California's Offshore Ecosystem

Far from the coast, California's offshore ecosystem consists of the open ocean environments over the deeper parts of the continental shelf, the continental slope, and ocean basins. This ecosystem is most often characterized by a deep luminous blue color, due to scattered light encountering fewer particles and dissolved substances than are found in rich coastal waters, where suspended sediment, marine organisms, and other material can absorb light and cause greenish or brownish colors.

California's offshore waters are dominated by the California Current, a relatively shallow, broad (approximately 300 km), and slow moving current. This current generally moves from north to south along the West Coast of North America, transporting cooler water toward the equator. Along our state, the California Current hugs the coast north of Point Conception during most of the year, except in winter when southeast winds force it farther offshore, producing the Davidson Current that flows north near the coast. In some years, this counter current is stronger than normal and is forced as far north as British Columbia, Canada. South of Point Conception, in the Southern California Bight, the coast bends sharply to the east. There the California Current breaks away from the coast and flows offshore along the continental edge until it swings back toward the mainland south of San Diego. In the Southern California Bight, the usual surface flow, called the California Countercurrent, moves north along the coast resulting in a counterclockwise gyre that mixes offshore and nearshore surface waters off southern California.

Off California, prevailing winds, most often from the north or northwest, blow surface waters away from the coast and nutrient laden subsurface waters are drawn up to replace them in a process called upwelling. California is in one of the major coastal upwelling regions of the world, with the most intense upwelling occurring during the summer near Cape Medocino in northern California. Productivity of marine plants is high along coasts with these features, and some of the largest fish populations are associated with productive coastal upwelling systems.

Although the offshore environment is generally less variable than nearshore and estuarine ecosystems, the California Current is a dynamic system with considerable inter-annual variation. Relatively short-term, dramatic events like El Niño (warmer water) and La Niña (cooler water) cause larger temperature changes, variation in productivity, and occurrences of organisms beyond their usual ranges. Long-term temperature regimes, periods of slightly warmer or cooler conditions that persist for decades, can affect reproduction and recruitment of marine species like sardines and rockfish for several generations and result in substantial changes in abundance over time.

The offshore ecosystem is home to groundfish species (shelf and slope rockfish, flatfish, sablefish, and Pacific whiting); coastal pelagic species (sardines, anchovy, mackerel, and squid); salmon during the ocean phase of their life-cycle; highly migratory species (tuna, billfishes, and pelagic sharks); marine mammals (such as whales and dolphins), pelagic seabirds (including albatross and shearwaters); phytoplankton; and zooplankton (including euphausids, copepods, salps, and occasionally red crabs). These species respond to the environmental variability in the California Current in different ways. The abundance and landings of coastal pelagic fish stocks such as sardines vary considerably due to environmental fluctuations, particularly temperature. Such highly fecund and fast growing species undertake extensive migrations as far north as British Columbia, when their population is large, to feed in upwelling areas and they tend to concentrate spawning in areas like the Southern California Bight, perhaps to help retain larvae in coastal habitats where they are less likely to be swept offshore by the strong offshore transport conditions of major upwelling centers. Highly migratory species like albacore make long trans-Pacific migrations and actively seek productive areas and avoid unfavorable conditions. Long-lived, slow growing and moderately fecund species such as rockfish persist by maintaining many reproductive age classes through periods of unfavorable environmental conditions.

The most significant challenge to effective management of fisheries for these species is the lack of understanding of the interactions among environmental variability, recruitment fluctuations, and fishing pressure. The current management strategy for sardines, a species that has recovered over the last 20 years from extraordinarily low levels in the 1950s through the 1970s, now takes temperature into account because of its effect on sardine productivity. In the last two years, seven species of groundfish have been designated as overfished and will require many years and special management efforts to recover. In retrospect, this occurred primarily as a result of our poor understanding of the relatively low productivity of these species, particularly low recruitment for many of these species over the last three decades, and resulting harvest levels that were inadvertently set too high.

Populations of many fish species in the offshore ecosystem extend along the entire or a major portion of the west coast, and so their fisheries cross state and sometimes national boundaries. To ensure coordination and more effective coast-wide management, coastal pelagic species, groundfish, highly migratory species, and ocean salmon are regulated by the Pacific Fishery Management

Council, a regional body of states (California, Oregon, Washington, and Idaho), tribal representatives, and federal agencies that has authority for West Coast fisheries in offshore waters. For those species we share with Mexico (coastal pelagic species and some highly migratory species), no formal bilateral management agreement exists.

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