Developing Indicator-Based Ecosystem Assessments for Diverse Marine Ecosystems in Alaska


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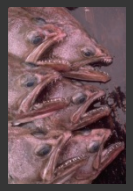
Introduction

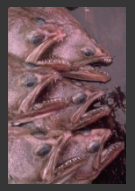


- Interest and mandates for ecosystem-based fisheries management (EBFM) ✓
- Guidance on how to operationalize it? *(still in development)*
- Integrated Ecosystem Assessments (IEA)
  - Provides a framework
  - Allows a diversity of objectives, indicators, approaches

Goal of this talk:

Describe lessons learned from a collaborative process to develop ecosystem assessments for the eastern Bering Sea and Aleutian Islands

Supplying ecosystem information to fishery managers in Alaska



- Ecosystem Considerations report (~200 p)
- Produced annually by NOAA ecosystem scientists
- Goal: to provide an overview of marine ecosystems in Alaska for the North Pacific Fishery Management Council
- Stock assessment recommendations are evaluated within an ecosystem context (EBFM, qualitative)

APPENDIX C

Ecosystem Considerations for 2011

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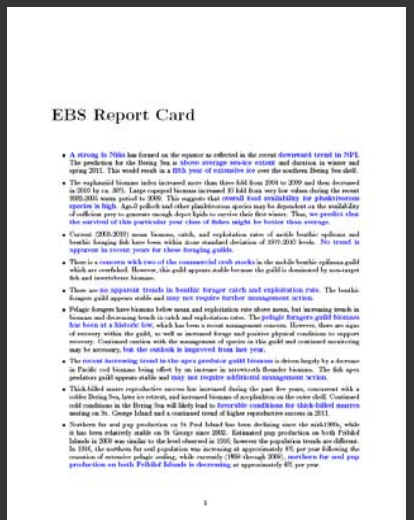
Reviewed by:

The Plan Teams for the Groundfish Fisheries of the Bering Sea, Aleutian Islands, and Gulf of Alaska

November 15, 2010
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, AK 99501



EBS Report Card

- A strong El Niño 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 2008 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 2006. This suggests that overall food availability for planktivorous species is high. Age-0 pollock and other planktivorous species may be dependent on the wealth-day 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 mobile benthic epifauna and benthic foraging fish have been within 2one 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 predator 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 early1980s, while it has been relatively stable on St George since 2002. Estimated pup production on both Pribilof Islands in 2010 was similar to the level observed in 1998, however the population trends are different. In 1981, the northern fur seal population was increasing at approximately 8% per year following the cessation of extensive pelagic sealing, while currently (1998 through 2010), northern fur seal pup production on both Pribilof Islands is decreasing at approximately 6% per year.

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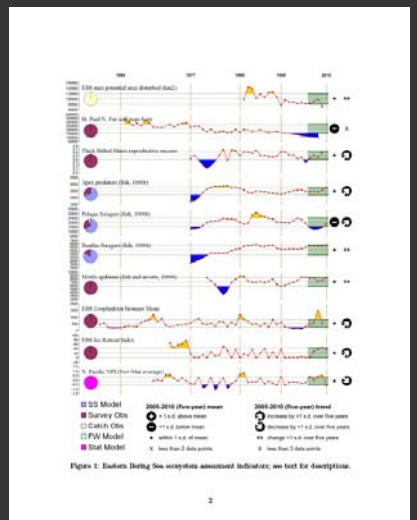
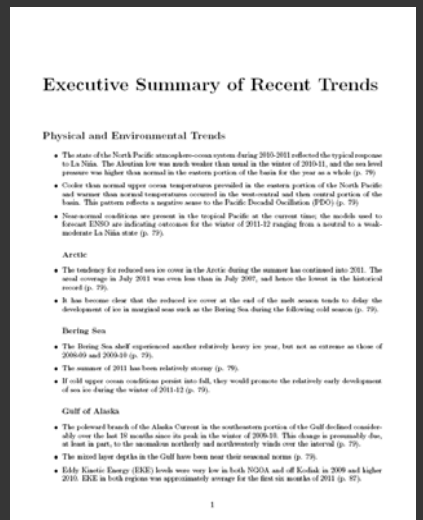


SS Model
Survey Obs
Catch Obs
FVW Model
Stat Model

Figure 1: Eastern Bering Sea ecosystem assessment indicators; see text for descriptions.

2



Executive Summary of Recent Trends

Physical and Environmental Trends

- The state of the North Pacific atmosphere-ocean system during 2010-2011 reflected the typical response to La Niña. The Aleutian low was much weaker than usual in the winter of 2010-11, and the sea level pressure was higher than normal in the eastern portion of the basin for the year as a whole (p. 79).
- Cooler than normal upper ocean temperatures prevailed in the eastern portion of the North Pacific and warmer than normal temperatures occupied in the west-central and then central portion of the basin. This pattern reflects a negative sense to the Pacific Decadal Oscillation (PDO) (p. 79).
- Near-normal conditions are present in the tropical Pacific at the current time; the models used to forecast ENSO are indicating outcomes for the winter of 2011-12 ranging from a neutral to a weak-moderate La Niña state (p. 79).

Arctic

- The tendency for reduced sea ice cover in the Arctic during the summer has continued into 2011. The areal coverage in July 2011 was even less than in July 2007, and hence the lowest in the historical record (p. 79).
- It has become clear that the reduced ice cover at the end of the melt season tends to delay the development of ice in marginal seas such as the Bering Sea during the following cold season (p. 79).

Bering Sea

- The Bering Sea shelf experienced another relatively heavy ice year, but not as extreme as those of 2008-09 and 2009-10 (p. 79).
- The summer of 2011 has been relatively stormy (p. 79).
- If cold upper ocean conditions persist into fall, they would promote the relatively early development of sea ice during the winter of 2011-12 (p. 79).

Gulf of Alaska

- The poleward branch of the Alaska Current in the southeastern portion of the Gulf declined considerably over the last 16 months since its peak in the winter of 2009-10. This change is presumably due, at least in part, to the anomalous northerly and northwesterly winds over the interval (p. 79).
- The mixed layer depths in the Gulf have been near their seasonal norms (p. 79).
- Eddy Kinetic Energy (EKE) levels were very low in both NGOA and off Kodiak in 2009 and higher 2010. EKE in both regions was approximately average for the first six months of 2011 (p. 87).

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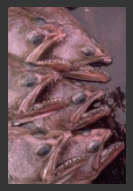
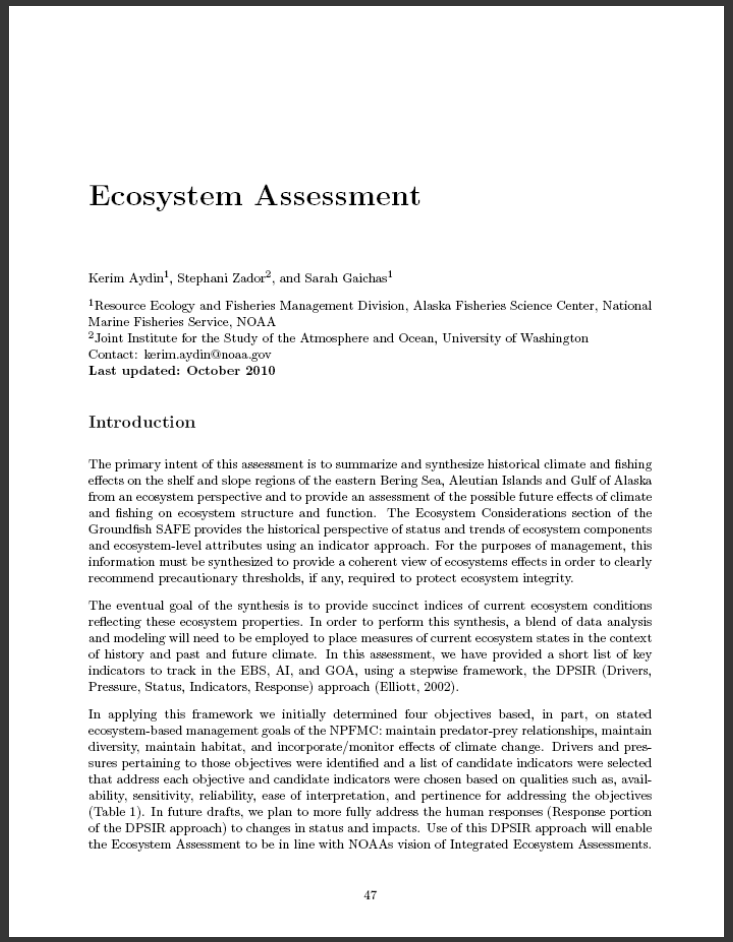
Ecosystem Considerations Report



- Major Sections
  1. Report cards
  2. Executive summary
  3. Ecosystem assessments
  4. Contributed data/indices



Ecosystem Assessment

Kerim Aydin[1], Stephani Zador[2], and Sarah Gaichas[1]

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[2]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington
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Last updated: October 2010

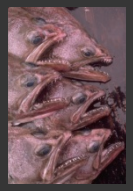
Introduction

The primary intent of this assessment is to summarize and synthesize historical climate and fishing effects on the shelf and slope regions of the eastern Bering Sea, Aleutian Islands and Gulf of Alaska from an ecosystem perspective and to provide an assessment of the possible future effects of climate and fishing on ecosystem structure and function. The Ecosystem Considerations section of the Groundfish SAFE provides the historical perspective of status and trends of ecosystem components and ecosystem-level attributes using an indicator approach. For the purposes of management, this information must be synthesized to provide a coherent view of ecosystems effects in order to clearly recommend precautionary thresholds, if any, required to protect ecosystem integrity.

The eventual goal of the synthesis is to provide succinct indices of current ecosystem conditions reflecting these ecosystem properties. In order to perform this synthesis, a blend of data analysis and modeling will need to be employed to place measures of current ecosystem states in the context of history and past and future climate. In this assessment, we have provided a short list of key indicators to track in the EBS, AI, and GOA, using a stepwise framework, the DPSIR (Drivers, Pressure, Status, Indicators, Response) approach (Elliott, 2002).

In applying this framework we initially determined four objectives based, in part, on stated ecosystem-based management goals of the NPFMC: maintain predator-prey relationships, maintain diversity, maintain habitat, and incorporate/monitor effects of climate change. Drivers and pressures pertaining to those objectives were identified and a list of candidate indicators were selected that address each objective and candidate indicators were chosen based on qualities such as, availability, sensitivity, reliability, ease of interpretation, and pertinence for addressing the objectives (Table 1). In future drafts, we plan to more fully address the human responses (Response portion of the DPSIR approach) to changes in status and impacts. Use of this DPSIR approach will enable the Ecosystem Assessment to be in line with NOAAs vision of Integrated Ecosystem Assessments.

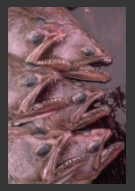
Ecosystem Assessments at the Alaska Fisheries Science Center

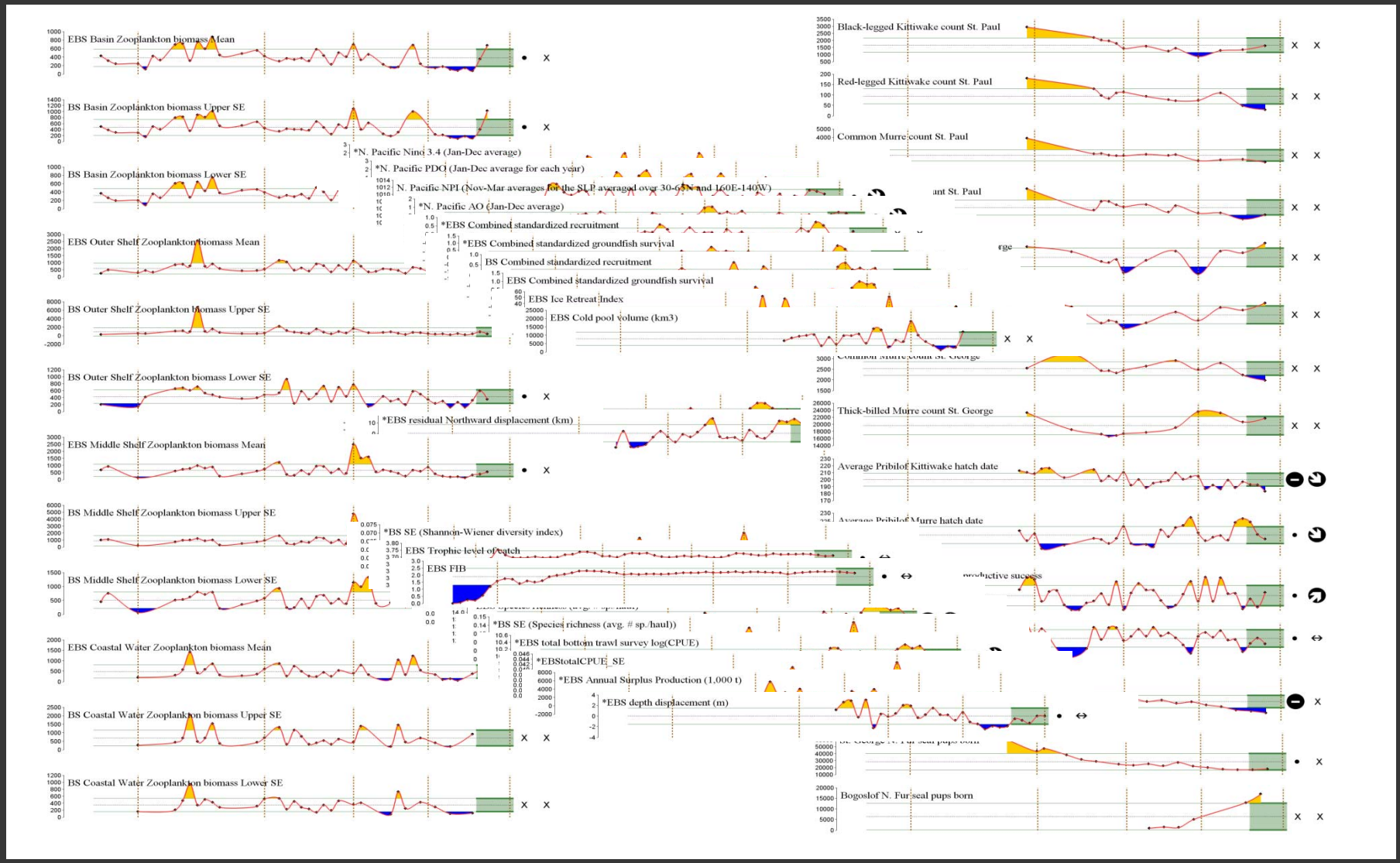


- Goal: to provide a synthesis of current and relevant scientific advice for fisheries managers
- New indicator-based assessments:
  - Eastern Bering Sea (2010)
  - Aleutian Islands (2011)

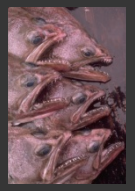
Same method → *Different product*

Raw materials for the assessment





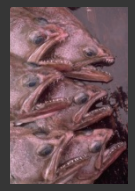
Assessment methods



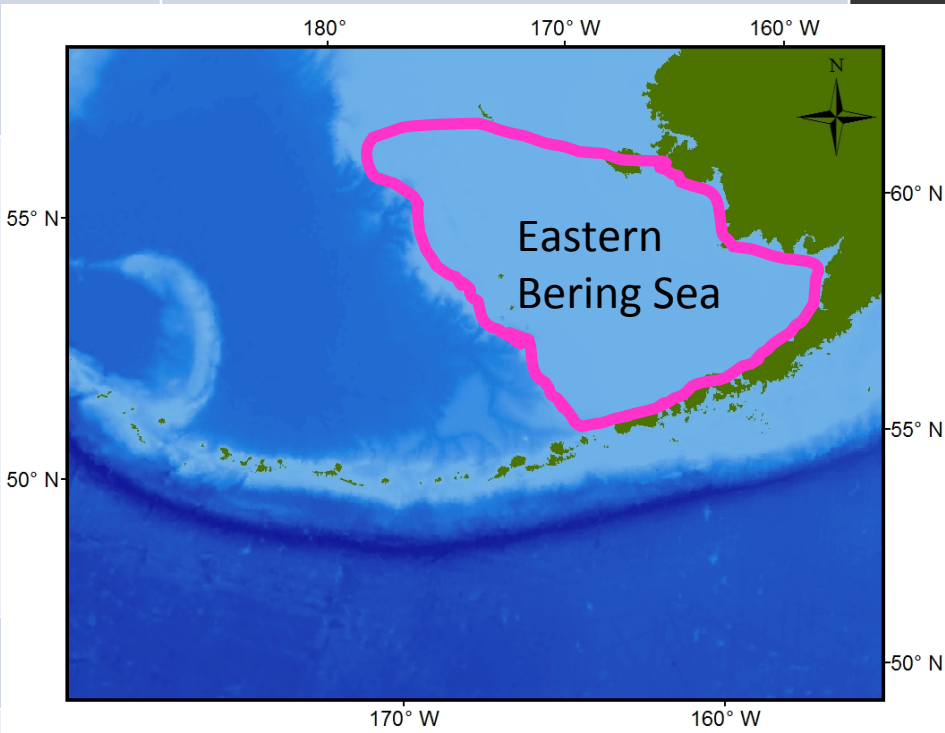
"Team-based Synthesis Approach"

- Created Ecosystem Assessment Synthesis teams:
  regional scientific experts, fisheries managers, others
- Met 1-2 times
- Chose structuring themes to guide indicator selection
- Developed list of 8-10 indicators:
  - "vital signs"
  - updatable

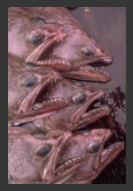
Ecosystem comparison



	Eastern Bering Sea	Aleutian Islands
Habitat	Broad, flat, muddy shelf. Valuable fisheries. Fish-related research.	
Team members: NOAA Academia Management Commercial Other Fed Non Profit Research sponsor	 17 2 1 (3)	
Structuring theme	Production	
Indicator focus	Broad, community-level, indicators of ecosystem-wide productivity, and those most informative for managers	



Results

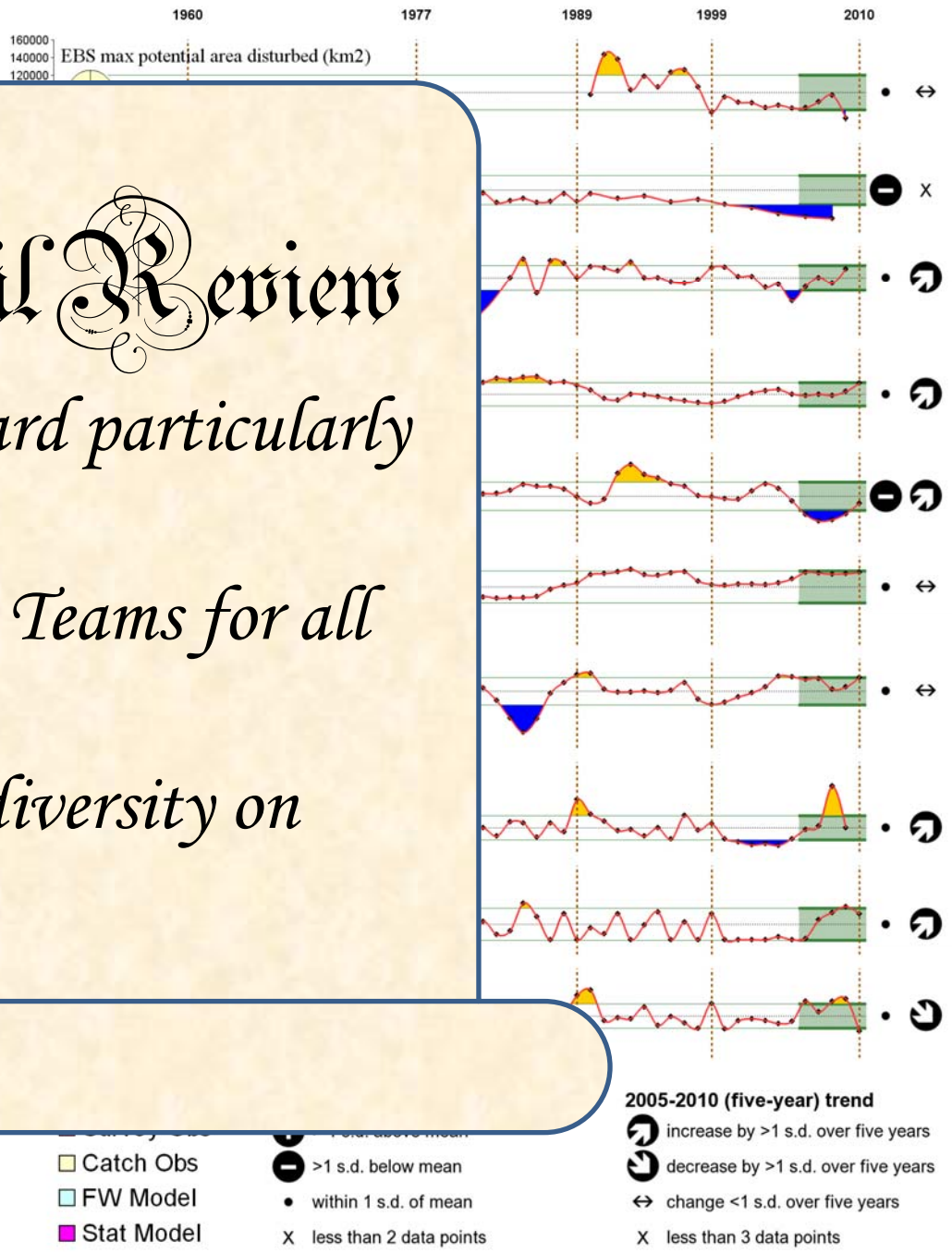


- North Pacific Index
- Ice Retreat Index
- Euphausiids/Copepods
- Motile epifauna biomass
- Benthic foragers biomass
- Pelagic foragers biomass
- Fish apex predator biomass
- St Paul fur seal pups
- St George thick-billed murre reproductive success
- Area trawled

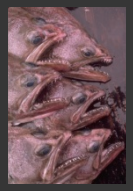
Indicators
Climate
Zooplankton
Forage fish
Fish biomass
Marine Mammals
Seabirds
Humans

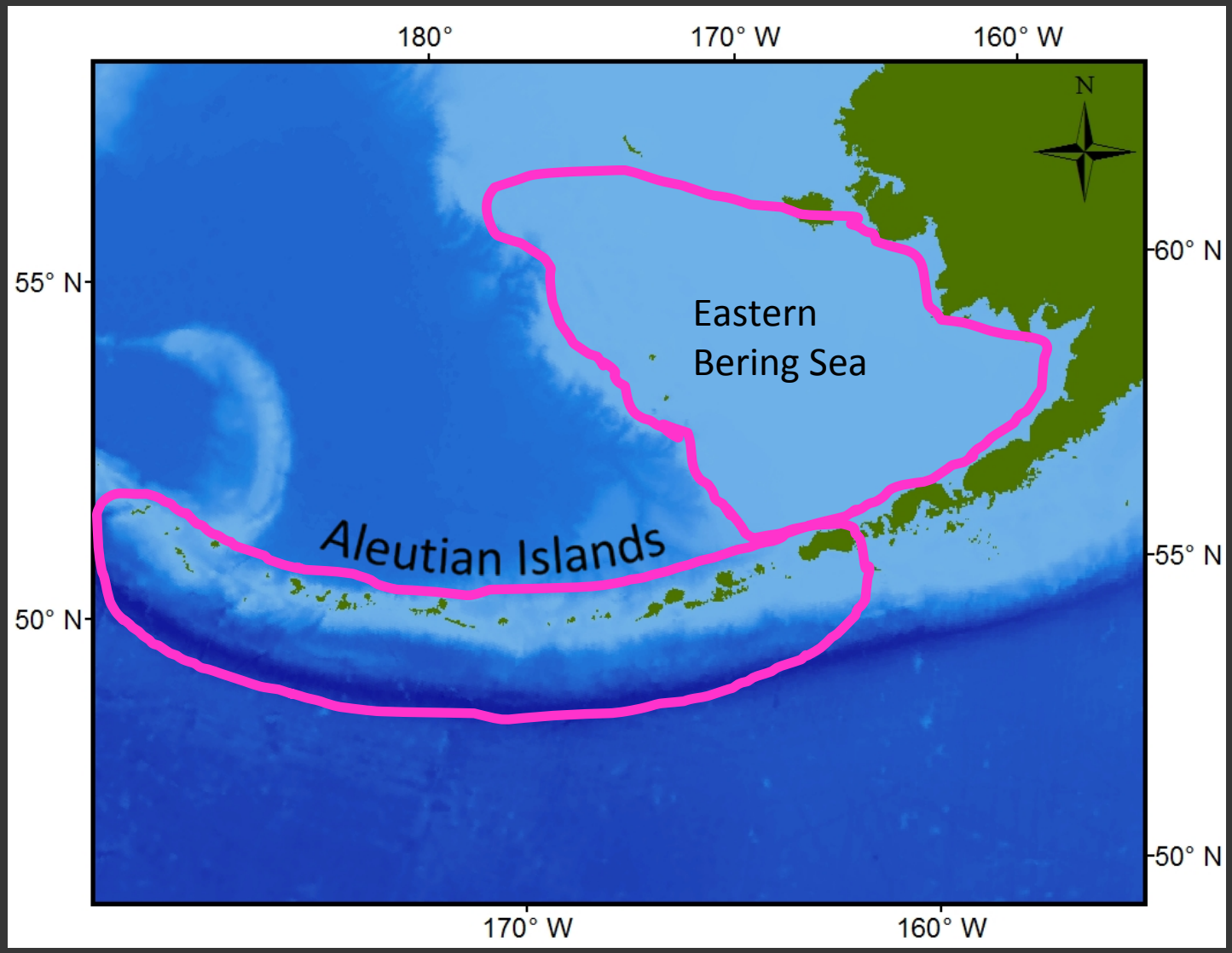
Council Review

1. *Report Card particularly useful*
2. *Establish Teams for all regions*
3. *Increase diversity on Teams*

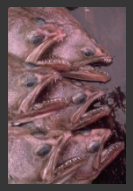


Aleutian Islands



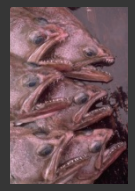


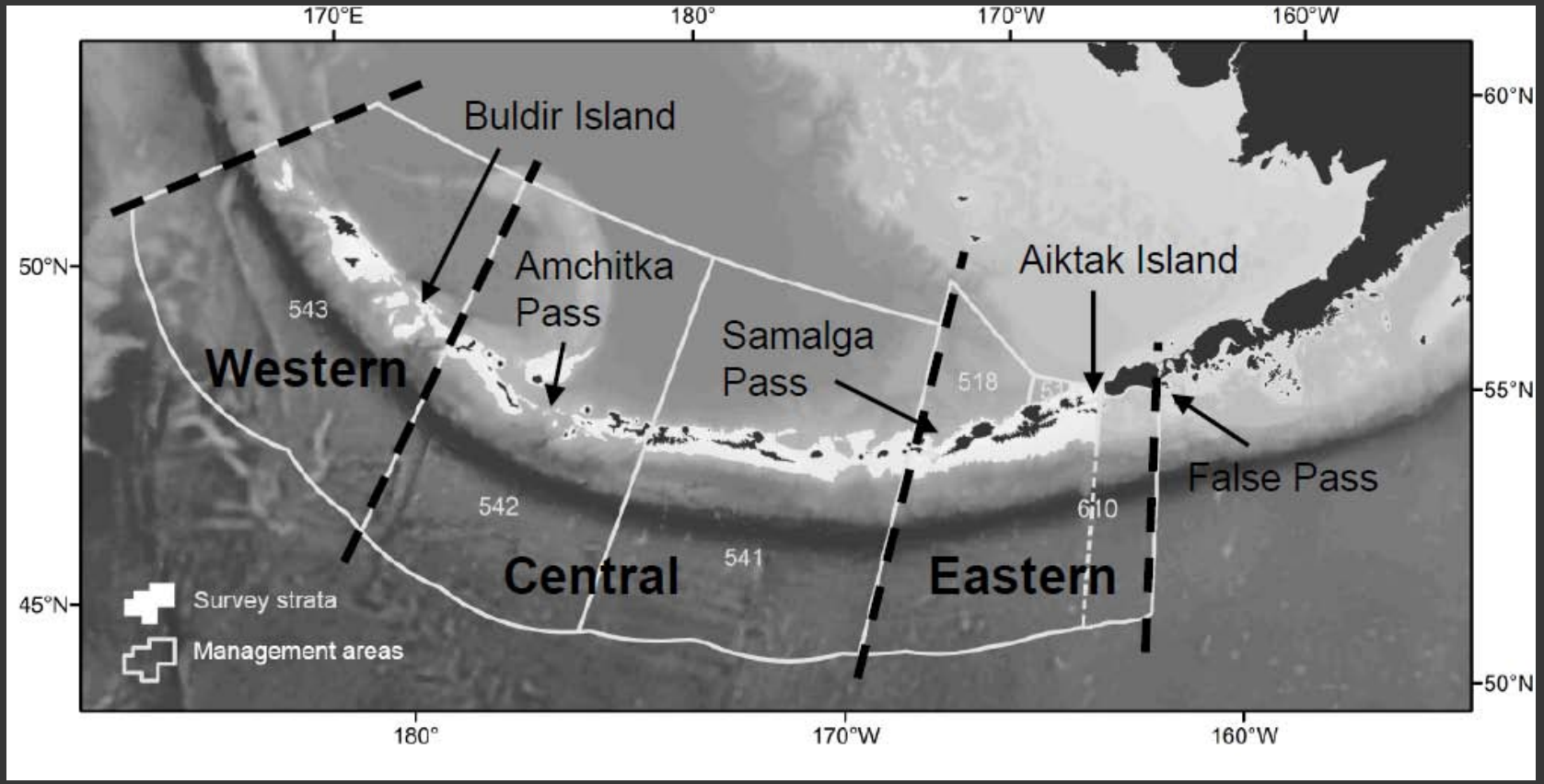
Ecosystem comparison



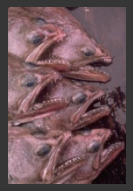
	Eastern Bering Sea	Aleutian Islands
Habitat	Broad, flat, muddy shelf. Valuable fisheries ->>br>Lots of fish-related research.	Extensive rocky island chain, deep trenches, oceanic basins. Smaller-scale fisheries (and research)
Team members: NOAA Academia Management Commercial Other Fed Non Profit Research sponsor	 17 2 1 (3)	 10 4 1 1 2 1 1
Structuring theme	Production	Variability
Indicator focus	Broad, community-level, indicators of ecosystem-wide productivity, and those most informative for managers	Characterize global attributes with local behavior

Aleutian Islands Ecoregions





Results



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- St Paul fur seal pups
- St George thick-billed murre reproductive success
- Area trawled

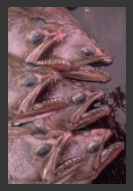
Indicators
Climate
Zooplankton
Forage fish
Fish biomass
Marine Mammals
Seabirds
Humans

- North Pacific Index
- Auklet reproductive success
- Tufted puffin chick diets
- Pelagic foragers biomass
- Fish apex predator biomass
- Sea otters
- Steller sea lion non-pups
- Area trawled
- K-12 enrollment

Council Review

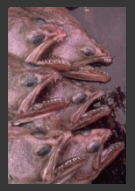
1. School trends important and informative
2. Concern about data gaps and indicators with little predicative value
3. Emphasize management implications

Next Steps



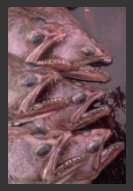
- Update assessments annually
- Systematically test predictions in following years
- Develop a Gulf of Alaska assessment (2013)
- Progress towards the inclusion of ecosystem data directly into stock assessments and resulting management recommendations
- Revisit and revise assessments periodically (~ 3-5 yrs)

Conclusions



1. Ecosystem assessments influenced by:
    - Physical and biological nature of ecosystem
    - Extent of regional scientific knowledge
    - Expertise and interests of Team members
2. Discussion of structuring themes should precede indicator selection
3. Assessment development should be iterative process with frequent review by managers

Acknowledgements



FATE

NPCREP

Ecosystem Assessment Teams:

EBS: Sarah Gaichas, Phyllis Stabeno, Jeff Napp, Lisa Guy, Kerim Aydin, Anne Hollowed, Patrick Ressler, Nick Bond, Troy Buckley, Jerry Hoff, Jim Ianelli, Tom Wilderbuer, Lowell Fritz, Diana Evans, Martin Dorn, Pat Livingston, Franz Mueter, Robert Foy, Ed Farley, Sue Moore, Stephani Zador

AI: Stephani Zador, Kerim Aydin, Steve Barbeaux, Nick Bond, Jim Estes, Diana Evans, Dave Fraser, Lowell Fritz, Stephen Jewett, Carol Ladd, Elizabeth Logerwell, Sandra Lowe, John Olson, Ivonne Ortiz, John Piatt, Chris Rooper, Paul Wade, Jon Warrenchuk, Francis Weise, Jeff Williams