synthesis

During the past five years, profound changes have occurred in the North Pacific climate system, in the characteristics of the North Pacific Ocean, in the composition, abundance, and distribution of its living marine resources, and in the human societies that depend on the North Pacific Ocean and its resources.

Society is learning to expect change, but how we anticipate its consequences and how we respond and adapt will depend upon a solid understanding of the nature of the changes. We are living in a period of global change where the experience of the past may not be our best guide to the world of the future. But not all changes are global, so it is important, when taking societal decisions affecting the ocean and its communities, to determine whether the changes are local, regional, hemispheric, or global in both origin and consequence. This report is the first attempt by scientists of the North Pacific to compare and contrast entire marine ecosystems throughout the region, to assess present conditions and how they compare with those of the recent past, and to look at the key stresses likely to affect future conditions.

keymessages

Climate

- **A new atmospheric pattern altered storm tracks across the North Pacific after 1998.** Historically, winter atmospheric pressure patterns were often characterised by a low pressure region occupying most of the subarctic North Pacific. This pattern tends to warm the North American coast and cool the Asian coast. Between 1998/99 – 2002, this low pressure pattern moved to occupy a region extending from northeastern China/Russia, across the Bering Sea to Canada, with a high pressure center occupying much of the south-eastern North Pacific in the area west of California and north of Hawaii.
- **This new climate pattern was associated with a change from warm to cool conditions from northern Vancouver Island to the Baja Peninsula,** warming in the central Pacific (north and west of Hawaii), but had little effect in the northern Gulf of Alaska and Bering Sea which stayed warm, or the Okhotsk Sea which stayed cool.
- **A moderate El Niño developed in winter 2002/03** which warmed the coastal waters of North America but its effects had disappeared by winter 2003/04.

information gaps

- **Knowledge of the North Pacific climate system is generally insufficient** to understand how much the future will be like past conditions.
- **Existing ocean monitoring activities are generally uncoordinated, have limited geographic coverage and inadequate sampling frequency.** Observing programs require strong institutional commitment over long periods of time.

Ocean Productivity

- Blooms of various species of **harmful phytoplankton are increasing around the North Pacific**. Some species are detrimental to fish and shellfish mariculture operations, and some species have harmful effects on marine mammals as the toxins are passed up the food web.
- **An unusual bloom of coccolithophorid phytoplankton occurred in the Bering Sea** during equally unusual ocean conditions in the summer of 1997, which created milky-coloured water visible from space.
- **Jellyfish blooms have appeared and disappeared** in Asia and Bering Sea without satisfactory explanations.
- **Large changes in the mix of species that make up the zooplankton** have occurred in the eastern North Pacific. Zooplankton are a major link in the food web of fish.

information gaps

- **Reliable timeseries of basic information on critical ocean nutrients are rare in the North Pacific.**
- At the base of the marine food web, there is a general **lack of systematic observations of plankton**, although improvements can be expected as satellite capabilities continue to expand.
- **Zooplankton are particularly difficult to observe at required time and space scales**, yet they are a crucial link from climate and ocean processes to fish and marine mammals.
- **Relatively little is known about the huge abundances of small fishes that occupy the mid-waters of the North Pacific.** They are significant components of oceanic food webs but without commercial interest they are poorly studied.

Living Marine Resources

- There have been **significant successes in maintaining productive fish stocks** through a combination of active and conservative management:
    - **Total Pacific salmon catches were at historical high levels through the 1990s,** supported by large releases of chum and pink salmon from hatcheries and wild sockeye salmon.
    - **Walleye pollock abundance in the eastern Bering Sea has been relatively stable** while elsewhere in the North Pacific, its abundance has been declining.
    - **The total biomass of Pacific halibut has remained high** in the Gulf of Alaska throughout the 1990s as a result of several years of good recruitment.
- **Some species/stocks have not faired so well.**
    - Rockfishes in the California Current System, walleye pollock in the Okhotsk Sea, and hairtail in the Yellow Sea are **heavily or over-exploited.**
    - Many individual salmon populations, especially of **coho and chinook, declined dramatically during the 1990s** in the southern part of their North American range, but there have been encouraging signs of recovery since 1999.
    - Small pelagic fishes naturally undergo very large changes in abundance. Pacific sardine abundances were very high in the late 1980s throughout the entire North Pacific, except in California, but declined abruptly in the early 1990s and have generally remained low since then. **This synchrony suggests an important role of a large-scale force such as climate in determining abundance.** In the California Current System, sardines remained low in the 1980s but began recovering in the late 1990s.

- **Steller sea lions are currently at very low abundances in most regions of the North Pacific**, and recoveries have been marginal to date. Mass mortalities of marine mammals (pinnipeds) have occurred over the past decade in the Gulf of California and off California, due to unusual harmful algal blooms.
- Intensive **mariculture is increasing dramatically** around the North Pacific rim and is well-established in the southwestern North Pacific.

information gaps

- **Fish habitats**, including important nursery areas for juvenile fishes**, are under increasing stress from coastal development**, particularly in the Yellow Sea and East China Sea. There is insufficient understanding of essential fish habitat and how it is affected by coastal development about the North Pacific.
- **Nearshore and intertidal information is generally missing from this report**. These data are collected at very local scales and integrating observations from around the Pacific can be difficult.

The background information that motivated these key messages is contained within this chapter, and greater details on these subjects can be found in the regional chapters that follow the Synthesis.