

Chapter 9. Other Ecological Concerns

Even though living marine resources are managed, for the most part, through regulatory measures that limit or alter fishing effort, factors beyond regulatory management often influence the health of fisheries. In general, factors such as pollution, water quality, habitat degradation, coastal development and land use have not been addressed by fishery management. Increasing scientific evidence that irrefutably ties these factors to the degradation of nearshore ecosystems requires that management acknowledge, mediate, or accommodate for these influences on the nearshore environment.

9.1 Environmental Variability

The management of living marine resources is primarily concerned with regulating the activities of people and has been largely preoccupied with the direct effects associated with the exploitation of these resources. However, climatic fluctuations in winds, ocean temperatures, and ocean circulation patterns also have measurable effects on the health and variability of these resources. The distribution of white seabass and success of fisheries in California waters appear to be strongly influenced by environmental conditions. The fishery presently exploits the northern fringe of the stock, and oceanic temperatures strongly influence the availability of seabass to fishermen (Radovich 1961).

El Niño/Southern Oscillation (ENSO) climate anomalies occur when the ocean-atmospheric system in the tropical Pacific is disrupted, effecting weather patterns over much of the globe. ENSOs are characterized by heavy rainfall, monsoons and warm sea-surface temperatures (SSTs) in the Eastern Pacific (Rasmusson and Wallace 1983). Along the coast of California, El Niños depress the thermocline and diminish the California Current (Dayton and Tegner 1984). Depression of the thermocline away from the upper surface layer reduces primary productivity and adversely affects the food chain in coastal up-welling ecosystems (Barber and Chavez 1985). White seabass are a component of food chains in southern Californian and Mexican (along Baja California) coastal waters. Hence, white seabass populations are affected by ENSO events in these waters.

ENSO events are known to affect white seabass habitat and prey. During mild ENSOs, such as the 1977-1978 and 1992-1993 events, and severe ones (1941, 1957-1958, 1982-1984, and 1997-1998), anomalously warm water adversely affected kelp beds. (CDFG 1994; CDFG 1999). Since juvenile and adult white seabass are associated with kelp beds, the reduction or loss of kelp habitat potentially effects these fish by removing shelter and prey. During the ENSO events mentioned above, two species preyed upon by white seabass, anchovies (Fiedler 1984) and market squid (CDFG 1999; Yaremko, pers. comm.) were not present, or were greatly reduced, in the Southern California Bight (SCB). During the 1997-1998 ENSO for example, statewide landings of market squid decreased from over 70,000 tons (63,504 metric tons (t)) in 1997 to 2,709 tons (2,458 t) in 1998 (CDFG 1999; Yaremko, pers. comm.). Although some white seabass prey are

reduced during ENSO years, others such as sardines, increase in abundance.

The above normal water temperatures that result from ENSO events affect the migration patterns of white seabass and often increase the availability of these fish to California fishermen. During non-ENSO years, white seabass landings center around Los Angeles and San Diego, with few fish landed north of Point Conception. However, during ENSO events, catches north of Point Conception increase (Vojkovich and Reed 1983; Karpov et al. 1995). For example, during the warm water years of 1957-1959, white seabass were caught as far north as Alaska (Radovich 1961).

9.2 Water Quality

Water quality is important to the health of marine organisms. Some characteristics, such as dissolved oxygen and water quality, are fundamental to life in the marine environment. Contamination can also have a profound effect on water quality. Contaminants enter coastal waters in a variety of ways, including ocean outfalls, rivers, ocean dumping, oil operations, and via current transport. Pollutants such as heavy metals, hydrocarbons, and agricultural chemicals (chlorinated hydrocarbons and organo-phosphates) are of particular concern because of their toxicity to aquatic biota. These substances are not readily transported from the ecosystem, nor are they readily broken down since the physical, chemical, and biological processes affecting them are slow. Polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) are known to suppress the immune systems of mammals and increase their susceptibility to disease (Ward 1985). PCB's and dichloro-diphenyl-trichloroethane (DDT) are known to disrupt the endocrine systems of organisms. These chemicals have a negative affect on an organism's reproduction and other processes regulated by hormones. PAHs, PCBs, and DDT bioaccumulate in marine food chains, thus, the effect of these pollutants are most damaging to apex predators including marine mammals and humans.

Juvenile white seabass are known to inhabit nearshore areas that are historically high in water contamination. According to Fitch (1958), juvenile white seabass in nearshore areas in Los Angeles County such as Belmont Shore, and areas within Santa Monica Bay, may be sensitive to some contaminants. White seabass he studied in these areas had experienced eye hemorrhaging, which often leads to blindness, and these fish frequently had external parasites attached to fins and other body parts; a sign of stress to the immune system. Although these observations imply that white seabass populations may be affected by pollution, the specific effects on white seabass have not been studied.

9.2.1 Municipal Discharge

Sewage

Historically, municipal wastewater (sewage) has been a significant source of contamination in southern California coastal waters and this problem is expected to

worsen as a result of increases in the human population and the volume of wastewater discharged from inland and coastal development projects (Napoli, pers. comm.).

Run-off

Urban runoff and storm water contamination in the SCB is a region-wide problem. The limited data and high variability of storm water discharge volume make it difficult for researchers to describe trends in run-off pollution. Associated pollutants include heavy metals, coliform bacteria, enteric viruses, pesticides, nutrients, PAHs, PCBs, organic solvents, sediments, trash and debris (Swamikannu 1997). White seabass may be directly affected by run-off pollutants, and indirectly affected when preying on fish and invertebrate species that have accumulated toxins in their tissues.

Urban runoff containing nitrogen and phosphorus can be detrimental to biotic communities in bays and estuaries. These pollutants cause plankton blooms which can lead to oxygen depletion and the possible reduction of other phytoplankton species that are an important food source for juvenile fish and invertebrates. Planktonic blooms can also harm the marine grasses and algae that serve as shelter for juvenile white seabass.

Industrial wastewater

Industrial wastewater effluent is regulated by the United States Environmental Protection Agency (EPA) through the National Pollution Discharge Elimination System (NPDES) permitting program. Non-power plant industrial dischargers have the potential to be an important source of ocean contaminants because a large percentage of their effluents can contain chemicals that are discarded as by-product of the industrial or manufacturing process (Raco-Rands 1997). In 1995, industrial facilities accounted for only 0.2% of the combined total volume of effluent generated by municipal wastewater dischargers, power generating stations, and industrial facilities discharging into the bight. Contributions of constituents from industrial facilities were usually less than 1% of the combined mass emissions from these three sources with the exception of selenium (7%), arsenic (4%), and chromium (1%) (Raco-Rands 1997).

9.2.2 Dredge and Non-dredge Material Disposal

Dredging can make formerly isolated contaminants available, several of which are known to bioaccumulate (SWRCB 1989). Three to five percent of dredged material is considered seriously contaminated. Examples of periodic dredging in marine habitats include the removal of sediments from navigation channels and the creation of new projects such as building marinas. The dredging process involves the removal or redistribution of sediments which changes the ecology of the dredged sea bottom.

Most contaminated material comes from dredging ports and harbors, or from areas where municipal and industrial discharges have polluted estuaries and coastal waters. Contaminant-laden sediments on the sea bottom may be resuspended, transported, and redeposited in areas far from the original source. Under certain conditions,

contaminants may "break free" from sediments (a process known as desorption) and be released into the water, making the bottom sediments not only a sink, but also a source of contaminants. Desorption is becoming less of a problem, however, because potential sources are 'capped' or covered over with non-contaminated sediments. Pollutants commonly found in dredge material include metals, chlorinated hydrocarbons, PCBs, DDT, PAHs, and other petroleum products (USHCMMF 1993).

White seabass are known to inhabit both Los Angeles Harbor and San Diego Bay (Emmett et al. 1991). Chemical analysis of outer Los Angeles Harbor sediments has shown elevated levels of mercury, DDE (the degradation product of DDT), and tributyl tin (TBT) in surface and near surface sediments (LAHD 1992). TBT is an active ingredient used in antifouling marine paints. Sediment toxicity was found to occur throughout much of San Diego Bay, and it was found to be quite severe in isolated areas near a naval station and in several of the marinas and boat harbors (NOAA 2000). It may be assumed that the effects of contamination from dredged sediments on white seabass would be similar to the effects related to municipal discharge and runoff.

Kelp and eelgrass beds are important white seabass habitat and could be significantly impacted by turbidity plumes created by dredging activity. Dredging and disposal of dredge spoils contribute to elevated levels of turbidity. Turbidity from dredging activities lowers light levels in the water column and leads to a decrease in primary production. Light, temperature, salinity, tidal range, and water motion influence the growth and productivity of eelgrass beds which are important for larval seabass. Light most often appears to be the controlling factor. Processes that increase the overall turbidity of the estuarine environment could have marked effects on eelgrass density and distribution. Suspended sediment can interfere with photosynthesis by lowering light levels and also can interfere with kelp recruitment (LAHD 1992). Recent dredging projects that could potentially affect white seabass habitat include the 147 acre fill at Pier J in Long Beach Harbor, and the Pier 400 landfill project in Los Angeles Harbor.

The Marine Protection Research and Sanctuaries Act of 1972 (MPRSA) is the principle statute regulating ocean disposal of dredged material.

9.2.3 Coastal Shipyards and Industrial Pollutants

Shipyards

Marine repair yard services typically include the repair and maintenance of mechanical systems, structural components, upholstery, electrical systems, and finished surfaces. Typical wastes generated from these operations include oils, coolants, lubricants, and cleaning agents; various chemicals, paints, and coatings; and dust from sanding, sand blasting, polishing and refinishing operations (EPA 1991). Wastes generated from these services that make their way into the marine environment could have a detrimental effect.

Tributyl tin (TBT) and copper are metal-based active ingredients used as pesticides in

antifouling marine paints. These substances are harmful to non-targeted marine life including fouling organisms (e.g., tunicates, bivalves, and algae). Metals can enter the water column and bottom sediments through sloughing of paint while vessels are in use and through the discharge of anti-fouling paint chips and paint removal materials during vessel maintenance activities. Studies have shown that low levels of TBT cause adverse reproductive effects on shellfish. Concerns about TBT's potency resulted in a 1989 federal law banning TBT from all non-aluminum vessels less than 25 m (82 ft) in length.

Elevated levels of pollutants exist in the bay bottom sediment adjacent to several shipyards in San Diego Bay (SWRCB 2000). A study conducted at the naval shipyard in San Diego Bay found in water hull cleaning to be a minor source of copper contamination. However, the leaching of copper from the hulls of naval vessels and recreational vessels was found to be the major source of copper contamination in the bay (Valkirs 1994). Contamination from shipyards could impact white seabass and their prey. However, pollution from shipyard contaminants is expected to decrease in the future due to increased restrictions in California on the criteria governing the allowable levels of these pollutants.

Oil and gas production

Currently, there are twenty-six production platforms, one processing platform, and six artificial oil and gas production islands located in California offshore waters. Four of the platforms are located within State waters and are offshore of Santa Barbara and Orange counties. The principal wastes from oil production are produced water (PW) and drilling muds (DM). Pollutants found in PW are oil and grease, metals, ammonia, phenols, cyanides, naphthalenes, and BTEX (benzene, toluene, ethylbenzene, and xylene) (MMS 2000).

In addition, the possibility of oil spills associated with commercial oil production is a potential threat to white seabass and the nearshore environment in which they live. The largest oil spill in the Pacific Outer Continental Shelf (OCS) Region occurred in 1969, when a blowout occurred on Platform A off Santa Barbara and spilled an estimated 80,000 barrels into the channel (Van Horn et al. 1988). No spill of this magnitude has since occurred anywhere on the U.S. OCS. Since then, a number of preventive measures have been implemented (MMS 2000).

Research has demonstrated that hydrocarbons and other constituents of petroleum spills can, in sufficient concentrations, cause adverse impacts to fish (NRC 1985, GESAMP 1993). The effects can range from mortality to sublethal effects that inhibit growth, longevity, and reproduction. Benthic macrofaunal and intertidal communities, which provide food and habitat to fish, can be severely impacted. Fish can accumulate hydrocarbons from contaminated food and studies have demonstrated food web magnification in fish. Fish have the capability to metabolize hydrocarbons and can excrete both metabolites and parent hydrocarbons from the gills and the liver. Nevertheless, oil effects in fish can occur in many ways: histological damage,

physiological and metabolic perturbations, and altered reproductive potential (NRC 1985).

The egg, early embryonic, and larval-to-juvenile stages of fish appear to be the most sensitive to oil for several reasons (Malins and Hodgins, 1981). Embryos and larvae lack the organs found in adults that can detoxify hydrocarbons, and most are not mobile enough to avoid or escape spilled oil. In addition, the egg and larval stages of many species, including white sea bass, are concentrated at surface waters where they are more likely to be exposed to the most toxic components of an oil slick (MMS 2000) and the dispersant chemicals used during oil spill clean-up operations (Napoli, pers. comm).

9.2.4 Fuel Use

According to the Environmental Protection Agency (EPA), spills that occur during boat fueling are a major contributor to the pollution of our waterways. Fuel is easily spilled into surface waters from the fuel tank air vent while fueling a boat and oil is easily discharged during bilge pumping (EPA 2001). Small oil spills released from motors and refueling activities contain petroleum hydrocarbons which attach to waterborne sediments and can persist in the aquatic environment. Fish and shellfish larvae are extremely sensitive to even small amounts of petroleum products. For example, one gallon of used motor oil dumped in one million gallons of water is enough to kill half of all Dungeness crab larvae (OSPR 2000). Emissions produced by two-cycle marine engines contain substances that have a negative impact on fish at all life stages (Balk 1994). Private and commercial fishing vessels engaged in the take of white seabass, in addition to other marine vessels operating in white seabass habitat, may have a cumulative impact on white seabass populations due to the combined effects of fuel spilled into the water column.

9.3 Air Quality

California's concern about air quality is second only to the concern over water quality. The State has adopted air quality standards that are as stringent as federal standards (Aspen Environmental Group 1992). The impacts to air quality are of greater concern in highly urbanized areas due to the existence of long term land-based impacts. Air quality is affected by local climatic and meteorological conditions. Therefore, in the Los Angeles basin where there are persistent temperature inversions, predominant onshore winds, long periods of sunlight, and topography that traps wind currents, the effects of pollutants are more severe than along the coast of central California where one or more of these components is missing.

Air quality is determined by measuring ambient concentrations of pollutants that are known to have deleterious effects. The degree of air quality degradation is then compared to health-based standards such as the California Ambient Air Quality Standards (CAAQS) and the National Ambient Air Quality Standards (NAAQS).

Air quality can be affected by emissions from gas and diesel engines in commercial and sport fishing vessels engaged in the take of white seabass. The calculation of emissions from CPFV's (commercial passenger fishing vessels) and commercial fishing vessels can be determined using the following emission factors for diesel fuel and gasoline:

Diesel

Carbon Monoxide (CO) = 110 lb/1000 gal fuel
 Hydrocarbons (HC) = 50 lb/1000 gal fuel
 Nitrogen Oxides (NO_x) = 270 lb/1000 gal fuel
 Sulfur Oxides (SO_x) = 27 lb/1000 gal fuel

Gasoline

Carbon Monoxide (CO) = 1,822 lb/1000 gal fuel
 Hydrocarbons (HC) = 11 lb/1000 gal fuel
 Nitrogen Oxides (NO_x) = 96 lb/1000 gal fuel
 Sulfur Oxides (SO_x) = 6 lb/1000 gal fuel

Table 9-1. South Coast vessel emissions (tons per day) (from Pera 1999)			
Pollutant	CPFV's	All fishing vessels	All marine vessels
CO	0	0.9	4.8
HC	0.1	0.3	3.3
NO _x	0.6	6.3	44.2
SO _x	0.1	1.1	26.7
PM	0	0.1	3.2

Pollution emissions released when vessels are underway are influenced by a variety of factors including power source, engine size, fuel use, operating speed, and load. Emission factors can only provide a rough approximation of daily emission rates. Most commercial vessels and CPFV's engaged in the take of white seabass have diesel engines. Currently, two-cycle diesel engines are most common, but four cycle engines, which are more efficient, are becoming more popular for CPFV use (Fadley, pers.comm.). Overall, fishing operations are responsible for less than 1% of the daily emissions from all sources (mobile and nonmobile) in California (CARB 1989; 1991; 1994), and do not have a significant effect on air quality in the nearshore environment.

9.4 Importance of Habitat Loss, Degradation, and Modification

White seabass have differing habitat needs throughout their lives. The most critical white seabass habitats influenced by human activities include nearshore waters, bays,

and estuaries. Many changes have occurred in each of these habitats over the last century which could limit the survival of white seabass. In addition to the habitat degradation caused by sources of pollution described above, 90% of California's estuaries have been lost to coastal development projects.

9.4.1 Coastal Development and Land Use

Growth along the Southern California coast from Santa Barbara to San Diego has been rapid. This region of the State accounts for more than 13% of the nation's coastal population (USDC 1999). Not surprisingly, southern California's high coastal population and growth rate has affected nearshore ecosystems.

Since the 1850s, 90% of the California's coastal wetland acreage has been destroyed, and the remaining 10% is continuously exposed to increasing sedimentation from eroding watersheds, raw sewage spills, and urban run-off pollutants. Because of soaring coastal land prices, wetlands are also subjected to the threat of being filled in. Water quality in some of these areas is very poor and high levels of toxins are present (Marcus 1989). Efforts are being made to change many of these potentially harmful situations by improving wastewater discharge requirements, erosion control, pollution control, and by the purchase of wetland areas for preservation. Juvenile white seabass are found in coastal wetland habitats, so recruitment could be affected by loss and degradation of this habitat.

An important characteristic of two large coastal wetlands in southern California, Mission Bay and San Diego Bay, is the presence of large eelgrass beds. (Marcus 1989). Eelgrass beds are a productive refuge for juvenile fish including white seabass. Eelgrass is an important and often critical component of the nearshore ecosystem. Eelgrass is commonly found in relatively calm estuarine environments and is vulnerable to coastal urbanization that heavily targets these same environments. White seabass are known to inhabit the Mission Bay and San Diego Bay wetlands during their second year of their life, and probably during other life stages as well (Crooke 1989b). Degradation of these eelgrass beds could have a negative effect on the survival of young white seabass. Mitigation of this potential loss by the planting of larger eelgrass beds, has been taking place for more than 15 years and continues to this day.

Another possible threat to white seabass habitat is the introduction of non-native species, which can potentially out compete native species and alter ecosystems that support white seabass. Recently, a green alga native to tropical waters, *Caulerpa taxifolia*, was discovered in a San Diego county lagoon. *C. taxifolia* poses a substantial threat to southern California coastal ecosystems, particularly to eelgrass beds and other benthic environments (Woodfield 2000).

Very small white seabass are often found with drifting kelp and debris near the surf line along sandy beaches (Allen and Franklin 1988). The construction of breakwaters and jetties along the coast have altered this habitat by affecting erosion and sedimentation

processes. For example, approximately 77% of the coastline between Carpinteria and Ventura contains engineered structures (Sherman 1997). The effects of this habitat alteration on white seabass are unknown.

9.4.2 Gear Use In the Marine Environment

Gear used in the commercial and sport fisheries of California can impact the nearshore environment inhabited by white seabass. Fishing gear was found to be the most common type of benthic anthropogenic debris in the central region (Point Dume to Dana Point) of the SCB (Moore 2000). Gill nets used by commercial fishermen can be lost and this gear will continue to capture fish, mammals, and invertebrates which become entangled and die. In addition, species that are not targeted during active fishing, can incur physical trauma from contact with nets and this trauma can increase susceptibility to disease. Finally, fishing debris such as lost hooks may be attractive to fish or other animals and cause injury if ingested, and the animals can become entangled in the monofilament line attached to the hooks.

9.4.3 Noise Effects in the Marine Environment

The response of animals to acoustic stimuli will depend upon the species and the characteristics of the stimuli (i.e., amplitude, frequency, pulsed or non-pulsed); season; ambient noise; physiological or reproductive state of the animal; and other factors. The possible adverse effects from loud sounds include discomfort, potential masking of other sounds, and behavioral responses resulting in avoidance of the noise source (MMS 1987).

Very little data on the effects of sound on fish, larvae, and eggs have been collected. There are some data showing that sound can cause some damage to sensory cells of the ears of fishes, but not of the lateral line or cristae of the semicircular canals (vestibular receptor) (Hastings et al. 1996). Some behavioral studies of fish suggest that anthropogenic sounds could affect a fish's ability to detect biologically meaningful environmental sounds (Gisiner 1998). This may have significance for white seabass because sciaenids are known to produce sounds which may be used to communicate with one another (Moyle 1996). Thus, potential sources of anthropogenic noise affecting white seabass are commercial shipping activities, military operations, fishing and recreational vessels, and machinery associated with dredging and other forms of coastal construction. Currently, no data exist on the effects of human generated noise on white seabass.