Executive Summary

Ecosystem indicators are part of a larger process that considers policy-level goals for an ecosystem. Other elements include operational objectives and performance criteria. The eastern Bering Sea is advanced in application of ecosystem-based considerations to the management of marine resources. For instance, an *Ecosystem Considerations* appendix is prepared by the Alaska Fisheries Science Center (AFSC) each year for the annual Stock Assessment and Fishery Evaluation (SAFE) reports published by the North Pacific Fishery Management Council (NPFMC). This report is reviewed annually by NPFMC's plan teams and Scientific and Statistical Committee, and scientific advice is provided annually to managers based on ecosystem trends relative to managed fish species. Similarly, the North Pacific Marine Science Organization (PICES) prepared a North Pacific Ecosystem Status report in 2004 and is beginning to plan for an updated version of this report. Both reports can be improved by developing consensus on operational objectives and appropriate indicators.

Progress toward operational objectives and development of appropriate indicators was made by conducting the following four activities during an international workshop held on June 1–3, 2006, in Seattle (Washington, U.S.A.):

1. Involve the Bering Sea and international communities in developing of a set of operational objectives for the southeastern Bering Sea ecosystem;
2. Evaluate two status reports with the goal of integrating results and streamlining the presentation. The two reports are:
   a. NPFMC. 2005. Appendix C: Ecosystem Considerations for 2006. North Pacific Fishery Management Council, Anchorage, Alaska (http://access.afsc.noaa.gov/reem/EcoWeb /index.cfm);
   b. PICES. 2004. Marine Ecosystems of the North Pacific, PICES Special Publication 1, 280 p. (http://www.pices.int/publications/special_publications/NPESR/2005/npesr_2005.aspx);
3. Investigate methodologies that monitor system-wide structural changes within the marine ecosystem;
4. Identify steps to validate indicator performance, improve the monitoring network, and integrate into predictive models.

In preparing the workshop a focus was on the southeastern Bering Sea because it represents the center of the Bering Sea/Aleutian Islands large marine ecosystem (LME), one of three LMEs (the other two are the Gulf of Alaska and Arctic Ocean) defining the North Pacific Research Board's (NPRB) research region. This endeavour was funded by NPRB. Although the project focused on the southeastern Bering Sea, the intent of this exercise was to provide insights, findings, and recommendations more broadly applicable to the North Pacific and its adjacent seas, a larger area representing the PICES region, including waters bordering China, Japan, South Korea, Russia, Canada, and the United States.

Workshop presentations included three white papers on (1) development of operational objectives for the southeastern Bering Sea ecosystem; (2) ecosystem-based management for the oceans: a perspective for fisheries in the Bering Sea; and (3) ecological indicators: software development. These papers were followed by presentations on indicator use in other regions with advice for the North Pacific and reports on the status of the southeastern Bering Sea. A series of break-out groups was then convened to discuss the *Ecosystem Considerations* appendix of the SAFE report and PICES North Pacific Ecosystem Status report, objectives and use of indicators, matching indicators to objectives, methods to monitor ecosystem-wide structural changes, and means toward communicating results. Although this project was ambitious, substantial progress was made, and the following recommendations resulted from the workshop:

Ecosystem Objectives and Indicators

1. Ecosystem-level and community-level conservation thresholds are relatively new ideas in marine conservation. Since they will require new kinds of indicators, research is needed for their development and application to the Bering Sea.
2. New research is needed to understand how to synthesize the large set of Bering Sea data records into a reasonable number of ecosystem status indicators.
3. A formal process of evaluating and selecting ecosystem indicators is a general requirement. The Alaska Fisheries Science Center should consider developing and applying such a process to the indicators in its *Ecosystem Considerations* appendix.
4. Enhancements to the ocean/ecosystem monitoring network are needed to fill data gaps at ecological pulse points (plankton, benthic infauna and epifauna, seasonal species interactions and movements, small pelagics, and cephalopods) to improve predictive models and the development of ecosystem indicators.
5. More collaboration between modelers at the Alaska Fisheries Science Center and the Pacific Marine Environmental Laboratory, and elsewhere is encouraged to link various climate/ecosystem and conservation/assessment models, and to use these models to evaluate management strategies.

Socio-economics

While the workshop did not address socio-economic operational objectives for the Bering Sea and North Pacific, linkages between the well-being of people and healthy marine ecosystems require a level of attention comparable to those for ecosystem conservation objectives:

6. Socio-economic objectives related with the marine environment should be developed for the region, along with their indicators and reference points.
7. The North Pacific Fishery Management Council should play a central role in shepherding the development of these socio-economic objectives and indicators for the southeastern Bering Sea and Gulf of Alaska ecosystems;
8. There is a need to conduct scientific and policy analyses of pathways to achieve socio-economic objectives while remaining within ecosystem-level conservation limits.

Communication

9. Plans should be developed at an early stage on how the information from indicators can best be communicated to scientists, policy and decision makers, and the general public. The plans should include publishing concise, attractive executive summaries of major ecosystem status reports that will describe important trends and patterns in marine ecosystems for non-scientists.
10. To reach policy makers and the public in Asian countries, future iterations of the Synthesis chapter in the PICES North Pacific Ecosystem Status report should be published in multiple languages.
11. The development by the National Marine Fisheries Service of an *Ecosystem Considerations* website greatly increased access to time series of ecosystem indicators for the Alaska region, and should be maintained and enhanced.
12. An overview of the status of the Bering Sea ecosystem(s) should be presented at the annual *Marine Science in Alaska* Symposium to foster broader communication among the diversity of regional scientists, managers and the public.

Specific recommendations from individuals/groups can be found under Discussion Group Results in this report.