

Ecosystem Considerations in Fisheries Management: Linking Ecosystem Management Goals with Ecosystem Research

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Introduction

As fishery management organizations make progress in incorporating ecosystem-oriented thinking into management, there is a need to more clearly define the ecosystem-oriented management goals of the organization and the tools available to managers to attain those goals. Parallel to this must be an expansion of the scientific advice provided to management beyond traditional single-species stock assessment advice. There is a broad spectrum of ecosystem research currently being conducted that can provide useful advice to managers in this regard including GLOBEC and GLOBEC-like research efforts, habitat research, ongoing trophic interactions work, and long-term monitoring of non-commercial species. Although the ultimate goal is to have quantitative predictions from this research to guide management, these efforts already serve as indicators of ecosystem status and trends. These indicators can provide an early warning system for managers, signalling human or climate-induced changes that may warrant management action. They can also serve to track the success of previous ecosystem-oriented management efforts. The North Pacific Fishery Management Council (NPFMC) has started to include some of this ecosystem research information in an ecosystem considerations document that accompanies the traditional stock assessment reports. I outline here a proposed revision of this document that will include ecosystem status and trend information and link management actions with ecosystem observations.

Ecosystem-Oriented Management Goals

Management goals with regard to the ecosystem must be explicitly stated in order to derive standards to measure and track the success of ecosystem-oriented management efforts.

Ecosystem Goals of the North Pacific Fishery Management Council

1. Maintain **biodiversity** consistent with natural evolutionary and ecological processes, including dynamic change and variability.
2. Maintain and restore **habitats** essential for fish and their prey.
3. Maintain system **sustainability** and sustainable yields for human consumption and non-extractive uses.
4. Maintain the concept that **humans** are components of the ecosystem.

Ecosystem Management Indicators

Purpose: Measure performance towards meeting the stated ecosystem management goals.

Advantages:

- Provides early signals of direct human effects on ecosystem components that might warrant management intervention
- Provides evidence of the efficacy of previous management actions

Ecosystem Status Indicators

Purpose: Measure ecosystem status and trends.

Advantages:

- Brings the results of ecosystem research efforts to the attention of stock assessment scientists and fishery managers, which will provide stronger links between ecosystem research and fishery management
- Brings together many, diverse research efforts into one document, which will spur new understanding of the connections between ecosystem components and the possible role that climate, humans, or both may have on the system

AN EXAMPLE OUTLINE FOR AN ECOSYSTEM STATUS DOCUMENT:

I. ECOSYSTEM MANAGEMENT INDICES

Purpose: To provide measures of performance towards meeting the stated ecosystem management goals.

A. Maintain diversity

1. Bycatch/discard amounts of prohibited species and non-target species and fish processing wastes
2. Amount of closed area and duration of time various species (salmon, herring, snow crab) are protected from groundfish capture fisheries
3. Time series of directed salmon and crab catch, salmon hatchery production by nation

B. Fish habitat protection

1. Amount of area closed to bottom trawling
2. Amount of groundfish fishing effort by gear type and bottom type
3. Non-federal fishery fishery closures (scallop, crab, salmon)

C. Sustainability (for consumptive and non-consumptive uses)

1. Trophic level of the catch and total amount of groundfish catch
2. Status summary of managed groundfish, crab, and salmon species
3. Amount of catch of protected species' prey inside critical habitat
4. Exploitation rates by specific time/area units for fisheries with time/area quotas

D. Humans are part of ecosystems

1. Number and efficacy of limited entry, licence, ITQ systems
2. Changes in fishing power and fleet composition of groundfish, crab, salmon, scallop fisheries
3. Coordination of activities with other organizations

II. ECOSYSTEM STATUS INDICATORS

Purpose: Measure ecosystem status and trends

A. Physical environment

1. Time series of the Pacific Decadal Oscillation Index (PDO) and Southern Oscillation Index (SOI)
2. Magnitude of the Bering Sea cold pool

B. Habitat

1. Indices of pollutant/contaminant levels in sediments, groundfish, and their prey
2. Summaries of bottom habitat composition by region

C. Living Marine Resources

Phytoplankton and zooplankton

1. Abundance trends of phytoplankton and zooplankton

Forage Fish

1. Forage species abundance trends
2. Forage abundance and diversity trends inside protected species' critical habitat

Benthic Invertebrates

1. Abundance and diversity trends of benthic macroinvertebrate groups, including crab
2. Epifauna abundance and diversity trends inside and outside protected areas

Non-target fish species

1. Abundance and diversity trends of non-target fish species

Marine Mammals

1. Status and diversity trends of N. fur seals, Steller sea lions, and harbor seals
2. Status and trends of other seals and cetaceans

Seabirds

1. Status and diversity trends of seabirds

Ecosystem or community indicators

1. Diversity trends of groups sampled by bottom trawl surveys
2. Trophic level trends of groups sampled by bottom trawl surveys
3. Size diversity trends of groups sampled by bottom trawl surveys