SEASONS OF THE NEAR SHORE WATERS

California's near shore waters provide a rich and varied habitat for a diversity of marine life; vast numbers of algae, invertebrates, fish, seabirds, and mammals inhabit these shallow waters, which overlie a gently sloping region called the *continental shelf*. Where the shelf drops off to the deep sea floor, the open ocean begins; in contrast to the especially rich near shore waters, the open ocean is much less fertile, gradually becoming less productive farther from shore. The fertility of near shore waters depends upon patterns of oceanic circulation that supply the nutrients necessary to support life.

Beneath the waters of the Pacific Ocean lies a topography as varied as that found on the continents. Along some shorelines, such as the Atlantic coast, the continental shelf is broad, but on the geologically active California coast, the shelf is very narrow, often no more than four or five miles wide. All along the California coast, submarine canyons etch the continental shelf and slope. Created by a series of complex processes, submarine canyons continue to be carved by sporadic turbidity currents--waterfalls of sand, gravel, and muddy sediments. Long shore transport along the shoreline carries beach sand and sediments into the submarine canyons, where they are then swept to the deep sea floor.

The oceans are in constant motion due to wind-driven currents. The California current, carrying water cooled by its passage through the northern latitudes flows southward along the shore from the Washington-Oregon border to Southern California. This basic current is modified by seasonal variations in wind direction that give California's near shore region its three more or less distinct "oceanic seasons."

Beginning in March, prevailing westerly winds, combined with the effects of the earth's rotation, drive surface waters offshore. These waters are replaced by deep, cold water that flows up over the continental shelf to the surface, carrying with it dissolved nutrients from the decay of organic material that had sunk to the ocean floor. This process, known as **upwelling,** is restricted mainly to west coasts of continents, and is responsible for the high productivity of California's near shore waters.

The upwelling period continues until **September** when northwesterly winds die down and the cold upwelling begins to sink. This period, characterized by relatively high surface temperatures, is known as the **oceanic period**, and lasts through October.

In winter, changes in atmospheric conditions over the Pacific Ocean bring southwesterly wind to the California coast. In response to these winds, a northward surface current begins and flows along the coast inland of the California Current. This current called the **Davidson Current**, generally lasts through February, when the prevailing winds shift again and the cycle begins anew.

Every few years this pattern is disrupted by a phenomenon known as El Nino. The El Nino bathes near shore areas in unusually warm, nutrient poor water from the south, which affects coastal food webs and causes phytoplankton production to drop, fisheries to decline, seabirds to starve, and marine mammals to temporarily stop breeding.

Phytoplankton, the basis of almost all ocean food webs, thrives under normal near shore summer conditions. Nutrient rich waters, combined with long sunlight days, cause the phytoplankton to "bloom." The resulting abundance of phytoplankton causes herbivorous and carnivorous zooplankton populations to expand. Common members of the zooplankton communities include

protozoans, jellyfish, copepods, krill, mollusk larvae, and arthropod larvae. These zooplankton provide food for fish which are in turn eaten by birds and mammals.

In addition to phytoplankton supported communities, lush growths of algae flourish in California's near shore waters. The kelp forest is a diverse and complex community that occurs along much of the California coast. Kelp forests are composed of dense stands of large brown algae, predominately giant kelp, with an understory of various red and brown algae. Giant kelp is one of the fastest growing plants known; growing an average of 10+ inches a day in spring, a frond of kelp may eventually reach a length of over150 feet. The fronds, anchored on the rocky sea floor by strong holdfasts, grow upwards towards the surface, buoyed by their gas-filled floats.

Kelp forests provide food and shelter for an array of organisms. The kelp blades and holdfasts are home to invertebrates, while anemones, abalones, sea stars, urchins, and sea cucumbers live on the rocky bottom of the forest. Kelp beds are also home to fish such as the blacksmith, kelp bass, and several species of rockfish and surfperch. Sea otters live in the canopy, feeding on the abalone, sea urchins, and other invertebrates they catch on the bottom, and harbor seals forage the kelp beds for fish.

The upwelling process that occurs in near shore waters does not occur in the open ocean off the California coast. As a result, the vast open ocean is less abundant. Because food is less abundant here, pelagic fish must be able to travel great distances to find prey. Plankton-feeding fish that range from near shore waters into the open ocean include Pacific herring and northern anchovy; predators include species of marlin, tuna, mackerel, and salmon, as well as squid. Many whales and porpoises also feed in the open ocean.

http://ceres.ca.gov/ceres/calweb/coastal/waters.html

Source: TOPP-Tagging of Pacific Predators

John Blanchard / The Chronicle