

The Habitat and Ecological Processes Research Program

By
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Shearwater, baleen whale, and euphausiid concentration near Akutan Island, Alaska.
Photo by Michael Sigler.

Ecosystem-based management recognizes the physical, biological, economic, and social interactions among the affected components of the ecosystem and attempts to manage fisheries [and marine mammal species] to achieve a stipulated spectrum of societal goals, some of which may be in competition. (Marasco et al. 2005)

The United States Congress passed the Oceans Act of 2000, thus establishing the U.S. Ocean Commission to examine national ocean policy, the first comprehensive examination of national ocean policy since the Stratton Commission in 1969. In 2004 the Ocean Commission reported that the effects of society's reliance on the oceans, including pollution, habitat loss, declining fisheries, and introduction of non-native species, substantially outpaced the nation's policies for managing healthy oceans. One of the overarching principles identified by the Ocean Commission was that management of ocean and coastal resources should reflect the relationships among all ecosystem components, including humans.

The Alaska Fisheries Science Center (AFSC), within the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS), is charged with generating scientific information necessary for stewardship of Alaska's living marine resources. In response to the Ocean Commission's findings, the AFSC began exploring ways to improve understanding of Alaska marine ecosystems. As a result, the AFSC established the Habitat and Ecological Processes Research (HEPR) Program in February 2005 with the goal of developing, facilitating, and integrating scientific research that supports implementation of an ecosystem approach to management.

While a single species approach has been the operational paradigm for fisheries and marine mammal management for decades, ecosystem considerations have been raised for nearly as long. However, applying an ecosystem approach to resource management brings substantial challenges. The information requirements for ecosystem monitoring substantially outpace single species monitoring, as substantial additional fieldwork is necessary to include trophic levels beyond the fish and marine mammal species

currently monitored. Demarcating what ecosystem considerations are sufficient for sustainable fisheries and protecting marine mammal species also is not obvious. For example, what trophic connections warrant understanding; what is the role of climate-ocean conditions; and what are the biological and economic risks of management measures?

To address these challenges, the HEPR Program focuses on integrated studies that combine scientific capabilities to create comprehensive research on habitat and ecological processes. The HEPR Program applies an innovative process for identifying and implementing new scientific research initiatives. The program is nonhierarchical and relies on collaboration among scientists from across the AFSC, as well as from NOAA's Pacific Marine Environmental Laboratory (PMEL), the NMFS Alaska Regional Office, and from other partnerships within the scientific community. These teams collaborate in developing new research using a proactive method to identify emerging issues.

Priority Research Areas

The HEPR Program has six priority research areas. Essential Fish Habitat, Loss of Sea Ice, and Critical Habitat were identified when the program started in 2005; Ocean Acidification, Oil and Gas Development, and Ecosystem Approach to Management were identified in 2006. Priority research areas were determined through a three-step process. First, scientists at the AFSC nominated emerging issues. An emerging issue was defined as an area of concern, resulting from changes in trends, climatic, man-made, or economic with the likelihood of becoming a prominent problem. Second, the HEPR Team prioritized the nominations. The team's direction for prioritizing research areas was driven by management application for producing results that inform fish or marine mammal managers. Third, the AFSC Board of Directors reviewed and approved the list of high priority research areas. The goal, in part, was to position the Center in a predictive, proactive role to develop the science necessary before a challenge matures into a crisis.

Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Alaska

has more than 50% of the U.S. coastline and is the nation's leading region in terms of area of fish habitat and value of fish harvested. Still, large gaps exist in our knowledge of EFH in Alaska. Federal regulations for EFH management require its identification and characterization, analysis of potential impacts from human activities, and development of possible actions to ensure conservation and restoration. Major research needs are 1) to identify habitats that contribute most to the survival, growth, and productivity of managed fish and shellfish species; and 2) to determine how to best manage and protect these habitats from human disturbance and environmental change.

The Essential Fish Habitat Research Plan for Alaska 2007-11 was written with input and review by AFSC scientists, the HEPR Core Team, and the Alaska Region Habitat Conservation Division. The plan has an overarching research priority of habitats most affected by human activities, including habitats with frequent human activity, as well as habitats sensitive to disturbance where human activity is infrequent. Priority habitats include offshore habitats susceptible to disturbance from fishing gear and coastal habitats susceptible to disturbance from nonfishing activities. Funding is limited and focuses on:

- Coastal areas facing development, including ShoreZone mapping
- Characteristics of habitat utilization and productivity
- Sensitivity, impact, and recovery of disturbed benthic habitat



Intertidal zone in Berners Bay, Alaska. Photo by Michael Sigler.



An iceberg off the LeConte Glacier near Petersburg, Alaska, June 2006. Photo by Dave Withrow.

The HEPR Team activities follow this plan and include reviewing and recommending proposals for support with EFH funds; it also encourages proposals for support by the North Pacific Research Board (NPRB). In 2007 the team will convene a workshop for AFSC staff to inventory available habitat data and to discuss development of improved data access. The complete EFH Research Plan is available on the AFSC web site at http://www.afsc.noaa.gov/HEPR/docs/EFH_researchplan.pdf.

Loss of Sea Ice

In response to the effects of climate change, marine ecosystems adapted to cold temperatures and seasonal sea ice likely will shift northward as ocean temperatures warm and sea ice retreats. However, NOAA currently has no program in place to observe potential shifts in living marine resources to higher latitudes. The commercial fisheries of the Bering Sea make up more than 40% of the total U.S. domestic catch and are located primarily within the southern Bering Sea. At least 30 Alaska Native communities in the region depend on the successful co-management of marine mammals for subsistence use. Addressing ecosystem-related shifts is critical for successful management of fisheries and marine mammals. Without a program in place now, the opportunity to monitor these changes will be foregone, and NOAA will be far less able to meet agency responsibilities for management of fish and marine mammal species.

To address these research needs, the HEPR Program formulated three basic questions:

1. Are the distributions and abundances of species in the Bering Sea changing? If so, are they in response to the loss of sea ice?
2. What are the linkages between sea ice and vital rates of living marine resources in the Bering Sea?
3. What are the economic and sociological impacts of a changing ecosystem on the human communities of the Bering Sea?

Substantial effort was devoted in 2006 towards writing a Loss of Sea Ice (LOSI) Research Implementation Plan. As envisioned, the LOSI program will utilize a multidisciplinary approach including combinations of field studies, modeling, and retrospective studies. Three independent but interrelated research themes are proposed that focus research on loss of sea ice in different seasons. A winter theme would enhance forecast capabilities by focusing on the influence of winter ocean conditions on spawning distributions of crab, pollock, Pacific cod, and rock sole. A spring theme would enhance forecast model capabilities by focusing on ice edge processes including the development of the spring phytoplankton bloom and the foraging behavior and movement of ice-dependent seals. Finally, a summer theme seeks to improve knowledge of stock status and trends by expanded assessments and compara-



Primnoa coral sheltering rosethorn rockfish. Photo by Bob Stone.

tive approaches with focus on outcomes of changing climate for benthic versus pelagic species. Research targeted at each of these themes will enable AFSC scientists to develop a comprehensive understanding of the response of living marine resources to loss of sea ice. A loss of sea ice funding initiative has been provided to NMFS Headquarters. Should the initiative find support within NOAA, funding would begin in 2009.

The HEPR teams plans to finalize the LOSI Implementation Plan in 2007 and publish the plan as an AFSC Processed Report. In addition, we will continue to support cross-Divisional studies that meet the LOSI plan objectives and to pursue funding through NOAA, NPRB, and Minerals Management Service (MMS) to fully implement the plan. The LOSI plan is available on the AFSC web site at <http://www.afsc.noaa.gov/Quarterly/amj2006/divrptsHEPR1.htm>

Critical Habitat

The Endangered Species Act defines critical habitat as “the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the

time it is listed that are determined by the Secretary to be essential for the conservation of the species.” In 2005, the HEPR core team identified studies focused on improving information on known or potential critical habitat of Alaska marine mammals as a very high priority. However, recent decisions about right whale critical habitat and new information on Cook Inlet beluga whale habitat have pre-empted the need for this to remain a very high priority for the HEPR Program. The HEPR team plans to revisit this topic in 2008.

Ocean Acidification

Approximately 30%-50% of global anthropogenic CO₂ emissions are absorbed by the world's oceans. Increased CO₂ uptake by the oceans is expected to reduce surface ocean pH by 0.3 – 0.5 units over the next century, which would be the largest change in pH to occur in the last 20-200 million years. Ocean acidification likely will impact the ability of marine calcifiers, such as corals and mollusks, to make shells and skeletons from calcium carbonate, and may indirectly affect fish and marine mammal species through reduced abundance of marine calcifiers at the base of the food web. In addition, ocean acidification may elicit broad physiological and ecological responses from noncalcifying organisms through less obvious pathways ranging from internal CO₂ concentrations of marine animals to coldwater corals that provide shelter for structure-oriented species such as rockfish.

The HEPR Program wrote the Alaska Fisheries Science Center's Research Plan for Ocean Acidification, which identifies four areas to address the threat of ocean acidification:



Steller sea lions (397) cooperatively foraging for eulachon in Bering Bay, Alaska. Photo by Jamie Womble.



Adult male ribbon seal hauled out on pack ice in the southeast Bering Sea. Photo by Michael Cameron.

- Conduct research targeted at understanding species-specific physiological responses to ocean acidification.
- Develop models to forecast the population, community and ecosystem impacts of the physiological responses.
- Develop scenarios to forecast socio-economic consequences of these impacts.
- Collaborate with PMEL to monitor ocean pH using AFSC's NOAA and chartered shiptime.

The HEPR Program helped develop a NOAA-wide initiative including a funding request for studies to understand species-specific physiological responses for corals and managed fish and shellfish species in Alaska. In addition, Mike Litzow (AFSC Kodiak Laboratory) and Jeff Short (AFSC Auke Bay Laboratories) completed a pilot study of early life stages of blue king crab at different pH levels. The pilot study will be expanded in 2007 if funding is available. The Ocean Acidification Research Plan is available on the AFSC web site at http://www.afsc.noaa.gov/HEPR/docs/ocean_acidification_%20research_%20plan.pdf

Oil and Gas Development

Increased energy prices are driving development of new oil fields and expansion of existing oil fields in Alaska. The Minerals Management Service

(MMS) may fund projects of scientific interest to the AFSC that support writing of Environmental Assessments for oil field exploration and development or that establish an environmental baseline for comparison to future impact studies. NOAA is responsible for accumulating baseline information in preparation for response to environmental impacts, including oil spills or other disasters. In addition, NOAA must be able to knowledgeably evaluate permit requests for oil and gas development and recommend restricted areas or seasons on oil and gas activities.

In 2006, the HEPR Program coordinated development of several fish-related preliminary research proposals by AFSC scientists for areas where MMS may conduct oil and gas lease sales. Forage fish and groundfish surveys were proposed for the Chukchi Sea, forage fish, juvenile flatfish, and ichthyoplankton surveys, and a seasonal movement (tagging) study were proposed for the southeast Bering Sea. In addition, a full proposal was submitted for a Beaufort Sea Marine Fish Survey in August 2008; currently we are waiting for final funding approval for the Beaufort survey. Finally, a socioeconomic survey of coastal communities was proposed for the southeast Bering Sea.

Ecosystem Approach to Management

The ecosystem approach to management warrants more study because the management goals and the metrics of success are not clearly defined for Alaska. While single-species management, the

protection of forage species, and the 2-million metric ton commercial harvest limit in the Bering Sea may be good fishery management, these actions may not adequately address bottom-up effects, energy flow, habitat utilization, or biodiversity—all aspects of the ecosystem approach to management. In an effort to better address and understand these issues, the topic of the AFSC seminar series will be “Ecosystem Approach to Management.” The purpose is to communicate to AFSC scientists possible approaches to ecosystem-based management.

Program Structure

The HEPR Program consists of a HEPR Core Team with a Program Leader, who works for the AFSC Science and Research Director and also serves on the AFSC Board of Directors, and representatives from each AFSC Division. The HEPR Core Team is responsible for identifying emerging scientific issues with potential management implications and formulating approaches to assess, predict, and respond to the impacts of these issues on living marine resources. The HEPR Core Team is responsible for engaging the creative energies of AFSC scientists through HEPR activities. Over the past year, the HEPR team has encouraged AFSC staff to participate on Center-wide research teams to identify, plan, and implement cross-Divisional research supporting HEPR goals. These research teams design and implement targeted research studies that are responsive to priority research needs. The HEPR Program Leader meets regularly with AFSC management to discuss AFSC research facilitated by the HEPR Program.

Relationship to Other Institutions

The NMFS Alaska Regional Office and the North Pacific Fishery Management Council (NPFMC) are the management side of a partnership with the AFSC. The Alaska Regional Office, NPFMC, and AFSC will continue to collaborate to ensure that HEPR-initiated projects anticipate and address emerging management issues. PMEL has been a long-term partner with the AFSC and brings oceanographic capability to cooperative projects. These continued collaborations are critical for the success of scientific studies in support of ecosystem-based management.

Members of the HEPR Core Team	
Michael Sigler	Program Leader
Robyn Angliss	NMML
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Approach

Two aspects of the HEPR Program approach to scientific research are unusual: the program is integrative and nonhierarchical. Studies are interdisciplinary and bring scientists together from across the AFSC to collaborate. Several scientific capabilities are integrated to create comprehensive studies. In addition, the program is not explicitly hierarchical. Traditional management with lines of authority and top-down direction is not followed. Instead the program is organized as a collaborative approach where scientists from the AFSC and PMEL gather together to organize research.

The planning approach typically has involved a series of workshops with cross-Divisional representation, periodic meetings of smaller workgroups, and meetings of the AFSC Board of Directors to review workshop outcomes and the final plan. Center-wide research teams design and implement targeted research projects that are responsive to high priority research needs. The HEPR Core Team encourages Center scientists to participate in the research teams. The HEPR Core Team recommends teams and research projects, which are subject to review and approval by the AFSC Board.

Example

The timeline and events for development of the EFH Research Plan for FY 2006 are shown in the following table. This example illustrates several features of research development for the HEPR Program:

- Center-wide group generates hypotheses for priority research in a workshop
- The proposed hypotheses are reviewed by a small group, typically the HEPR Team
- Center-wide group proposes projects for priority hypotheses

- The proposed projects are reviewed by a small group, typically the HEPR Team
- The AFSC Board reviews the prioritized projects for approval and coordination
- Center-wide group reviews prioritized projects for information and approval

Conclusion

The HEPR Program develops scientific research that supports implementation of an ecosystem approach to management. We view the collaborative approach where AFSC and PMEL scientists gather together to organize research as an effective way to develop cross-divisional ecosystem-related research. Multiple capabilities come together to create studies

Timeline and events for development of the HEPR Program's EFH Research Plan for Fiscal Year 2006

Date	Event
14-15 July	Initial EFH workshop
15 August	Publish Habitat and Ecological Processes Research Plan, Progress Report (including EFH workshop report)
29 August	AFSC Board review of prioritized hypotheses
7 September	Workshop to develop projects from the list of prioritized hypotheses
6 October	Workshop to review prioritized projects
7 October	HEPR Team review
7 October	AFSC Board review of prioritized projects for FY 2006
20 October	HEPR Team review of draft research priorities for FY 2006 EFH funding
30 November	EFH proposal deadline for FY 2006 funding
14 December	HEPR Team and AKRO review of proposals
11 January	Approval by Science Director and Regional Administrator of recommended projects

that are broader based and more comprehensive than otherwise, thus creating stronger scientific studies. The HEPR Program Leader and Core Team look forward to working as an integral part of the AFSC to improve our understanding of Alaska marine ecosystems and better inform managers of fish and marine mammals of Alaska.

Additional Resources

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