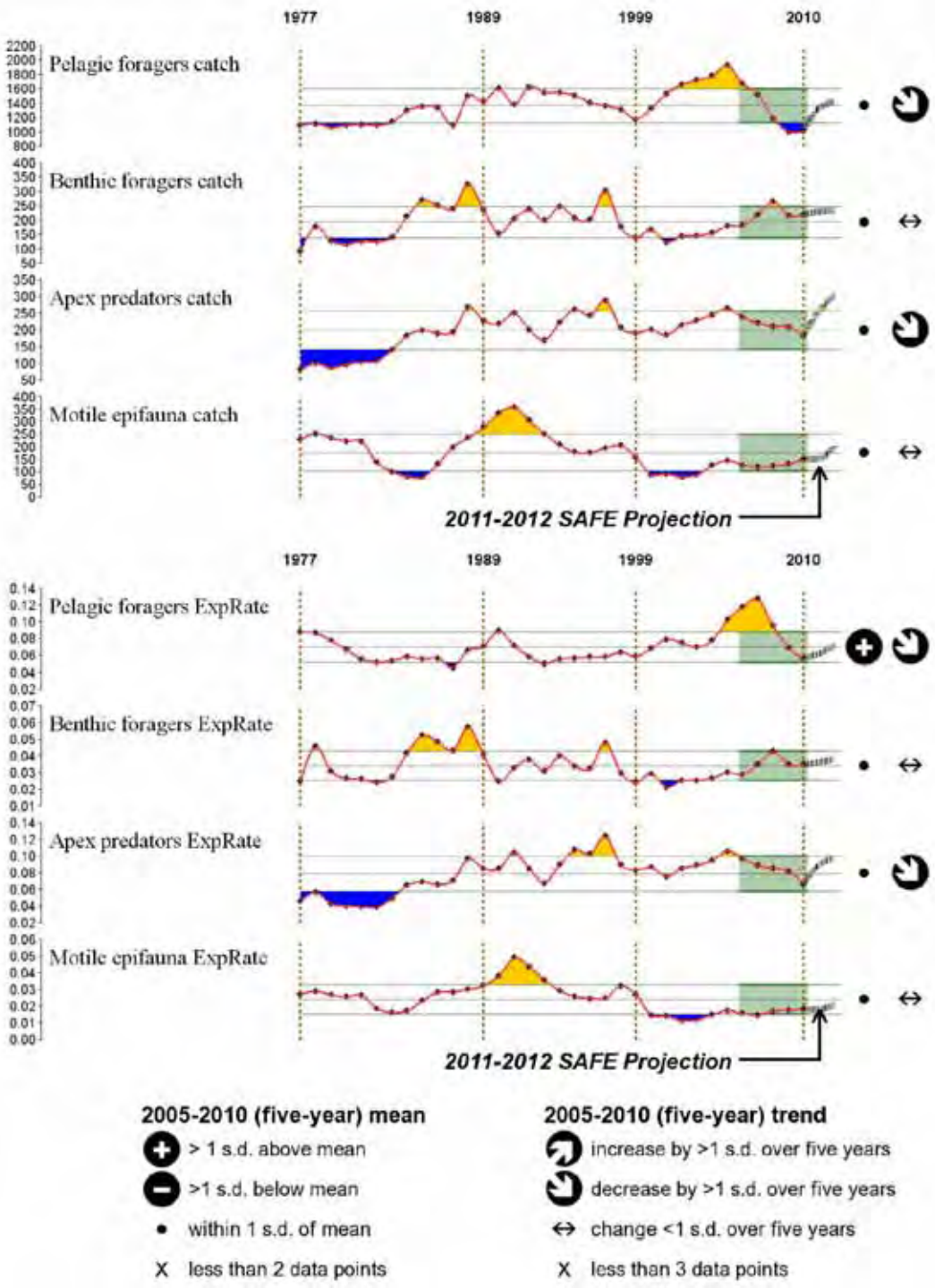
Indicator Time Series

10. Maximum potential trawl area disturbed
9. Thick-billed murre reproductive success on St. George Island
8. St. Paul Island fur seal pup production
7. Fish apex predators aggregate biomass
6. Pelagic foragers aggregate biomass
5. Benthic foragers aggregate biomass
4. Motile epifauna aggregate biomass
3. Zooplankton - euphausiid hydroacoustic data and copepod index
2. Eastern Bering Sea ice retreat
1. North Pacific Index

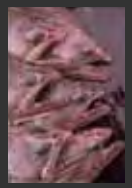


Guild Catch and Exploitation Rates

6. **Pelagic foragers** aggregate biomass
5. **Benthic foragers** aggregate biomass
7. **Fish apex predators** aggregate biomass
4. **Motile epifauna** aggregate biomass

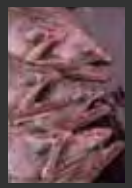


Gaps and Needs



1. Climate index development
2. Primary production time series
3. Spatial scales for assessment
4. Fishery performance index
5. Integration with stock assessments
6. Future use of ecosystem/climate models in development

Next Steps



- Assemble similar teams to develop assessments for the Gulf of Alaska and the Aleutians ecosystems (*this year*)
- Progress towards the inclusion of ecosystem data directly into stock assessments and resulting management recommendations (*ongoing*)
- Revisit and revise assessments periodically

http://access.afsc.noaa.gov/reem/ecoweb/index.cfm