

# Student Resources for Lesson 1 Activity

Prepared by William Jones

## **Resources for “Fisherman”**

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- Commercial and Recreational Fisheries Graphs
- White Seabass Fishery Regulations

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# White Seabass Background Information

## Information Prepared by William Jones

The white seabass (*Atractoscion nobilis*) is the largest member of the Sciaenid (croaker) family found in California waters. Seven species of croakers (Family Sciaenidae) are native to the West Coast of the United States and off Baja California (Collins 1981). As a group, croakers exhibit strong estuarine ties during all or part of their lifecycle (Weinstein 1981). Most croakers emit sounds, which have been variously described as ‘drumming’, ‘croaking’, ‘grunting’, ‘snoring’, ‘bellowing’, ‘purring’, ‘buzzing’ and ‘whistling’ (Welsh and Breder 1923). These sounds are produced by vibrations of the swim bladder.

### Scientific Classification

**Kingdom:** Animalia  
**Phylum:** Chordata  
**Class:** Actinopterygii  
**Order:** Perciformes  
**Family:** Sciaenidae  
**Genus:** *Atractoscion*  
**Species:** *nobilis*

Age at Maturity	Growth Rate	Max Age	Max Size	Fecundity	Species Range	Special Behaviors
Females: 4 years (24 inches); Males: 3 years (20 inches)	k=0.128	27 years	5 feet, 90 pounds	760,000–1.5 million eggs per clutch	Magdalena Bay (Baja, CA) to Juneau, AK; Coastal	Aggregate near shore during spawning

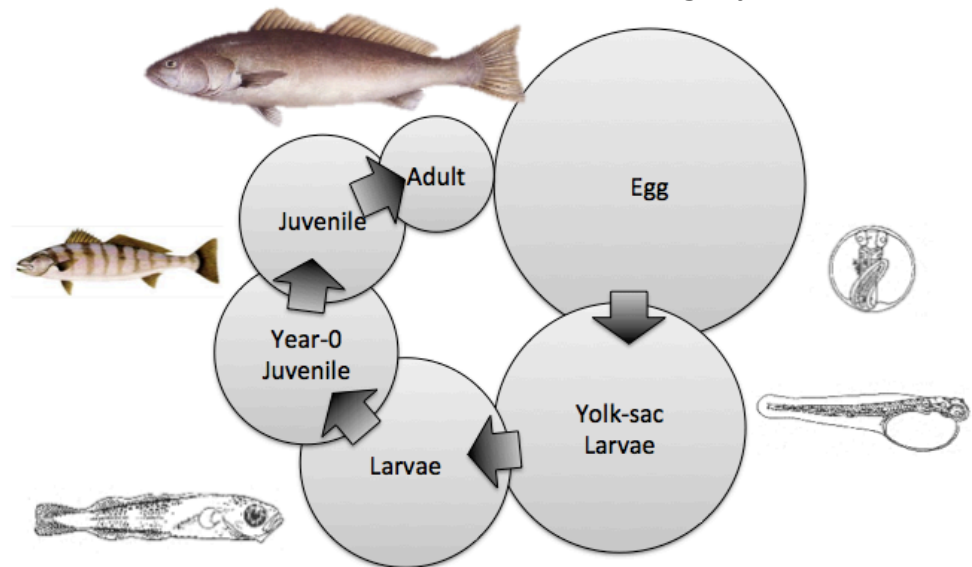
### Characteristics

The white seabass (*Atractoscion nobilis*) has an elongated body, large mouth, and a raised ridge along the length of its belly. It is bluish-gray to copper on the dorsal (top) with dark speckling. Its belly region is silvery. It has a black spot on the inner base of its pectoral fins. Juveniles have several dark vertical bars. It is distinguishable from other croakers by a ridge running along its belly.

Image by W. Jones

### Live Cycle (see

**picture):** The adult sea bass spends most of its life traveling in schools in the open ocean. It returns to shallow coastal regions in the spring to spawn in the kelp beds off the western coast of the United States. The exact locations of spawning areas have not been determined, but data indicate that peak spawning occurs in southern California from



April through August (Skogsberg 1925). During this period, mature fish appear to congregate near shore, over rocky habitat, and near kelp beds (Thomas 1968).

White seabass have the largest eggs of the west coast sciaenids at approximately 1.24 mm. These eggs are buoyant and drift with the ocean currents. The dark-colored larvae appear to settle out in coastal areas (Moser et al. 1983). Female seabass starting at 5 kg (11 lbs) released an average of 700,000 eggs per batch, increasing at a rate of approximately 100,000 eggs/kg as the females grew. Drawbridge (2003) reported that an isolated female of 10 kg (22 lbs) released 1.2 and 1.4 million eggs during spawning events spaced 10 days apart.

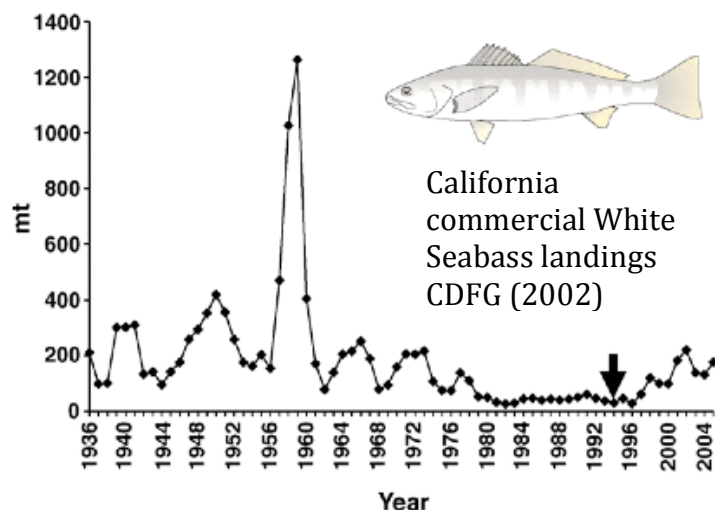
**Feeding:** The white seabass diet consists mostly of northern anchovy, Pacific sardine, market squid, pelagic red crab, and other small fish in their hunting area. Larger adult white seabass will eat larger fish, such as mackerel. White sea bass often target kelp beds and rocky outcrops off the western coast of the United States to feed on mackerel and other fish spawning in kelp beds.



**Range:** White seabass range over the continental shelf of the Eastern North Pacific Ocean from Juneau, Alaska, to Magdalena Bay, Baja California, Mexico. This species also inhabits the upper Gulf of California, Mexico, as a subpopulation that appears to be isolated from the coastal mainland megapopulation (or stock) (Thomas 1968).

**Habitat:** Young-of-the-year (age 0) white seabass ranging in length from 6 to 57 mm (0.25 to 2.25 in.) inhabit the open coast at depths of from 4 to 9 m (12 to 30 ft). These young fish are closely associated with small drifting debris and algae in shallow areas just outside the surf zone (Allen and Franklin 1988; 1992). By the time white seabass are two years old, some have moved into protected bays and are found in association with eelgrass beds (Crooke 1989). Larger juveniles (three and four years old) are caught off piers and jetties and in kelp beds. Large white seabass school over rocky substrate in or near the large kelp beds that fringe the beaches and offshore islands. They are also found several miles offshore in schools swimming at or near the surface (Skogsberg 1939; Squire 1972).

**Fishing:** There have been commercial and recreational fisheries for white seabass in California since the 1890s. The fisheries occur primarily in southern California but in some years may extend to central California. The commercial fisheries use primarily drift gill nets but some fish are taken on hook-and-line. Historically, the white seabass resource extended as far north as San Francisco Bay, but as oceanographic conditions changed and the various segments of the fishery grew, there was a steady decline in availability and subsequently catch.



White seabass catches peaked during the 1940-1960s and declined through the 1970s, 1980s and most of the 1990s due to changing ocean conditions and overfishing. Although a current stock assessment has not been done for white seabass there are indications that the white seabass population in California is recovering from low levels seen in the 1970s, 1980s, and most of the

1990s. It appears that white seabass may be entering a pattern similar to the 1940s, where abundance increased following a shift from a period of warmer to colder ocean waters, which white seabass prefer. In addition to increased catches of white seabass, there has been a steady increase in the size of fish taken. For example, the weight of white seabass caught by the recreational fishery averaged about 2.4 kilograms (5 lbs) in the 1980s but increased to 6.2 kilograms (14 lbs) in the 1990s.

References:

California Department of Fish and Game. 2002. White Seabass Fishery Management Plan. State of California Resources Agency. Pp. 219.

Collins, R.A. 1981. Pacific coast croaker resources. Pp. 41-49.

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Crooke, S.J. 1989. The ocean enhancement and hatchery program 1989. Calif. Dept. Fish Game, Rpt. to the Legislature. 22 pp.

Moser H.G., D.A. Ambrose, M.S. Busby, J.L. Butler, E.M. Sandknop, B.Y. Sumida, and L-9 E.G. Stevens. 1983. Description of early stages of white seabass, *Atractoscion nobilis*, with notes on distribution. Calif. Coop. Oceanic Fish. Invest. Rep. 24: 182-193.

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Squire, J.L., Jr. 1972. Apparent abundance of some pelagic marine fishes off the southern and central California coast as surveyed by an airborne monitoring program. U.S. Fish. Bull 70(3):1005-1019.

Thomas, J.C. 1968. Management of the white seabass (*Cynoscion nobilis*) in California waters. Calif. Dept. Fish Game, Fish Bull. 142:1- 34.

Weinstein, M.P. 1981. Biology of adult sciaenids. Pp. 125- 138 in Marine Recreational Fisheries---6 (Henry Clepper, ed.) Sport Fishing Institute, Washington, D.C.

Welsh, W. W. and C.M. Breder, Jr. 1923. Contributions to the life histories of the Sciaenidae of the eastern United States coast. Bull. U.S. Bur. Fish. 39:141-201.

## Commercial and Recreational Fisheries Graphs

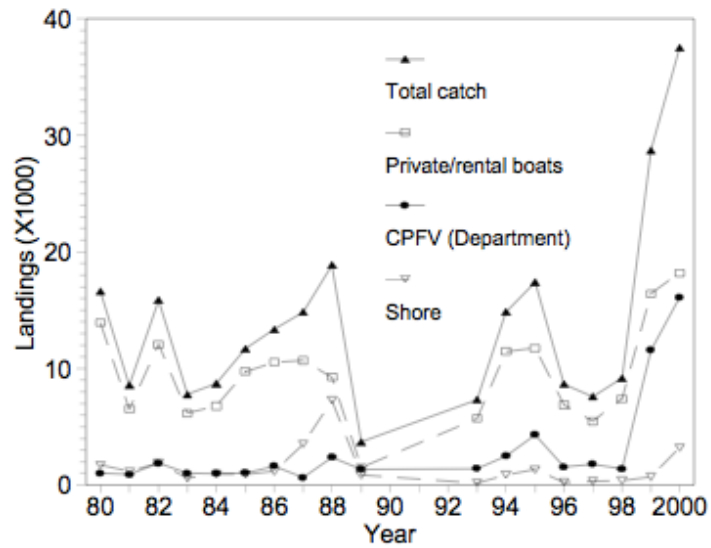


Figure 3-4. Recreational catch of white seabass (thousands of fish) by fishing mode from 1980-2000. Private/rental boats and shore data from RecFIN database; CPFV data from Department logbooks.

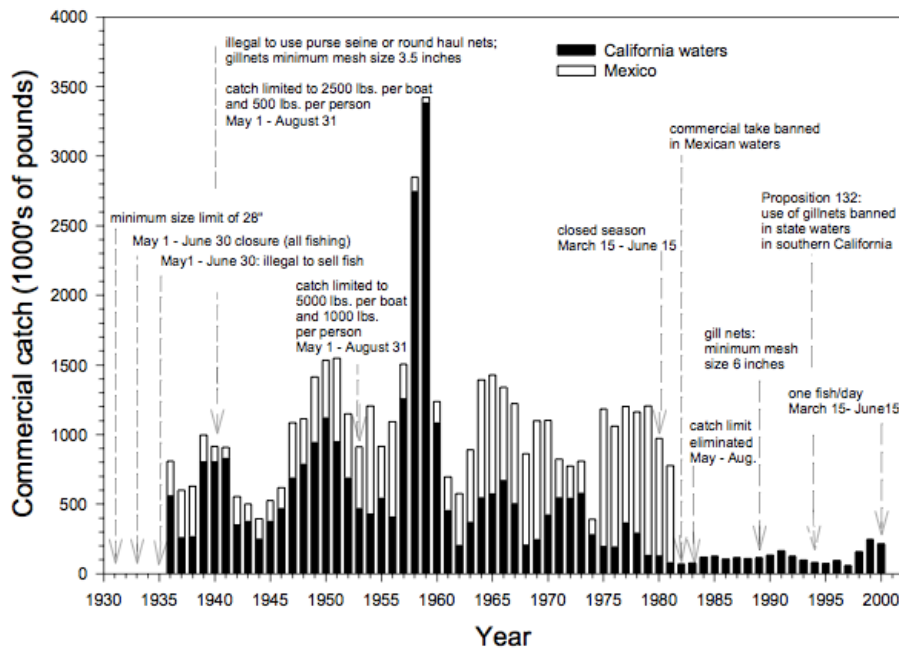


Figure 3-6. Regulation changes and total white seabass commercial catch from U.S. and Mexican waters taken by California fishermen from 1936-2000. Modified from Thomas (1968).

Graphs From:

California Department of Fish and Game. 2002. White Seabass Fishery Management Plan. State of California Resources Agency. Pp. 219.

# White Seabass Fishery Regulations

The following are regulations on the catch of white seabass in California from CDFG (2002) prepared by William Jones.

A complete list of regulations can be found in; California Department of Fish and Game. 2002. White Seabass Fishery Management Plan. State of California Resources Agency. Pp. 219.

## **Commercial (From Fish and Game Code)**

2362: White seabass may be imported from Mexico according to regulations established by the Fish and Game Commission.

8051(a)(a18): Landing tax of \$0.0125 per lb.

8383: Commercial fishing closed 15 March to 15 June, inclusive, between Pt. Conception and the Mexican border. No inter-boat transfers of fish. Restrictions do not apply to fish taken in Mexican waters. A valid permit issued by the Mexican government is evidence that seabass were taken in Mexican waters.

8383.5: Unlawful to possess, sell, or purchase any white seabass smaller than 28 inches total length.

8623(a): Unlawful to use purse seine or round haul nets for white seabass.

8623(b): Unlawful to possess white seabass on a boat carrying or using any purse seine or round haul net unless taken off Mexico.

8623(d): Six inches minimum stretched mesh size for gill nets used to take white seabass except during 16 June to 14 March when not more than 20% by number of white seabass (greater than 28 in.), up to 10 fish per load, can be taken in gill or trammel nets with meshes 3.5 to 6 inches.

8610(b): Marine Resources Protection Act of 1990, effective as of 01 January 1994. Specifies that white seabass, in addition to all other species, cannot be taken by gill and trammel nets in ocean waters: 1) 0-3 miles from the mainland shore between Point Arguello and the U.S.-Mexico border, 2) in waters less than 35 fathoms between Point Fermin and the south jetty at Newport Beach, or 3) in waters less than 70 fathoms deep or within one mile, whichever is less, of the Channel Islands.

## **Recreational (From Title 14, California Code of Regulations)**

27.60: Daily bag and possession limit for white seabass is three fish except as provided in Section 28.35.

27.65: Fillets taken from white seabass must be a minimum of nineteen inches in length. Each fillet shall bear intact a one-inch square patch of silver skin.

28.35: The minimum size for white seabass is twenty-eight inches total length or twenty and one-half inches alternate length. The season is open all year.

# White Seabass Fishery Management Background

## **Information from:**

California Department of Fish and Game. 2002. White Seabass Fishery Management Plan. State of California Resources Agency. Pp. 219.

## **Background**

White seabass, which are targeted by both recreational and commercial fisheries, have great economic and intrinsic value to the people of California. The fisheries for white seabass have existed since the late 1800s, but increased fishing pressure, oceanographic fluctuations, and habitat degradation have resulted in reductions of white seabass populations. Currently, our scientific monitoring and assessment of white seabass stocks is inadequate for effective management of this important resource.

## **Purpose and Need for Action**

The overall trend in commercial and recreational landings of white seabass from 1960 to 1997 was one of decline. During the late 1980s and early 1990s, concern over the decline in white seabass landings and conflict between recreational and commercial fishermen over this resource lead concerned citizens to ask the Legislature for management improvements. The resulting legislation required the development of a white seabass fisheries management plan (WSFMP) which was developed in 1995. The plan was adopted by the Fish and Game Commission (Commission) in 1996; however, no regulations were adopted at that time, so the plan was not implemented.

In 1998, the Marine Life Management Act (MLMA) was enacted and changed the way in which recreational and commercial fisheries are managed in the State of California. Under MLMA, the Commission was granted authority to regulate specific commercial fisheries, including the white seabass fishery.

## **Problem Statement**

Our knowledge of white seabass population dynamics and the role this species plays in the nearshore ecosystem is limited. Further, there is an urgent need to acquire essential fisheries information, which can only be obtained gradually, over a period of several years, and at a considerable cost. As a result, management decisions have lagged behind the development of the fishery and it is difficult to determine whether or not current fishing is at sustainable levels.

The potential effects of changes in fishing effort, oceanographic conditions, and many other factors affecting white seabass stocks need to be assessed in order to manage this resource effectively. Since the ban on gill and trammel nets went into effect in 1994, the recreational seabass catch has surpassed commercial landings. In addition, white seabass range into Mexican waters and may be heavily impacted by Mexican harvests. Thus, an essential step to ensure the long-term maintenance of a healthy white seabass resource in California waters is to develop a management plan for this species.

# White Seabass Fishery Fact Sheet

Prepared by William Jones

Information from: <http://blueocean.org/documents/2012/06/seabass-white-full-species-report.pdf>

## **Species exhibits high natural population variability driven by broad-scale environmental change** (e.g. El Nino; decadal oscillations)

Growth and distribution of White Seabass is affected by broad-scale environmental changes like El Nino events. Water temperature has a positive effect on growth rates of juvenile fish, with faster growth during warmer periods (Williams et al. 2007). For example, in the Southern California Bight, White Seabass had higher growth rates during warm El Nino years, compared to colder non-El Nino years (Williams et al. 2007).

## **Species has a small or restricted range** (e.g., restricted to one coastline)

White Seabass are primarily found from Point Conception, California to Bahia Magdalena, Mexico (Miller and Lea 1972; Eschmeyer et al. 1983; Vojkovich and Reed 1983). Although historically found up to Alaska, shifting oceanographic conditions have reduced their range.

## **Population appears to be recovering from an overfished condition.**

The main US commercial White Seabass fishery occurs in Californian waters. They are also caught throughout northern Baja California including the Gulf of California but information from this region is unavailable (Chao et al. 2010). White Seabass were heavily fished in California waters during the 1920's and 1930's (MacCall 1996; Dayton et al. 1998), reaching historically low levels in the early 1980's (Vojkovich and Reed 1983). Commercial catches in recent years have been heavily influenced by the closure of Mexican waters to US fisherman (1982) and Proposition 138, which banned gillnets in California state waters south of Point Conception beginning in 1994 (CDFG 2002).

Due to a lack of a formal population assessment for White Seabass, the California Department of Fish and Game have developed 3 criteria for determining if overfishing is occurring (CDFG 2002). These include 1) a 20% decline in total annual landings for the past two consecutive seasons compared to the prior five-season average 2) a 20% decline in both the number of fish and the average weight of White Seabass observed in the recreational fishery and 3) a 30% decline in recruitment indices for juvenile White Seabass compared to the prior five - year average (DFG 2010). The 2008/09 total catch of White Seabass was below the optimum yield and the 2008/09 commercial landings of White Seabass in California decreased 2% compared to the average of the past five seasons (DFG 2010). Currently the Department of Fish and Game does not consider the population to be overfished (DFG 2010).

In addition, evidence from sampling programs conducted off southern California from 1995 through 2005 indicated an increase in catch rates, suggesting White Seabass populations

were recovering (Allen et al. 2007). The International Union for the Conservation of Nature (IUCN) considers White Seabass to be of Least Concern (Chao et al. 2007).

### **The fishing method does little damage to physical or biogenic habitats**

Most White Seabass are taken with set or drift gillnets (Sweetnam 2009). Drift gillnets, because they are off the seafloor, cause no damage to bottom habitat (Morgan and Chuenpagdee 2003). Some White Seabass are caught with hook and line, which also cause little or no habitat damage.

### **Current Management measures**

In the US, White Seabass are caught in Californian waters, and managed by the California Department of Fish and Game under their White Seabass Fishery Management Plan (CDFG 2002). The following management measures can be instituted on an annual basis; harvest control, quotas, bycatch regulations, time/area closures, landing limits or trip frequency limits, allocation rules, size limits, mesh size restrictions, bag limits, effort controls, controls on fishing gear, observer programs, reporting regulations, fees/permits and vessel identification (CDFG 2002). Currently, the fishery is managed through observer programs, quotas, size limits, gear restrictions and time/area closures (CDFG 2002). In addition, there is a state law banning the use of gillnet, set nets and trammel nets within three nautical miles of shore from the US Mexico border to Pt. Arguello, California and in waters less than 79 fathoms within one nautical mile of the Channel Islands (Carretta and Chivers 2003). Similar regulations are not currently in place throughout Baja California.

There has also been a stocking and restoration program (Ocean Resources Enhancement and Hatchery Program) since 1983 for White Seabass, along with other species although the success of this program is somewhat limited because of the only a small proportion of legal sized fish are ever recaptured (Sweetnam 2009).

### **There is limited scientific monitoring of stock status.**

No formal population assessment has been completed but the California Department of Fish and Game is required to release an annual review of the White Seabass Fishery Management Plan (FMP), which identifies the status of the fishery and recommends additional management measures (CDFG 2002). According to this FMP, catch, effort, and biological data is collected by the state of California but fishery dependent data is often limited or inaccurate and does not provide good information on fishing locations (CDFG 2002).

**Bycatch in this fishery is moderate AND does not regularly include "threatened, endangered or protected species."** Some marine mammals are incidentally caught in this fishery (including but sea lions, beaked whales, and harbor seals) the State of California has implemented regulations to reduce their bycatch.

### **Species has special behaviors that make it especially vulnerable to fishing pressure.**

Adults form transient spawning aggregations throughout southern California and in northern Baja California, Mexico (Aalbers and Drawbridge 2008). There is a commercial

fishing closure in California from March 15 through June 15 but this only protects part of the spawning populations of White Seabass (Aalbers 2008).

References:

Aalbers, S.A. 2008. Seasonal, diel and lunar spawning periodicities and associated sound production of white seabass (*Atractoscion nobilis*). *Fisheries Bulletin* 106:143-151.

Aalbers, S.A. and Drawbridge, M.A. 2008. White seabass spawning behavior and sound production. *Transactions of the American Fisheries Society* 137:542-550.

Allen, L.G., Pondella, D.J. and Shane, M.A. 2007. Fisheries independent assessment of a returning fishery: abundance of juvenile white seabass (*Atractoscion nobilis*) in the shallow nearshore waters of the Southern California Bight, 1995-2005. *Fisheries Research* 88:24-32.

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Dayton, P.K., Tegner, M.J., Edwards, P.B. and Riser, K.I. 1998. Sliding baselines, ghosts and reduced expectations in kelp forest communities. *Ecological Applications* 8:309-322.

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MacCall, A.D. 1996. Patterns of low-frequency variability in fish populations of the California current. *California Cooperative Oceanic Fisheries Investigations Reports* 37:100-110.

Miller, D.J. and Lea, R.N. 1972. Guide to coastal marine fishes of California. California Department of Fish and Game Bulletin 157:1-249.

Morgan, L.E. and Chuenpagdee, R. 2003. Shifting gears: addressing the collateral impacts of fishing methods in US waters. Pew Science Series. Washington, D.C. Island Press.

Sweetnam, D. 2009. White seabass. *Fisheries Review CalCOFI Report Vol. 50*: 27-30.

Williams, J.P., Allen, L.G., Steele, M.A. and Pondella, D.J. 2007. El Nino periods increase growth of juvenile white seabass (*Atractoscion nobilis*) in the Southern California Bight. *Marine Biology* 152:193-200.

Vojkovich, M. and Reed, R. 1983. White seabass *Atractoscion nobilis* in California-Mexican waters: status of the fishery. *California Cooperative Oceanic Fisheries Investigations Report* 24:79-83.

## Ecological Concerns of the White Seabass Fishery

**From:** California Department of Fish and Game. 2002. White Seabass Fishery Management Plan. Chapter 9: Other Ecological Concerns. State of California Resources Agency. Pp. 219.

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.

### **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 oceanatmospheric 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) 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). 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).

### **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.

### **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.

#### *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).

### **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.

### **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<sub>x</sub>) = 270 lb/1000 gal fuel  
 Sulfur Oxides (SO<sub>x</sub>) = 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<sub>x</sub>) = 96 lb/1000 gal fuel  
 Sulfur Oxides (SO<sub>x</sub>) = 6 lb/1000 gal fuel

Pollutant	CPFV's	All fishing vessels	All marine vessels
CO	0	0.9	4.8
HC	0.1	0.3	3.3
NO <sub>x</sub>	0.6	6.3	44.2
SO <sub>x</sub>	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. Overall, fishing operations are responsible for less than 1% of the daily emissions from all sources (mobile and nonmobile) in California (1994), and do not have a significant effect on air quality in the nearshore environment.

### **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.

### **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.

### **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.

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