



**NOAA**  
**FISHERIES**

# Using Ecosystem Indicators to Inform Fisheries Management

Stephani Zador  
Elizabeth Siddon  
Ellen Yasumiishi  
Kerim Aydin

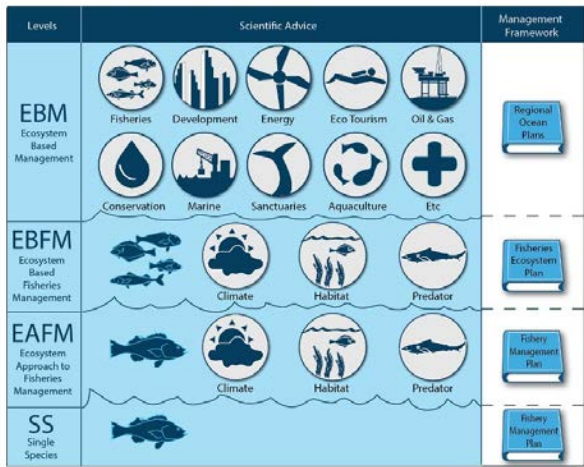
# NOAA Fisheries Mission

Providing vital services for the nation: **productive and sustainable fisheries**, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems—all backed by sound science and an **ecosystem-based approach to management**

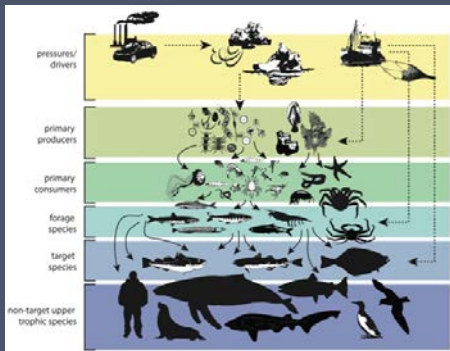


The AFSC provides science to inform how the North Pacific Fisheries Management Council *balances competing interests*

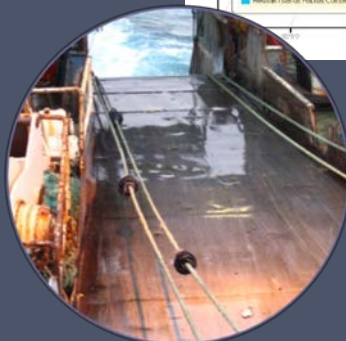
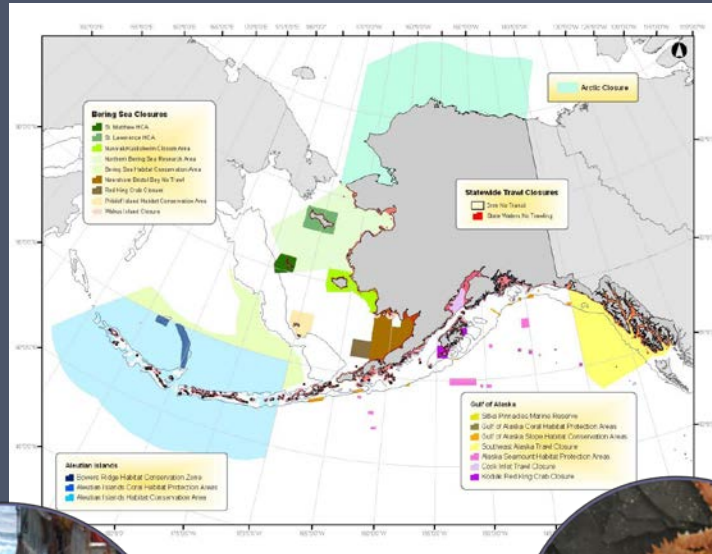
# There are a variety of ways we practice EBFM/EAFM in Alaska



Optimum Yield (OY) caps



Ecosystem models



Gear modifications



Fishery Closures

# Ecosystem Status (Considerations) Reports

- Indicator-based assessments
- EBS, GOA (AI and Arctic)
- Targeted for managers
- Linked with stock assessments

## Ecosystem Considerations 2017 Status of the Gulf of Alaska Marine Ecosystem



Edited by:  
Stephani Zador<sup>1</sup> and Ellen Yasumishi<sup>2</sup>  
<sup>1</sup>Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA  
<sup>2</sup>Auke Bay Laboratories, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA

With contributions from:

Mayumi Arimoto, Sonia Batten, Jennifer Boldt, Nick Bond, Jennifer Cedarleaf, Kristin Ceciel, Seth Danielson, Annette Dougherty, Sherri Dussell, AnneMarie Eich, Niels Fern, Emily Fergusson, Ben Fiske, Shannon Fitzgerald, Christine Gabriele, Sarah Gaidwan, Andrew Gray, Clark Guthrie, Dana Hanselman, Coleen Harpold, Bradley Harris, Scott Hatch, Kyle Hebert, Jerry Hoff, Steve Kuiperski, Arthur Kettle, David Kimmel, Carol Ladd, Ned Laman, Jesse Lamb, Anna Lavoie, Joan Lee, Daniel Lew, Steve Lewis, Jennifer Mondragon, John Moran, Jamal Moss, Franz Muerter, Jim Murphy, Janet Neilson, Joseph Orsi, Wayne Paulson, Melanie Papain, Heidi Pearson, John Platt, Alexei Pischak, Steven Porter, Heather Remont, Patrick Rossler, Lauren Rogers, Nora Rojick, Chris Rooper, Joshua Russell, Kadi Shotwell, Kim Sparks, William Stockhausen, Janice Straley, Wes Strauburger, Andy Szaba, Marysia Szymkowiak, Louise Taylor-Thomas, Scott Valutek, Jordan Watson, Andy Whitehouse, Matthew Wilson, Sarah Wise, Carrie Worton, Ellen Yasumishi, and Stephani Zador

Reviewed by:  
The Gulf of Alaska Groundfish Plan Team

## Ecosystem Considerations 2016 Status of the Aleutian Islands Marine Ecosystem



Edited by:  
Stephani Zador  
Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA  
790 West Dock Street #11  
Seattle, WA 98145

With contributions from:

Scott Branta, Jaakko Dohk, Neil Dual Skonane, Eugene D. Frazer, Craig G. Hall, Gail G. Hall,  
Jerry Hoff, Carol Ladd, Ned Laman, John Lee, Jennifer Macgregor, John Olson, Jordan Orsi,  
Chris Rooper, Anna Szaba, Tom Tolosa, Andy Whitehouse, Stephen Zador

Reviewed by:  
The Plan Team for the Southeastern Fisheries, the  
Bering Sea, Aleutian Islands, and Gulf of Alaska

November 24, 2016  
2016 Pacific Fisheries Management Council  
625 W. 4<sup>th</sup> Avenue, Suite 506  
Anchorage, AK 99501

## Ecosystem Considerations 2017 Status of the Eastern Bering Sea Marine Ecosystem



Edited by:  
Elizabeth Sikkink<sup>1</sup> and Stephani Zador<sup>2</sup>  
<sup>1</sup>Auke Bay Laboratories, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA  
7700 Pt. Barrow Road  
Anchorage, AK 99501

<sup>2</sup>Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center,  
National Marine Fisheries Service, NOAA

With contributions from:

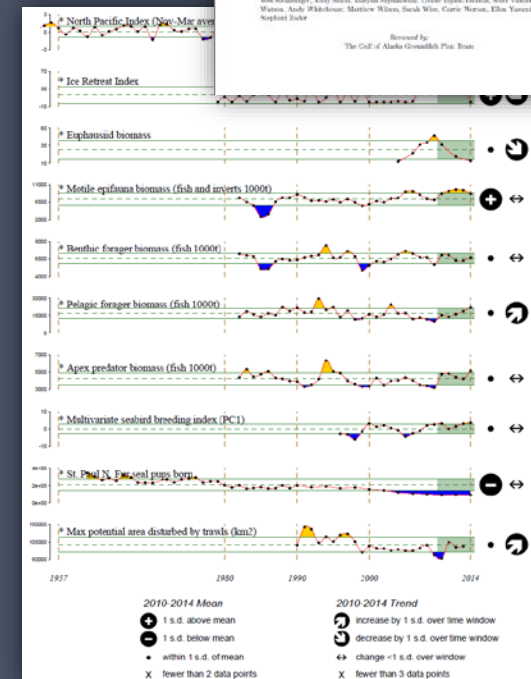
Alex Anderson, Kerin Aydin, John Beutchen, Jennifer Dohk, Nick Bond, Lyle Britt, Hillary Burgett, Kristin Ceciel, Anne Marie Fish, Lisa Finzer, Ed Farley, Benjamin Fowl, Shannon Fitzgerald, Robert Fox, Sarah Gaidwan, Jennifer Goss, Coleen Harpold, Ben Hesse, Jerry Hoff, Kristin Holman, Katherine Howard, Jim Inaudi, Taylor Jarvis, Timothy Jones, Robb Kaler, Steve Kuiperski, David Kimmel, Kacie Kiefer, Liz Lohman, Carol Ladd, Christie Long, Geoff Long, Robert Lantz, Anna Lavoie, Joan Lee, David R. Lee, Michael Linton, Jennifer Mondragon, Franz Muerter, Jim Murphy, John V. Olson, Jan Overland, Julia Parich, Bill Rosen, Heather Rowan, Jan Richter, Mary Romano, Chris Rooper, Sarah Saha, Elizabeth Sikkink, Kim Spore, Phyllis Stachow, Kate Stafford, Jimmy Sterling, Marysia Szymkowiak, Grant Thompson, Rod Towell, Martin Wang, Andy Whitehouse, Tom Willerton, Michael Williams, Sarah E. Wise, Ellen Yasumishi, and Stephani Zador

# ESR Goals and Objectives

- Synthesis of ecosystem(s) status
- Provides context for EAFM/EBFM
  - Data external to stock assessment
- Spurs discussion, which can influence the quota-setting process

# A brief history of the reports

- Produced **annually** since 1995
- **Evolving** documents
  - 1995: a compendium of general information on EBS, AI and GOA ecosystems and a general discussion of ecosystem-based management.
  - 2016: **Separate reports** for each Large Marine Ecosystem
- **Adaptive** documents
  - Revised annually in response to review and new information available
  - **New indicators every year**



# Report Outline

Increasing level of detail

- Report Cards (1-3 p)
  - Eastern Bering Sea
  - Western and Eastern GOA
  - (Western, Central and Eastern AI)
  - (Arctic)
- Executive Summary (~5p)
- Response to SSC Comments (~10 p)
- Ecosystem Assessments (Includes Hot Topics) (~20 p)
- Ecosystem Status and Management Indicators (70-160 p)

# Indicator Categories

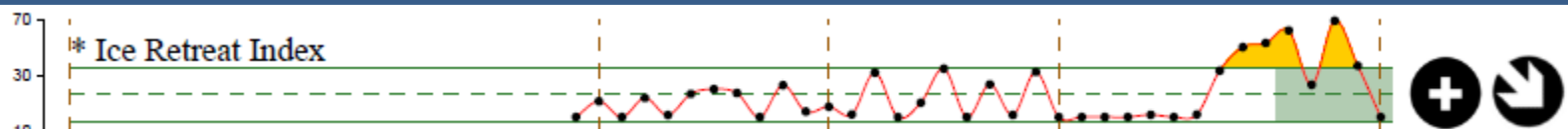
## Ecosystem Status

- Physical
- Phytoplankton
- Zooplankton
- Forage fish
- Herring
- Salmon
- Groundfish
- Groundfish Recruitment Predictions
- Benthic Communities and Non-Targets
- Seabirds
- Marine Mammals
- Ecosystem or Community Indicators

## Fishing and Human Dimensions

- Discards and Non-Target
- Habitat
- Sustainability
- Seafood Production
- Profits
- Recreation
- Employment
- Socio-cultural

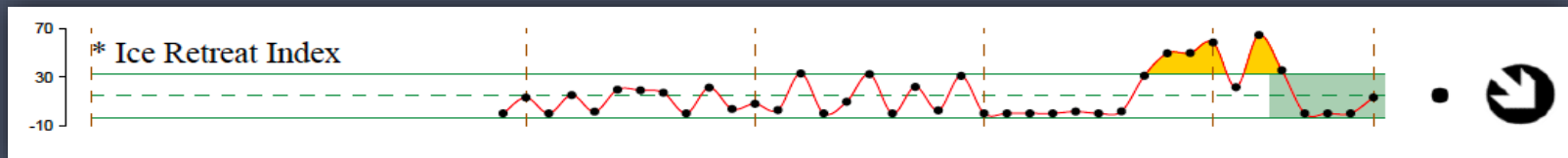
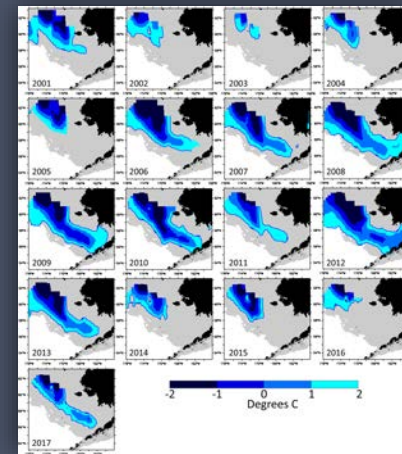
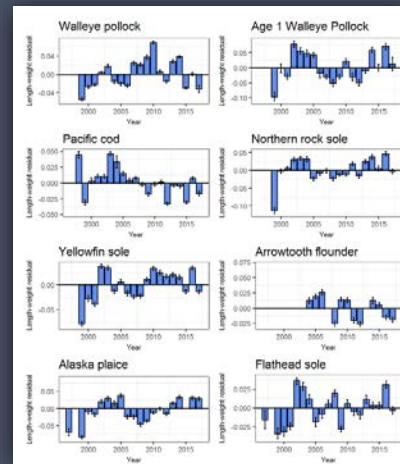
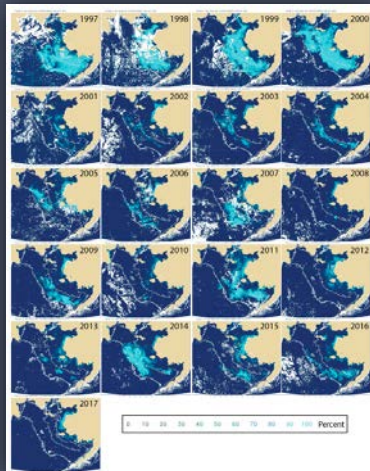
Types:  
Observations  
Model-based  
Multivariate



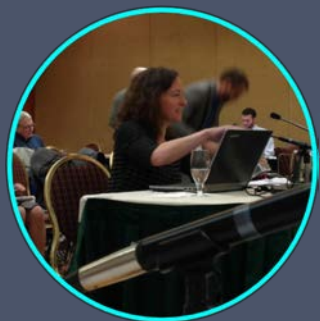


# The ideal indicator...

- Fills gaps in, or improves, the current suite of indicators
- Characterized at annual scales
- Long-term time series and/or likely to be measured for many years
- Available for current year or year before (at most)
- Known (or surmised) implications for fisheries management



# Ecosystem context for quota deliberations



Updates on the status of our large marine ecosystems

NOAA Ecosystem considerations

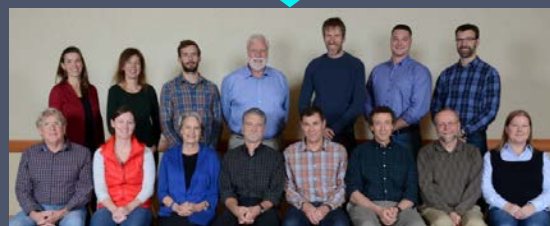
NOAA Stock assessments

August & September



Regional Plan Teams

September & November



Scientific and Statistical Committee

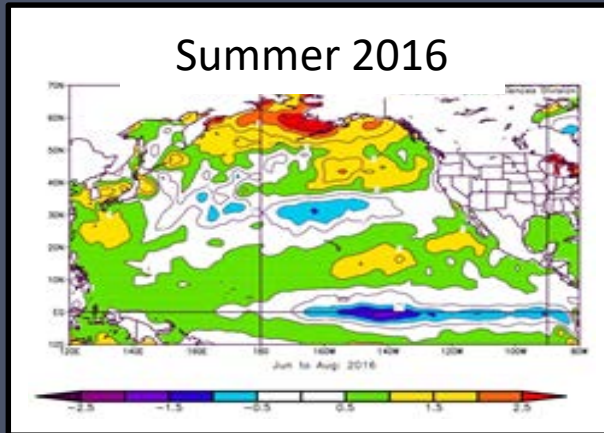
December



Council

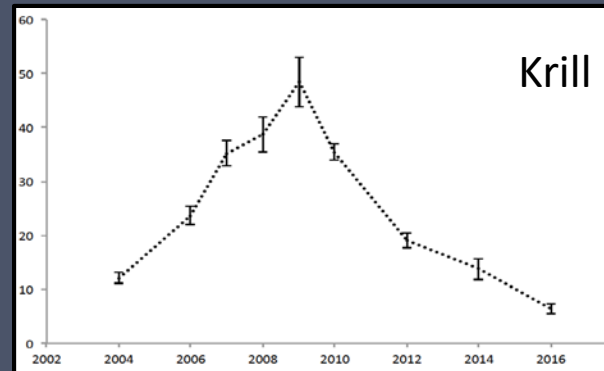
Fishery quotas set

# 2016 Eastern Bering Sea Pollock example



## 2016 Pollock Stock assessment

“Additional precaution may be warranted since warm conditions are thought to negatively affect the survival of larval and juvenile pollock.”



## Scientific & Statistical Committee

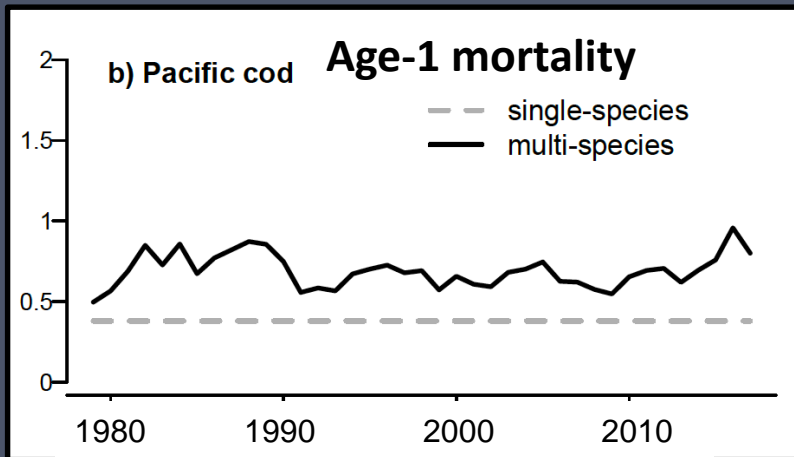
“Our current understanding of pollock early life dynamics suggests that recent survival from age-0 to age-1 may be low due to low availability of suitable prey.”



## Council

Quota was reduced under a more conservative Tier 3 approach; consideration of ecosystem indicators impacted management decisions.

# 2017 Eastern Bering Sea Pacific cod example



## BSAI Groundfish Plan Team

“The Team spent a significant amount of time discussing **ecosystem considerations.**”

- **Negative indicators:** (i) low recruitment, (ii) high age-1 mortality, (iii) low weight-at-age, (iv) warming ocean temperatures, (v) bird die offs, and (vi) low crab abundance.
- **Positive indicators:** (i) high abundance in NBS, (ii) relatively high Fulton’s condition, and (iii) cooler temperatures predicted in future years.
- “...the Team felt that the ABC should be **reduced from the maximum ABC in 2018.**”

## Scientific & Statistical Committee

“Ecosystem and population information provided a **mixed signal.**”

- Recommended setting the 2018 ABC at the maximum permissible level because there is **“not unequivocal information justifying a further reduction.”**

**U.S. Fish & Wildlife Service**  
**Seabird Die Off: Point Hope to Bristol Bay, June to September 2017**

USFWS Alaska Region  
Migratory Bird Management  
5011 L. Tudor Rd.  
Anchorage AK 99503  
1 866 327 3358 (ahove) AK\_MBM@fws.gov  
December 2017

**What Happened?**  
During June to September 2017, USFWS received reports of dead and dying seabirds from the Bering and Chukchi regions - from Point Hope south to the Bristol Bay. Responders at Deering, Gambell, Nome, Point Hope, Shishmaref, Unalakleet, Unalakleet, St. George, St. Paul and other coastal areas have counted nearly 1600 beached seabird carcasses since early June 2017, including northern fulmars, shearwaters, and kittiwakes. Murres, gulls, and puffins have also been reported. The USFWS coordinated with the Coastal Observation and Seabird Survey Team (COASST) to monitor several beaches. Twenty-one carcasses were examined by the USGS National Wildlife Health Center, USGS Alaska Science Center, and the NOAA Laboratory in Beaufort, North Carolina.

**Contributing Partners:**

**What Did We Learn?**  
Seabird carcasses from Point Hope, Shishmaref, Gambell, St. George and St. Paul Islands indicated death by drowning and starvation. There was no evidence that the deaths were caused by an infection. Saxitoxin is a toxin naturally produced by algae that can affect the mammalian nervous system if ingested in high concentrations. Saxitoxin was detected in the intestinal contents and livers of five northern fulmars from Shishmaref, Gambell, St. George and St. Paul Islands. All samples were below human consumption limits for shellfish (60 µg/100 g); however, potential impacts of algal toxins on birds are unknown. Domoic acid, which is also associated with algae, was not detected in any samples. We do not have evidence of acute toxicity as a direct cause of seabird deaths, but it is possible that exposure to saxitoxin may have been a contributing factor.

**Remember to...**  
Report unusual numbers of sick or dead birds to: 1-866-327-3358 or email AK\_MBM@fws.gov  
Information needed includes:  
• Time & Date you see sick or dead birds  
• Location of the sick or dead birds  
• Type & number of birds (count or estimate)  
• Photos of sick/dead birds (see above; include scale if possible)  
• Videos of any unusual behaviors (approachable, drooping head and wings, etc.)

Participate in monitoring efforts on your local beaches  
The Coastal Observation and Seabird Survey Team (COASST) provides training in how to identify birds and collect data that are shared with researchers and resource management agencies. Visit [www.coasst.org](http://www.coasst.org) to learn more or contact COASST at 1-206-221-6993 or email [coasst@uw.edu](mailto:coasst@uw.edu).

# Next steps for indicators

- Formalization of indicator review
- Coordination with SA authors
  - GOA cod example – Steve Barbeaux
- Ecosystem and Socio-Economic Profiles (ESPs)

# Stock Assessment information

## Ecosystem Status Report information

	Not okay	Okay
Not Okay	2006 EBS pollock 2017 GOA cod	2016 EBS Pollock
Okay	“No red flags were indicated.”	EBS Yellowfin sole

# Next steps for indicators

- Formalization of indicator review
- Coordination with SA authors
  - GOA cod example – Steve Barbeaux
- Ecosystem and Socio-Economic Profiles (ESPs)

# Next steps for indicators

- Formalization of indicator review
- Coordination with SA authors
  - GOA cod example – Steve Barbeaux
- Ecosystem and Socio-Economic Profiles (ESPs)



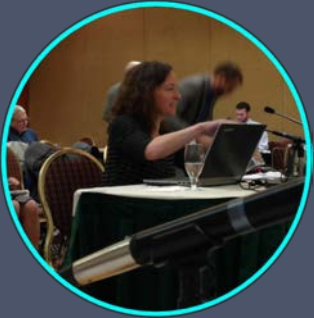


ESPs

Stock-specific indicators

NOAA Stock assessments

NOAA Ecosystem considerations



Updates on the status of our large marine ecosystems



Regional Plan Teams



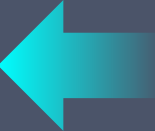
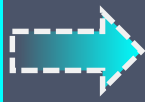
Scientific and Statistical Committee



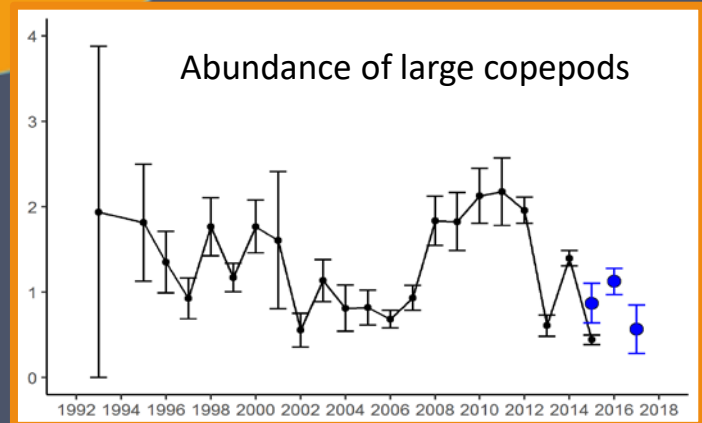
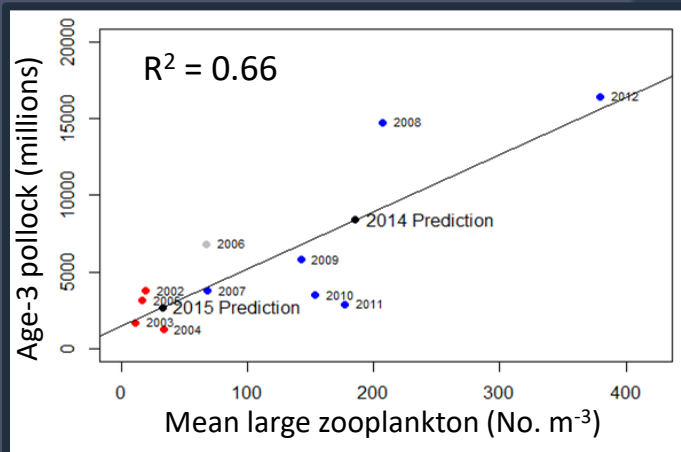
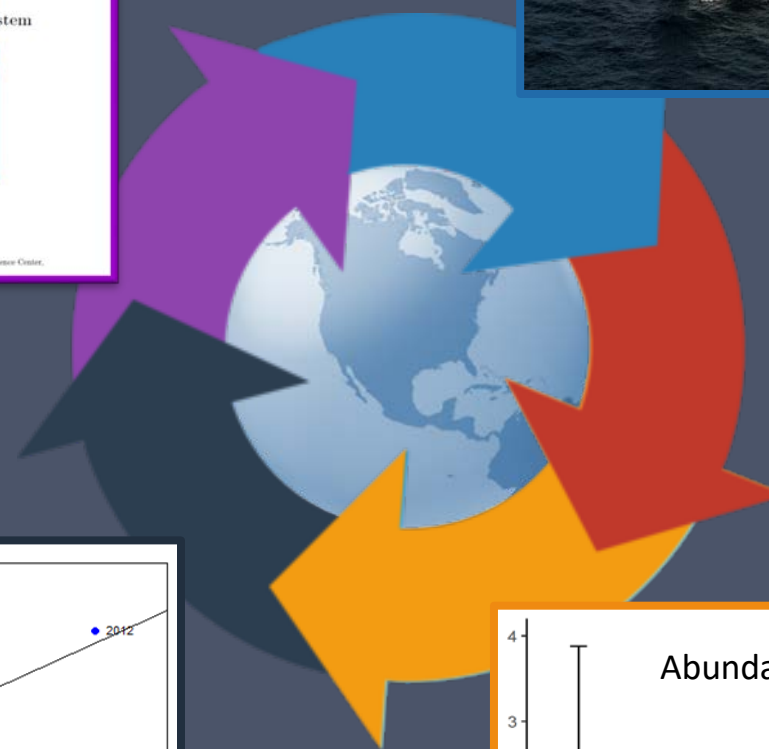
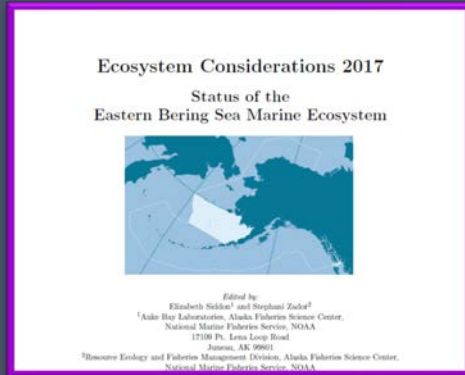
Council



Fishery quotas set




# Science to Management





**NOAA**  
**FISHERIES**

Alaska Marine Ecosystem Status Reports 

Home

Home    Data    Assessments    Report Cards    Hot Topics    Links

Ecosystem Status Reports are produced annually to compile and summarize information about the status of the Alaska marine ecosystems for the [North Pacific Fishery Management Council](#), the scientific community and the public. As of 2016, there are separate reports for the the Eastern Bering Sea (updated 2017), Aleutian Islands (updated 2016), the Gulf of Alaska (updated 2017), and Arctic (forthcoming) ecosystems. These reports include ecosystem report cards, ecosystem assessments, and ecosystem and ecosystem-based management indicators that together provide context for ecosystem-based fisheries management in Alaska.

<p><b>Eastern Bering Sea</b></p> <ul style="list-style-type: none"><li>• <a href="#">Executive Summary</a></li><li>• <a href="#">Assessment</a></li><li>• <a href="#">Report Card</a></li><li>• Hot Topic<ul style="list-style-type: none"><li>◦ <a href="#">Thinking Outside the Survey Box</a></li><li>◦ <a href="#">Local Environmental Observer Network</a></li><li>◦ <a href="#">Dead and Dying Seabirds</a></li></ul></li><li>• <a href="#">Full Report (.pdf)</a></li></ul>	<p><b>Aleutian Islands (2016)</b></p> <ul style="list-style-type: none"><li>• <a href="#">Executive Summary</a></li><li>• <a href="#">Assessment</a></li><li>• <a href="#">Report Card</a></li><li>• Hot Topic<ul style="list-style-type: none"><li>◦ <a href="#">Aleutian Life Forum</a></li></ul></li><li>• <a href="#">Full Report (.pdf)</a></li></ul>
<p><b>Gulf of Alaska</b></p> <ul style="list-style-type: none"><li>• <a href="#">Executive Summary</a></li><li>• <a href="#">Assessment</a></li><li>• <a href="#">Report Card</a></li><li>• Hot Topics<ul style="list-style-type: none"><li>◦ <a href="#">Pyrosomes in Research Surveys</a></li><li>◦ <a href="#">Local Environmental Observer Network</a></li></ul></li><li>• <a href="#">Full Report (.pdf)</a></li></ul>	<p><b>Arctic (2015)</b></p> <ul style="list-style-type: none"><li>• <a href="#">Assessment</a></li><li>• Hot Topic<ul style="list-style-type: none"><li>◦ <a href="#">Polar Bears</a></li></ul></li><li>• <a href="#">Full Report (.pdf)</a></li></ul>

Contact us:

- Stephani.Zador@noaa.gov
- Elizabeth.Siddon@noaa.gov
- Ellen.Yasumiishi@noaa.gov
- Kerim.Aydin@noaa.gov

<https://access.afsc.noaa.gov/reem/ecoweb/Index.php>