

Incorporation of Climate Effects on Marine Ecosystems

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Climate change affects all aspects of NOAA's living marine resource management efforts. To limit the social and economic impacts of climate change on the Nation, NOAA Fisheries Service provides the information required to adapt to changing climate conditions. This ensures that the recommendations from NOAA Fisheries Service management matches our evolving environmental conditions.

Climate change has significant impacts on marine ecosystems and the living marine resources that NOAA manages. Some of the major impacts include:

- **Ocean physical changes:** (e.g. changes in water temperature, stratification, currents, timing of coastal upwelling). These changes affect species' distributions, ocean productivity, and the timing of seasonal biological events.
- **Loss of sea ice:** Leads to reduced habitat for ice dependent species in the Arctic and Antarctic. It also changes the habitat and productivity for other species in polar regions.
- **Ocean acidification:** Caused by increased concentrations of carbon dioxide. Acidification decreases the availability of calcium carbonate in the oceans. The growth rate and viability of many marine species may be impacted by ocean acidification since they construct their shells or other structures (e.g. coral reefs) with calcium carbonate they obtain from seawater.
- **Sea-level rise:** Causes changes to and loss of coastal habitat, which is critical to many marine species.
- **Altered freshwater supply and quality:** Impacts coastal habitat influenced by freshwater input and affects spawning migrations and survival of species such as salmon.

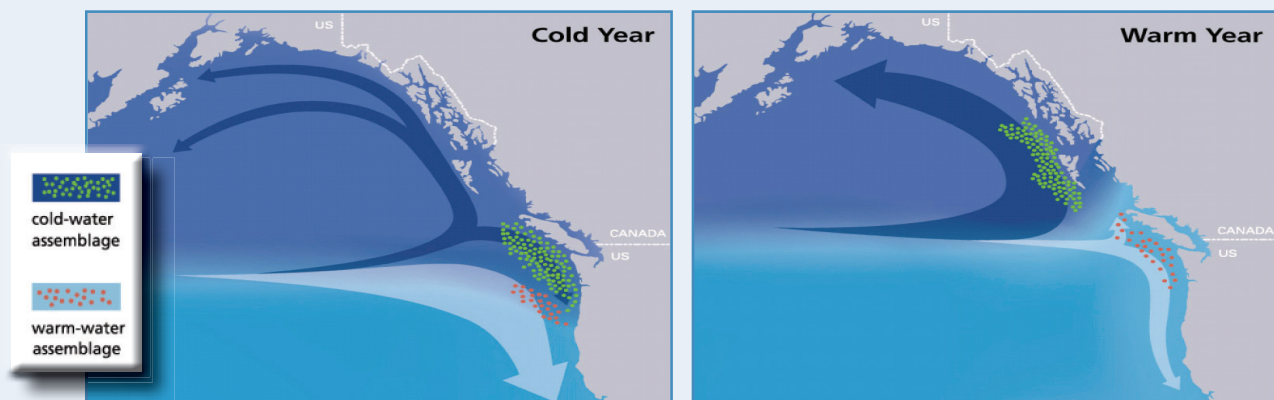
Data from NOAA Fisheries observation programs are being integrated with physical and ecological data from NOAA and its partners to provide a comprehensive view of the status of marine ecosystems, including how they relate to current

climatic conditions, and to living marine resource populations. These and other integrated products improve living marine resource population assessments and allowable catch recommendations. Climate information is also incorporated in determinations of critical habitat for living marine resources and considerations for endangered or threatened species.

In addition, NOAA Fisheries studies explore specific environmental mechanisms that influence living marine resources. Examples include the North Pacific Climate Regimes and Ecosystem Productivity (NPCREP) study and the fisheries oceanography program, Fisheries and the Environment (FATE). NPCREP enhances management and protection of Alaskan marine resources by providing applied research and decision making guidance for stakeholders. The NPCREP study focuses on how changing climate affects the growth, survival, and recruitment of Alaska's living marine resources. The project uses observations and studies to investigate the physical and biological controls on ecosystems and to learn how these factors are affected by climate variability and change.

The FATE program supports regional studies to develop and evaluate ecological and oceanographic indices to be used to improve fishery stock assessments and advance understanding of marine ecosystem dynamics. FATE investigators incorporate indices and functional relationships into stock and ecosystem assessments to improve forecasts of the implications of environmental change and fishing on the current and future status of living marine resources.

While much remains to be accomplished, these programs and activities provide the building blocks for NOAA's efforts to understand and ultimately forecast the impacts of climate change on the populations and ecosystems that NOAA Fisheries is required to manage. ■



▲ Schematic of the flow of the North Pacific Current south into the California Current and north into the Gulf of Alaska.