the human population

The coasts surrounding the North Pacific Ocean include very lightly populated areas such as in Alaska and Russia, and very heavily populated cites such as Los Angeles and Tokyo.

Population densities within 100 km of the coastline range from less than 2 to 100 persons per km^2 in Russia and North America, to greater than 500 persons per km^2 in Asia. The proportions of the total populations living within 100 km of a coastline (all seacoasts, not just the North Pacific) in 2000 were:

Canada	24 %
China	24 %
Japan	96 %
Korea	100 %
Russia	15 %
United States	43 %

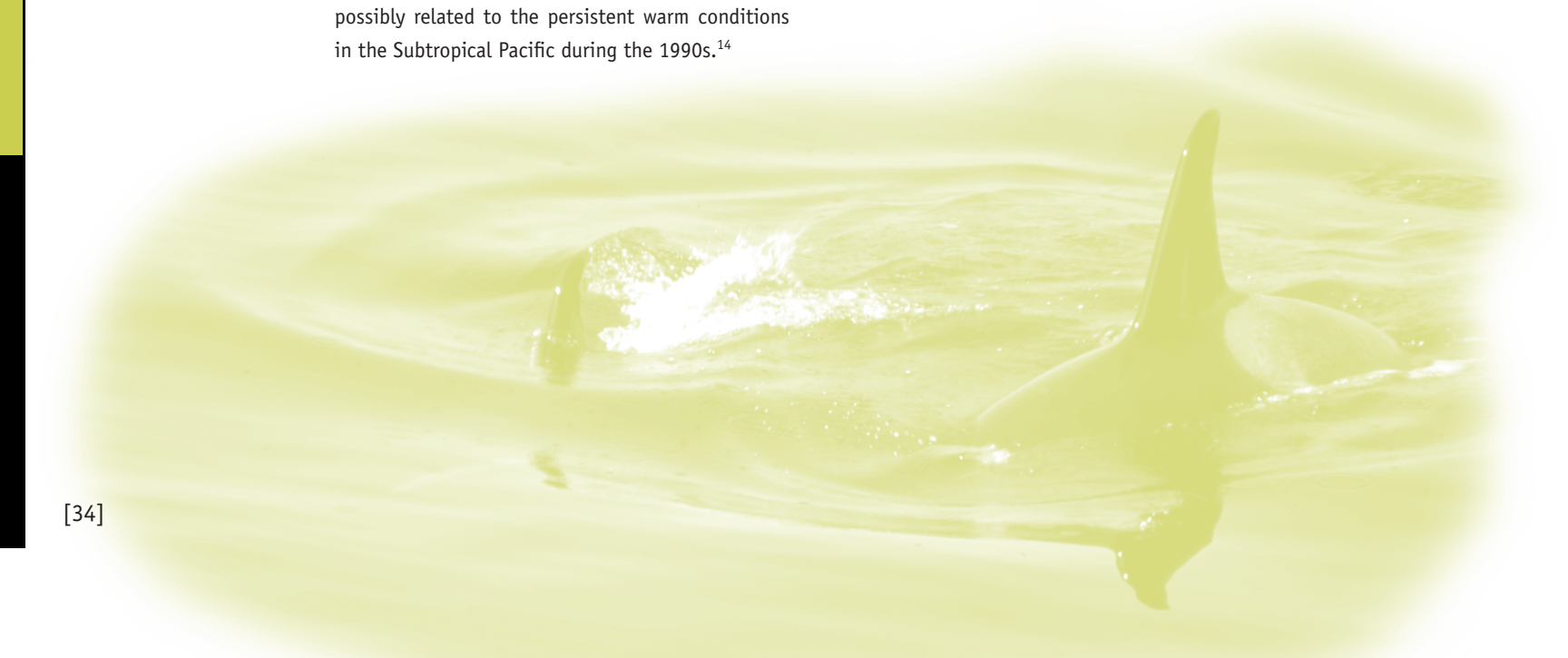
Although population growth rates have been declining, and are projected to continue to decline (projected growth rates over the next 5 years for Canada and the United States are 0.7-0.8%; for China, Korea and Japan they range from 0-0.7%; and for Russia -0.2%), there are still expected to be, for example, over 350 million people in China, and 52 million people in Korea, living within 100 km of the sea by 2025.[11] Clearly, the continuing increases in human population in coastal regions and further urbanisation around the North Pacific Ocean will stress the ability of local marine systems to provide goods and services from these ecosystems.

contaminants & habitat modifications

These issues tend to be local to particular areas, and are often patchy in their spatial distribution. However, long-distance transport may be one of the reasons for extremely high PCB concentrations in some fish-eating populations of killer whales (*Orcinus orca*) in British Columbia. [12]

Although not a chemical contaminant in the same sense, the North Pacific is an important sink region for atmospheric carbon dioxide, and therefore it plays an important role in the fate of CO_2 on Earth.[13] Studies conducted in the subtropical North Pacific just south of the North Pacific Transition Zone suggest there has been a 10-15% decrease in oxygen in the upper thermocline over the past two decades. This region has also seen a major shift from a nitrate-based, diatom-dominated ecosystem to one dominated by nitrogen-fixing organisms, possibly related to the persistent warm conditions in the Subtropical Pacific during the 1990s.[14]

The extent of chemical contamination of marine ecosystems by heavy metals, polyaromatic hydrocarbons (PAHs), polychlorinated biphenols (PCBs), etc. is unevenly reported in the chapters of this report, and will be a topic in subsequent versions of this report.



aquaculture

Aquaculture represents the fastest growing sector of food production in the world. More than half of this production now comes from brackish and marine waters.

Brackish water production has been based largely on shrimp (Penaidae), while mariculture has been dominated by seaweeds and molluscs. Global aquaculture production is dominated by Asia. China accounts for the highest proportion (69%), with Japan (3%) and Korea (2%) as significant contributors in the PICES area. Rates of mariculture production continue to increase, with China reporting an average annual rate of 14% compared with 5.4% in the rest of the world. Priority issues in aquaculture include systems to improve environmental performance and to reduce environmental impacts, health issues related to aquatic animals, impacts of aquaculture on native species, and new technologies such as offshore culture systems, ecosystem impacts, and genetic and stock improvements.

knowledgegaps

Basic information is lacking in many regions on processes important for sustaining productive marine ecosystems in the North Pacific, such as plant nutrients, plankton, and contaminants.

Some coastal regions have better information than other regions, but the open ocean is where such information is most difficult to obtain. Observing an area as large as the North Pacific is a significant task. This is made more difficult by the need to observe plankton processes at weekly to monthly frequencies, and fish populations at least once per year. Remote sensing by satellites is providing more frequent sampling over large regions of the North Pacific, but many of these sensors are limited to observing only the sea surface, and most cannot penetrate the clouds which are frequent over this area. New technologies such as profiling robot floats (Project Argo http://www-argo.ucsd.edu/) are beginning to sample temperature and salinity throughout the water, and deep currents, but at present they do not include any biological sensors. In some cases, such as the Census of Marine Life's Tagging of Pacific Pelagics (TOPP) project, several species of fish, turtles, and marine mammals are being equipped with electronic data-logging tags to provide information on the distribution and behaviour of pelagic organisms in the context of the oceanography of the North Pacific.

Long-term monitoring programs that sample physical and biological conditions exist at only a few locations or regions in the North Pacific, and these are constantly under severe funding pressures. The longest programs, such as the California Cooperative Fisheries investigations (CalCOFI) program which has been operating for over 50 years, are just becoming long enough for scientists to detect recurring patterns of regime shifts in the North Pacific. Sustaining long-term ocean observation programs so that they can contribute to understanding the effects of global environmental changes and human impacts on marine ecosystems is one of the most challenging tasks facing the countries surrounding the North Pacific Ocean.

[glossary]*

Chlorophyll front A region of rapid change from low to high chlorophyll concentration in the surface ocean. The largest chlorophyll front in the North Pacific extends from North America to Asia, separating the subtropical ocean (low chlorophyll, blue water) from the subarctic ocean (high chlorophyll, green water).

Coccolithophore Single-celled marine plants (phytoplankton) that produce numerous minute limestone plates as an outer covering. When very abundant, they can turn the ocean colour to a murky turquoise.

Demersal Fishes and other animals that live on or near the ocean bottom.

El Niño A warming of the surface waters of the eastern equatorial Pacific that occurs at irregular intervals of 2-7 years, usually lasting 1-2 years.

Gadids cod-like fishes

gC Grams of carbon

Hypoxic zone Region of low oxygen concentration.

La Niña A period of stronger-than-normal trade winds and unusually low sea-surface temperatures in the central and eastern tropical Pacific Ocean; the opposite of El Niño.

mgC Milligrams of carbon (i.e. thousandths of a gram of carbon)

Mixed layer depth A vertical distance measured from the ocean surface to the depth at which vertical mixing of seawater stops (or is greatly reduced). Seawater is less dense at the surface than at depth because surface waters are generally warmer and fresher so it takes energy, usually from winds) to create and maintain vertical mixing.

Pelagic Fishes and other animals that live near the ocean surface.

Phytoplankton Microscopic marine organisms (mostly algae and diatoms) that are responsible for most of the photosynthetic activity in the oceans.

Primary productivity in the upper ocean is the amount of photosynthetic activity by phytoplankton. For regional intercomparisons, it is often measured as gC m^{-2} yr^{-1} (grams of carbon per square meter per year).

Recruitment Is a measure of the numbers of young individuals of a species, or population within a species, surviving to an age/size where they can be harvested in a fishery.

s^{-1} Per second

Stratification The creation of layers of differing density. If mixed together, oil and vinegar form two distinct layers because oil is much less dense than vinegar. In the ocean, layers are formed by differences in salinity and/or temperature. Freshwater is lighter than saltwater and warm water is lighter than cold water. The density differences can be so great that layers do not mix.

Thermocline Sunshine causes the seasonal warming of the surface ocean in spring and summer. If one measures the temperature of seawater at various depths, it is usually warmest in the surface layer and becomes colder with increasing depth. The thermocline is the depth at which the ocean temperature drops most quickly as you descend.

t Metric tonnes (= 1000 kg = ~2200 lbs).

yr^{-1} Per year

* This glossary is intended as a general aid for non-scientific readers so some of the complexities have been simplified.