



**NOAA
FISHERIES**

Highlights from the **Alaska Regional Action Plan for the Southeastern Bering Sea** **NOAA FISHERIES CLIMATE SCIENCE STRATEGY**



The Need for Action

Alaska is on the front lines of climate change. While temperatures are anticipated to increase globally, the largest changes are expected in the Arctic including the Bering Sea.

The Bering Sea is one of the world's largest and most biologically productive semi-enclosed seas. To reduce impacts and increase resilience of the region's valuable marine resources and the communities that depend on them, decision-makers need information on what's changing, why it's changing and how to respond.



What's at Risk?

The southeastern Bering Sea supports some of the most valuable commercial fisheries in the world for salmon and walleye pollock. High numbers of seabirds, whales, walrus, seals and other marine mammals live in or visit these cold waters seasonally.

In an area considered remote to most Americans, Alaska coastal communities continue a traditional way of life based on subsistence hunting that has endured for centuries.

Climate-related changes in ocean and coastal ecosystems likely will impact the zooplankton, fish, seabirds, and marine mammals of the southeastern Bering Sea, and the people, businesses, and human communities that depend on them.



Regional Action Plan for Southeastern Bering Sea

Climate Science

This Regional Action Plan identifies key actions to address priority information needs over the next five years to better understand, prepare for and respond to climate changes in the Bering Sea ecosystem.

NOAA Fisheries' Alaska Fisheries Science Center is collaborating with NOAA Research's Pacific Marine Environmental Laboratory to acquire needed scientific data and information for science-based strategies that sustain fisheries, healthy ecosystems, marine mammals, and coastal communities in a changing climate.

The Regional Action Plan, part of the NOAA Fisheries Climate Science Strategy, focuses on seven science objectives. Figure 2 shows how the Plan's actions address each of the seven Climate Science Strategy Objectives.

This science will be used to inform policy and management decisions. "Climate-ready" management will be precautionary, preemptive, and flexible enough to respond rapidly to changing environmental conditions.



Current Efforts

The Alaska Fisheries Science Center, the Pacific Marine Environmental Laboratory and other partners already have the scientific infrastructure needed to produce the analyses and deliver benchmarks for the eastern Bering Sea.



The Center and its partners have long-standing, regular field surveys. Socio-economic studies, regional and ocean modeling and ecosystem process studies complement this time series of physical and biological observations. All are used to produce timely information on short-term changes and long-term shifts in the abundance and distribution of federally managed species.

More than 30 projects are ongoing including:

- **NPFMC Bering Sea Fisheries Ecosystem Plan.** Approved for development by the North Pacific Fishery Management Council in December 2015, this plan is expected to synthesize current climate change project outcomes and develop management measures for affected species and their habitat under different climate scenarios. On a 5-7 year cycle, scientists will produce an eastern Bering Sea Climate Change and Fisheries Assessment Report which will include updated data and information from ongoing research that will be used to guide future management actions. (Objective 2)
- **Alaska CLIMate project (ACLIM).** This multi-year project involves a suite of models designed to provide scenarios of future fish production under a variety of climate and fishing scenarios. (Objectives 1-4)
- **Climate vulnerability assessment for the southeastern Bering Sea.** This project will qualitatively assess species vulnerabilities to climate change and provide guidance on research prioritization, and will be completed during 2016. (Objective 4)
- **Belmont Forum project.** This project, which is expected to be completed in 2017, will synthesize information from regional studies conducted by Japan, the United States, and Norway to examine how climate impacts in the subarctic to arctic transition zone may affect future marine ecosystems of the Atlantic and Pacific Arctic (including the southeastern Bering Sea), their resource management, and the socioeconomic status of human communities in the regions. (Objective 2)
- **Recruitment Processes Alliance (RPA).** This ongoing research focuses on understanding recruitment processes of important southeastern Bering Sea fish species. The research includes field-work, laboratory analysis of field sample collections (e.g., feeding, growth, and bioenergetics), laboratory studies, and modeling. (Objectives 5-7)
- **Loss of sea ice research.** This effort extends standard surveys for crab, fish and marine mammals of the southeastern Bering Sea into the northern Bering Sea to better understand changes in species distribution that may be occurring as a result of changing sea ice conditions. (Objective 6)
- **Ocean acidification research.** This ongoing research seeks to better understand the potential effects of ocean acidification on commercially important king and tanner crabs, walleye pollock, cod and northern rock sole and cold water corals, which provides habitat for some of these species. (Objective 5)
- **Fur seal research.** The fur seal population on the Pribilof Islands has been declining since 1998. It is suspected that direct and indirect effects from fishery competition and climate could be affecting prey availability and distribution. This project unites fishery and marine mammal biologists who will link, for the first-time, fine-scale changes in fur seal foraging behavior with measures of walleye pollock distribution and abundance in real time. (Objective 5)
- **Assess economic and human community impacts.** Field surveys and modeling of the climate effects on fisheries and the related economic and human community impacts will continue. (Objectives 4-6)
- **Alaska Integrated Ecosystem Assessments and Alaska Marine Ecosystems Considerations.** The Ecosystem Considerations report is produced annually to summarize information about the Alaska Marine Ecosystem for the North Pacific Fishery Management Council, the scientific community and the public. (Objective 6)
- **Standard ecosystem monitoring.** Ecosystem trends are monitored through a combination of field observations, ongoing standardized resource assessment surveys, fisheries oceanography, seabird, and marine mammal surveys. (Objective 6)

Data → Science → Management Cycle

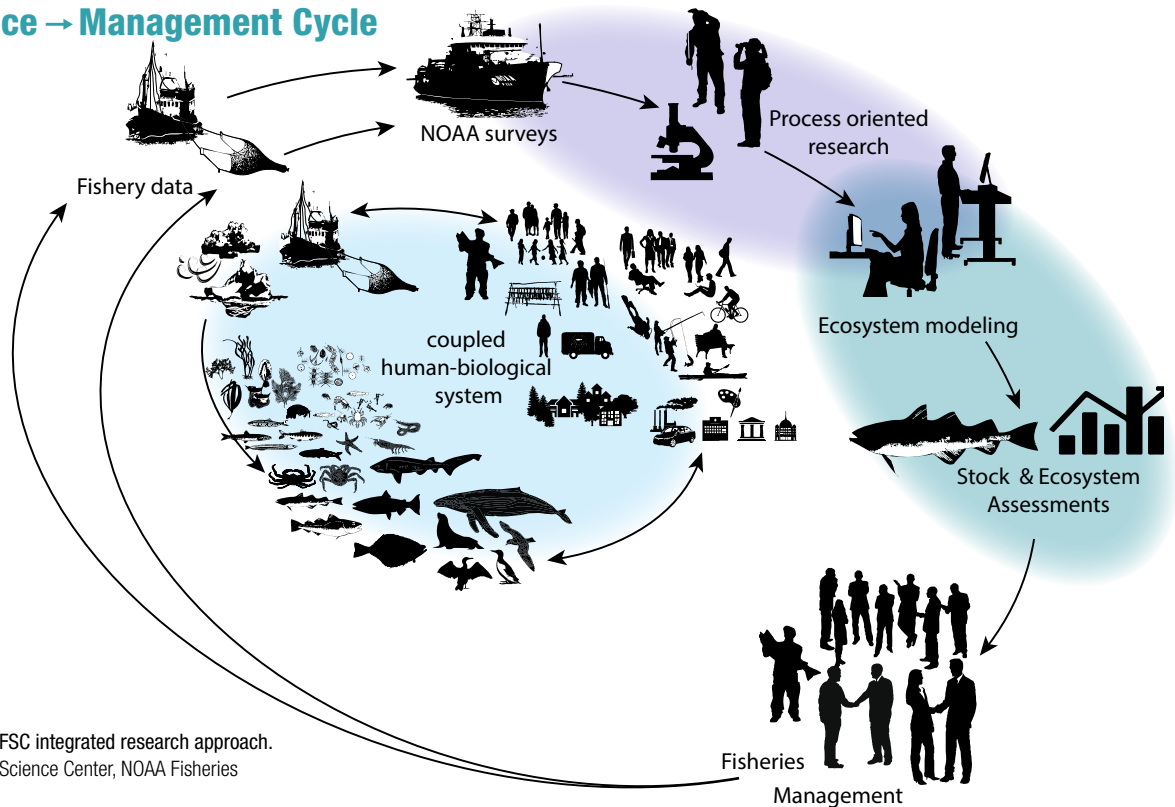


Figure 1. The AFSC integrated research approach. Alaska Fisheries Science Center, NOAA Fisheries

Climate Science Strategy Objectives

1. Climate-Informed Reference Points

- Climate enhanced assessment models

2. Robust Management Strategies

- Council Fisheries Ecosystem Plan, climate module
- Management Strategy Evaluations
- Alaska CLIMate project (ACLIM)
- Multispecies technical interaction model
- Belmont Forum project

3. Adaptive Management Processes

- Design adaptive decision processes
- Identify ecosystem thresholds & regime shifts*

4. Project Future Conditions

- Comprehensive climate assessment (every 5 yr)*
- Ocean model projections
- Climate-enhanced projection models
- Climate vulnerability assessment for the SE Bering Sea
- Identify climate impacts on living marine resource dependent human communities
- Arctic Council, Arctic Monitoring and Assessment Programme (AMAP), impacts on coastal communities
- Incorporate ocean acidification effects into existing ocean models
- Integrate tools and data*
- Integrate and couple models*

5. Understand Mechanisms of Change

- Bering Sea Project
- SE Bering Sea Ecosystem Assessment
- Ocean acidification research
- Fur seal research
- Ice-associated seal surveys
- Passive acoustic surveys for whales
- National seabird program
- Economic effects of climate change

6. Track Change and Provide Early Warnings

- Alaska Integrated Ecosystem Assessment and Ecosystems Considerations Report
- Standard ecosystem monitoring
- Loss of Sea Ice research
- Coastal Assessments
- NOAA oceanographic moorings*

7. Build and Maintain Adequate Science Infrastructure

- Existing surveys and stock assessments
- Recruitment Processes Alliance
- Laboratory infrastructure
- Predator-prey food habits studies
- Ecosystem modeling
- Assess economic impacts
- Assess community impacts
- International coordination*
- Build and maintain critical partnerships
- Communication of climate change risks
- Training, education, and outreach*
- Invest in modeling infrastructure*

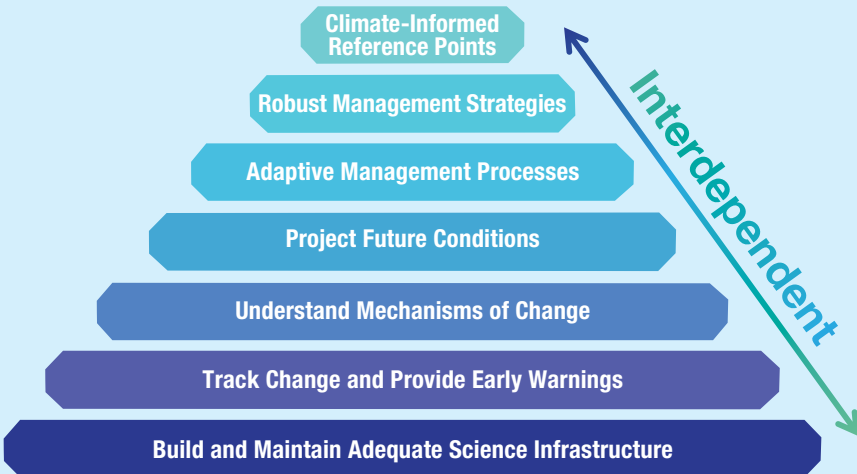


Figure 2. The seven NOAA Fisheries Climate Science Strategy objectives and the research projects supporting these objectives for the southeastern Bering Sea.

* Asterisks indicate projects that will be supported if additional funding is available. The remaining projects will be supported if funding remains level.

Future Efforts

The Regional Action Plan identifies key actions needed over the next five years to increase the production, deliver and use climate-related information in fisheries management and protected species conservation.

These actions will provide decision-makers with some of the information they need to help reduce impacts and increase resilience of the region's valuable marine resources and the industries and communities that depend on them including:

WHAT'S AT RISK: Scientists will seek to determine the vulnerability and adaptability of fish, crabs, protected species of whales and seals, fisheries, and coastal communities to changing environmental conditions by conducting rapid assessments. They will identify potential "winners" and "losers" of climate change, updating these analyses every five years.

WHAT IS CHANGING: Eventually, the Alaska Fisheries Science Center and the Pacific Marine Environmental Laboratory's integrated surveys can be used to provide climate-informed reference points to project future conditions, and identify climate-driven mechanisms of change. These reference points will inform a range of adaptive management strategies and harvest limits that can help mitigate or amplify climate impacts.

HOW TO RESPOND: The Regional Action Plan will help Alaskan communities, commercial and recreational fishermen and others who are dependent on Alaskan marine resources respond and adapt to changes that may be ahead in response to a changing climate and help ensure the sustainability of these marine resources.



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Looking for More Information?

Please visit:

Regional Action Plan at

www.afsc.noaa.gov/News/Regional_action_plan_Bering_Sea.htm

NOAA Fisheries Climate Science Strategy at

www.st.nmfs.noaa.gov/ecosystems/climate/national-climate-strategy

Alaska Fisheries Science Center at

www.afsc.noaa.gov