Ecological Forecasting Overview

Issue

America's ocean and coastal environments provide a wealth of resources, a habitat for marine life, and opportunities for business and recreation. Sustaining productive ecosystems, and restoring damaged ones, depends on our ability to understand and predict the impacts of human activities and natural processes on those systems — in other words, to forecast change. Forecasts are a part of our everyday lives. We rely on weather forecasts to plan the day's events or to prepare for a severe storm. We use climate forecasts in agricultural and energy planning. Economic forecasts help individuals and businesses navigate the uncertainties of the financial world. Similarly, ecological forecasts allow resource managers to answer the "what if" questions that are the foundation for assessing management and policy options. These forecasts of alternative policy options often span decadal time scales, allowing managers to be proactive in their policy decisions.

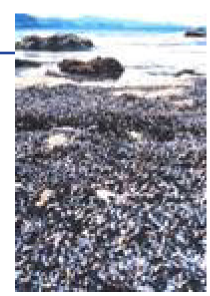
Ecological forecasts are predictions of the impacts of chemical, biological and physical changes on ecosystems, ecosystem components and people. Major benefits of ecological forecasts include:

1. improving decisions meant to sustain ecosystem productivity and lessening the impacts from extreme natural events and human activities;
2. bringing scientists and resource managers together to solve resource management problems; and
3. focusing future scientific research and monitoring priorities to reduce uncertainties in ecological forecasts.

Approach

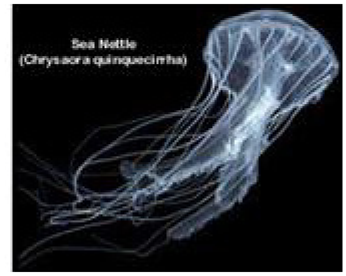
CSCOR is committed to developing predictive capabilities for coastal ecosystems, and to supporting the transition of science results to management tools. To this end, in Fiscal Year 2004, CSCOR solicited collaborative proposals between managers and scientists in the development of predictive capabilities for coastal ecosystems impacted by natural and anthropogenic stresssors (e.g., climate change, extreme natural events, pollution, invasive species, and land and resource use). Two new grants were awarded, which will advance ecological forecasting capabilities in support of ecosystem-based management and NOAA's ecosystem and climate goals. These projects are examples of the types of ecological forecasts that can be developed by top academic and NOAA scientists working in concert with coastal managers. The EcoFore program intends to continue to stimulate such work with another call for proposals for FY06.

Current Projects



- *Climate Change and Intertidal Risk Analysis: Forecasting the effects of climate change on the biogeography of foundation species in estuarine and rocky intertidal ecosystems* (University of South Carolina Research Foundation) This project will develop mechanistic links between climate, geography and population biology of the dominant large estuarine sediment-dwellers and rocky intertidal space occupiers, in order to forecast the impact of climate change on the suitability of estuaries and rocky intertidal shores as nursery grounds for commercially and recreationally important marine species. Ground and satellite based climate and ocean water quality data are used as inputs to heat flux models of body temperature of marine ecosystem foundation species as a function of latitude on the Atlantic and Pacific coasts of the United States. Models will be tested at five latitudinally separated National Estuarine Research Reserve System sites on each coast, representing all of the marine biogeographic provinces. The models will be used to identify "hot spots" and "cold spots" on the coastlines that should be the most sensitive to environmental change, either from long term global warming, or from decadal scale processes like El Nino. The hot spots are locations where natural resource managers and planners should expect to see local mass die-offs, and shifts in population distributions in response to El Nino or the North Atlantic Oscillation (NAO).

- *Development of an operational model for predicting the near real-time distribution and abundance of the scyphomedusae Chrysaora quinquecirra in Chesapeake Bay* (Yale University, lead, University of Maryland, Western Washington University, Chesapeake Bay Research Consortium, NOAA's Satellites and Information Cooperative Institute of Climate Studies, and NOAA's Center for Operational Oceanographic Products and Services). This project will transition to operations a model that combines hydrodynamics with temperature and salinity distributions to predict the likelihood of occurrence of jellyfish and to incorporate these jellyfish distributions into Chesapeake Bay ecosystem models. Jellyfish are believed to be increasingly important in structuring coastal ecosystems such as the Chesapeake and may exert controlling influences on fish populations and energy flow processes via complex mechanisms.



Sea Nettle
(Chrysaora quinquecirra)

Management & Policy Implications

The EcoFore program is designed to directly integrate coastal managers and scientists working together to identify problems and seek solutions. By involving managers in the entire process, from writing the proposal through the course of the project, CSCOR intends to provide science results that can be applied immediately to important coastal management needs.

Accomplishments

The Southeast Bering Sea Carrying Capacity (SEBSCC) project provides an example of long-term research program focused on forecasting pollock recruitment in the Bering Sea. Researchers examined pollock distribution and physical processes in the Bering Sea, and CSCOR supported an integrated multi-disciplinary program of modeling, process studies, and moored observations to improve the understanding and management of coastal and living resources. The focus was on understanding linkages among environmental factors, recruitment, growth rates, predation and distribution of key fisheries, and other components of the Bering Sea ecosystem, with a special emphasis on the southeastern Bering Sea shelf.

SEBSCC research led to a new paradigm for understanding the timing and fate of the spring phytoplankton bloom, based on the timing of sea ice retreat. During cold regimes, the ecosystem is limited by the production of phytoplankton and zooplankton, and pollock populations experience "bottom-up" regulation. When sea ice retreats early, and phytoplankton bloom earlier, more zooplankton are supported, leading to increased pollock populations. At these times, the pollock experience competition and cannibalism of older stages on younger pollock, and the populations are "top-down" regulated. Results of SEBSCC research have been compiled in the COP Decision Analysis Series no. 24, *The Southeast Bering Sea Ecosystem: Implications for Marine Resource Management*. Research results such as these are leading to predictive capabilities for such large ecosystem changes.

CSCOR/COP's Bering Sea research emphasized an ecosystem approach in providing a pollock recruitment index to be incorporated into NMFS stock assessments for more accurate recommendations on allowable biological catch estimates. SEBSCC research results are used to provide an annual "state of the ecosystem" report to the North Pacific Fishery Management Council (NPFMC). New indices of ecosystem condition to predict pollock abundance were developed to provide information to the Scientific and Statistical Committee of the NPFMC.

Additional CSCOR accomplishments can be found at: http://www.cop.noaa.gov/aboutus/accomplishments.html

For more information, contact:
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CSCOR Web site: http://www.cop.noaa.gov/welcome.html