Effects of Interdecadal Climate Variability on the Oceanic Ecosystems of the Northeast Pacific Ocean

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Abstract

It is increasingly apparent that a major reorganization of the Northeast Pacific biota transpired following a climatic "regime shift" in the mid-1970s. In this paper, we characterize the effects of interdecadal climate forcing on the oceanic ecosystems of the northeastern Pacific Ocean. Our approach is to first discuss the concept of scale in three dimensions: time, space, and oceanic ecosystem. In so doing, we develop a conceptual model to illustrate how climate variability is linked to ecosystem change. Next we describe a number of recent studies relating climate to marine ecosystem dynamics in the northeastern Pacific Ocean. These studies have focused on the major components of marine ecosystems — primary and secondary producers; primary, secondary, and top level predators. They have been undertaken at different time and space scales. Taken together, however, they reveal a more coherent picture of how decadal-scale climate forcing may affect the large oceanic ecosystems of the northeastern Pacific. Finally, we conclude by synthesizing the insight gained from interpreting these studies. Several general conclusions can be drawn:

- There are large-scale, low frequency, and sometimes very rapid changes in the distribution of atmospheric pressure over the North Pacific, which are, in turn, reflected in ocean properties and circulation.
- Oceanic ecosystems respond on similar time and space scales to variations in physical conditions.
- Linkages between the atmosphere/ocean physics and biological responses are often different across time and space scales.
- While the cases presented here demonstrate oceanic ecosystem response to climate forcing, they provide only hints of the mechanisms of interaction.
- A model whereby ecosystem response to specified climate variation can be successfully predicted will be difficult to achieve because of scale mismatches and nonlinearities in the atmosphere-ocean-biosphere system.

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