FOREWORD

A Bering Sea Working Group was established at the first North Pacific Marine Science Organization (PICES) Annual Meeting, in 1992. The group is interdisciplinary as well as international, and its activities have included identification of key unanswered questions (see Appendix) and organization of a Bering Sea Symposium held in October 1995 during the Fourth Annual Meeting of PICES, in Qingdao, China. An early charge was to initiate preparation of a book reviewing present knowledge of the climatology, oceanography, and biology of the Bering Sea.

Recently, several substantial Bering Sea volumes have appeared. Russian papers edited by Kotenev and Sapozhnikov (I 995) are concerned with the Bering Sea ecosystem, and Russian investigations are also the basis for Mathisen and Coyle's (1996) compilation of papers on ecology of the Bering Sea. A different sort of review is found in the Committee on the Bering Sea Ecosystem's (1996) analysis of the state of the Bering Sea ecosystem.

Each of these publications is specialized, in purpose, geography, nationality, or scientific discipline. Changes in the political relations among countries working in the Bering Sea, and the advent of a regional international scientific organization, PICES, have now provided the opportunity to bring the findings of scientists of all disciplines and countries together in a contemporary synthesis of the oceanography of this region.

Vast as the Bering Sea is (2.3 million km^2 according to Fairbridge [1966]), it is a convenient microcosm for such a synthesis. Although the basin is semi-enclosed, in a geographical sense, it actively exchanges with the Arctic Ocean and the North Pacific. Atmospheric forcing is on a large scale, with the Aleutian Low playing an important role. Biological conditions reflect the oceanic forcing, with tides being particularly important on the continental shelf. The ecosystems are complex like those of other high latitude regions, and are enormously productive of finfish and shellfish, along with marine mammals and seabirds. It seems likely that even before commercial harvesting of living resources began, the resident populations exhibited large fluctuations in distribution and abundance, resulting just from the physical forcing and the internal dynamics of the ecosystems.

One reason for the recent interest in the Bering Sea is the perception that commercial fisheries, among the largest in the world, have seriously damaged Bering Sea ecosystems. Evidence cited for this damage includes declines in several conspicuous populations, including king crab, Steller sea lions, and several species of seabirds. There is a popular sentiment that all human activities in favored ecosystems are inherently bad, and fishery biologists have traditionally assumed that essentially all changes, but especially decreases, in fish stocks have resulted from human activity.

Meanwhile, evidence is accumulating that climate variations on decadal to century scales have identifiable ecosystem effects and that interdecadal changes such as the 1976 regime shift have been associated with major changes in fish stocks in the North Pacific. For example, a recent study (Wyllie-Echeverria 1996) showed that the coverage of winter sea ice in the Bering Sea, which correlates with the distribution of Pollock the following summer, was significantly different before and after the late 1970s. Variations in ocean circulation and mixing, driven by the atmosphere, may affect ecosystems either from the bottom up or the top down, and the linkages are as yet poorly understood. At the same time, it is obvious that ecosystems are also forced by human predation, and our skill at sorting out the relative importance of these kinds of forcing in any given case is limited.

Such questions led PICES in 1993 to initiate planning for a program called Climate Change and Carrying Capacity (CCCC), as part of an international program on Global Ocean Ecosystem Dynamics (GLOBEC). The goal of CCCC is to understand the effect of climate variations on marine ecosystems. A comparable effort is also needed to establish the effect of fishing on these ecosystems. Ultimately, predicting the response of climate and human forcing on any specific marine populations will depend on a much better understanding of these systems than we now have. For any given region, such as the Bering Sea, a synthesis of existing knowledge such as the present volume, is a key to the eventual achievement of that predictive capability.

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