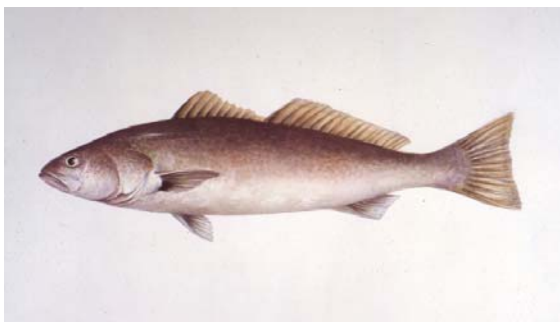
Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

White Seabass
Atractoscion nobilis



(Image courtesy of the Monterey Bay Aquarium)

California

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About Seafood Watch® and the Seafood Reports

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from the Internet (seafoodwatch.org) or obtained from the Seafood Watch® program by emailing seafoodwatch@mbayaq.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices", "Good Alternatives" or "Avoid". The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Fisheries Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling (831) 647-6873 or emailing seafoodwatch@mbayaq.org.

Disclaimer

Seafood Watch® strives to have all Seafood Reports reviewed for accuracy and completeness by external scientists with expertise in ecology, fisheries science and aquaculture. Scientific review, however, does not constitute an endorsement of the Seafood Watch® program or its recommendations on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Executive Summary

The white seabass (*Atractoscion nobilis*) is found in Eastern Pacific coastal waters from Juneau, Alaska to Magdalena Bay, Baja California. Fisheries for white seabass operate primarily in the coastal waters of southern California and Baja California, Mexico, where stocks are most concentrated. Commercial landings of white seabass are caught using a variety of methods, but drift and set gillnet fisheries are responsible for the vast majority of total U.S. landings. However, since 1985 the number of hook and line vessels in California has been increasing. The predominant fishing method for white seabass landed in all Monterey Bay ports (includes: Monterey, Moss Landing, and Santa Cruz) is hook and line. Commercial fishermen in Monterey use multiple fishing rods with a double hook rig (herein referred to as hook and line). Since white seabass are sensitive to noise, fishermen will not troll, but drift fish since it is a quieter method.

White seabass has experienced severe declines in the past, but populations and landings have increased over the last two decades. Recent increases are largely attributed to increased regulation, particularly the closure of gillnet fishing in California state waters south of Point Arguello. This report encompasses the U.S. white seabass fishery concentrated in southern California between Pt. Conception and the U.S.-Mexico border as well as the Monterey Bay fishery. The Mexican white seabass fishery is not assessed in this report.

Due to their low age at maturity and high fecundity, Seafood Watch® considers white seabass to be inherently resilient to fishing pressure. Although white seabass aggregate to spawn—a characteristic that makes the species vulnerable to fishing—stocks are protected throughout their primary breeding season in early summer. Current stocks have been classified as healthy by the California Department of Fish and Game (CDFG). However, fishing mortality rates and current biomass relative to the biomass at maximum sustainable yield are unknown. As such, Seafood Watch® deems the stock status of white seabass to be a moderate conservation concern. Bycatch rates and trends are mostly unknown, but the gillnet fishery does show documented mortality of protected species, such as Pacific white sharks, long-beaked bottlenose dolphins, California sea lions and cormorants. There is no evidence that bycatch of long-beaked bottlenose dolphins, California sea lions, and cormorants is contributing to their decline or limiting recovery. However, it is unknown whether the bycatch of Pacific white sharks in the white seabass fisheries is contributing to its decline or limiting its recovery. Therefore, bycatch in the white seabass fishery using gillnets is a high conservation concern according to Seafood Watch®. The Monterey Bay hook and line fishery is thought to have minimal bycatch, and because of the nature of the fishing technique, incidentally caught species can be released unharmed. This leads Seafood Watch® to deem bycatch in the hook and line fishery a low conservation concern.

Drift gillnets and hook and line gear in the white seabass fishery do not contact the seafloor and have benign habitat and ecosystem impacts. Set gillnets, however, have moderate habitat and ecosystem impacts because the gear involves dropping and often dragging weighted nets over rocky habitats. Management has a proven track record of maintaining stock productivity, following scientific advice and enforcing regulations. Based on this information, Seafood Watch® deems management to be highly effective. The U.S. drift gillnet and set gillnet fisheries for white seabass receive a recommendation of **Good Alternative** due to moderate stock health, high bycatch concerns and effective management. The Monterey Bay hook and line fishery for

white seabass receives a ranking of **Best Choice** due to low bycatch concerns, low habitat and ecosystem impacts and effective management.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√ **(Monterey Bay hook and line)**		√ **Set and drift gillnets**	
Habitat & Ecosystem Effects	√ **(Drift gillnet; Monterey Bay hook and line)**	√ **(Set gillnet)**		
Management Effectiveness	√			

About the Overall Seafood Recommendation:

- A seafood product is ranked **Best Choice** if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.
- A seafood product is ranked **Good Alternative** if the five criteria "average" to yellow (Moderate Conservation Concern) OR if the "Status of Stocks" and "Management Effectiveness" criteria are both of Moderate Conservation Concern.
- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.

Overall Seafood Recommendation:

U.S. (drift gillnet, set gillnet):

Best Choice | **Good Alternative** | Avoid

Monterey Bay Hook and Line:

Best Choice | Good Alternative | Avoid

II. Introduction

White seabass (*Atractoscion nobilis)* are large, mobile, substratum predatory fish that primarily inhabit the coastal waters of southern California and Baja California, Mexico (Allen *et al.* 2007); they are also found in the northern Gulf of California (CDFG 2001). During periods of higher ocean temperatures such as El Niño Southern Oscillation (ENSO) events, white seabass have been observed as far north as Juneau, Alaska (Donohoe 1997; Allen *et al.* 2007). Contrary to their name, white seabass are not true bass but are the largest member of the croaker family (Sciaenidae). Species belonging to the Sciaenidae family can be identified by their chin barbells, which are used for detecting prey (Allen et al. 2007), and the characteristic "croaking" sound produced by males beating their abdominal muscles against their swim bladder (CDFG 2002). The largest white seabass ever recorded caught in California waters was five feet (1.52 meters) in length and weighed 93 pounds (42 kg), but individuals weighing more than 60 pounds are uncommon (Thomas 1968; Vojkovich 1992; CDFG 2009a).

Figure 1: White seabass are typically concentrated between Pt. Conception, California and Magdelena Bay, Baja Mexico, although they can be found as far north as Juneau, Alaska in warmer years (Map from Donohoe 1997).

White seabass live in a variety of habitats throughout their life cycle. Adults aggregate over rocky reefs to spawn from March to July (Vojkovich *et al.* 1983), producing pelagic eggs. Once they reach 4–5 mm in length, larvae settle and become demersal (Donohoe 1997). Juveniles inhabit coastal waters 4–8 meters deep (Vojkovich *et al.* 1992; Donohoe 1997) and are strongly associated with drift macrophytes (*e.g.*, giant kelp and filamentous algae) (Allen *et al.* 1992; Vojkovich 1992; Donohoe 1997). Adult white seabass inhabit coastal areas including the surf zone, rocky reefs, kelp beds, offshore banks and the open ocean. They can be found both in schools and as solitary individuals (Vojkovich *et al.* 1983; Airame *et al.* 2000; Vojkovich *et al.* 2001; Allen *et al.* 2006). Adults are thought to feed nocturnally, preying on anchovies (*Engraulis spp.*), herring (C*uplea spp.*), sardines (*Sardinops spp.*), squid (*Loligo spp.*) and pelagic crabs (*Pleuroncodesplanipes*) (Thomas 1968; Vojkovich *et al.* 1983).

In Monterey Bay, white seabass generally feed on and follow squid as they move into the bay (Tanaka pers. com., 2010). When squid are abundant and water temperatures are warmer than usual in the bay, white seabass may become more abundant, which increases fishing effort and landings for Monterey Bay ports (Tanaka pers. comm., 2010). Historic data on white seabass landings illustrate that white seabass move seasonally north along the California coast as water temperatures warm (Skogsber 1939; Radovich 1961; Karpov 1995; cited in CDFG 2002). This was shown in the early 1900's, when during a period of warmer water temperatures in Monterey Bay, commercial white seabass catches increased substantially (CDFG 2002). Since 1999 commercial catches of white seabass have been increasing in areas north of Pt. Conception, which may be indicating a range-shift for white seabass (CDFG 2002).

Commercial fisheries for white seabass have existed for over a century (Vojkovich 1992; CDFG 2006b) and have been historically concentrated between Magdalena Bay, Baja California and Pt. Conception, California (Figure 1) (Vojkovich 1992; Airame *et al.* 2000). Fishing for white seabass occurs in Baja California, but there is little available information about the Mexican fishery. Fishing effort in the U.S. is concentrated south of Point Conception, California. Landings north of Pt. Conception are usually minor and rarely account for more than 20 percent of total white seabass landings in the U.S. (Vojkovich *et al.* 2001; CDFG 2002).

Commercially, white seabass are caught almost exclusively with set and drift gillnets, which made up 96 percent of commercial landings in 2007 and nearly 98 percent in 2008 (Lynn, pers. comm., 2009). However, there is an active commercial hook and line fishery in Monterey Bay. The Monterey Bay white seabass fishery consists of landings made at Monterey Bay ports including: Monterey, Moss Landing, and Santa Cruz. The white seabass fishery in Monterey Bay is almost exclusively fished by hook and line. In Monterey, outside of one mile from shore, longlines with no more than 15 hooks are legal (Tanaka pers. com. 2011). However, commercial fishermen in Monterey Bay exclusively use multiple fishing rods with a double hook rig (herein referred to as hook and line). Since 2005, and up to November, 2010, there has been a total of 56,170 lbs of white seabass landed in Monterey Bay (Figure 4; 2010 data are preliminary). The vast majority of landings have been from hook and line with the exception of 281 lbs (0.5%) that were landed using trawls or fish traps (CDFG unpublished data; Oda pers. com., 2010).

From 1981 to 2000, an annual average of 141 vessels (range: 91-199) throughout California have participated in the white seabass fishery (CDFG 2002). However, in most years, approximately twenty vessels participate directly in the commercial white seabass fishery and land 80 percent (range: 56 to 94 percent) of the annual catch (CDFG 2002). The number of vessels involved in the fishery in California waters varies significantly from year to year (Figure 2). The majority of landings occur along the coast of Santa Barbara and Los Angeles counties, and peak in the early to mid-summer (Figure 3) (CDFG 2007). The Monterey Bay fishery has been characterized as a largely opportunistic fishery where fishing effort is highly variable and relies on how abundant white seabass are in the bay (Tanaka pers. comm., 2010). When local boats fishing in Monterey Bay begin to catch white seabass, others (through word-of-mouth) will begin fishing them as well (Tanaka pers. comm., 2010). As of October 2010, there were 18 vessels targeting white seabass in Monterey Bay (Tanaka pers. com., 2010). There has been an increase in landings for white seabass in Monterey Bay in recent years, most likely caused by increases in squid and warmer bay temperatures (Figure 4).

Neither the size of vessels nor the fishing techniques have changed significantly in the past 13 years (Allen *et al.* 2007). A total of 95 boats were involved in the fishery in 2008 (Lynn, pers. comm., 2009). The average commercially caught white seabass is 3.5 feet long (1.02 meters) and weighs 20 pounds (CDFG 2002). Because white seabass caught in drift gillnets are commonly targeted together with yellowtail (*Seriola lalandi*) and California barracuda (*Sphyraena* *argentea*), all three species are categorized as a single gillnet fishery (Carretta 2003, 2004, 2005; NMFS 2007).

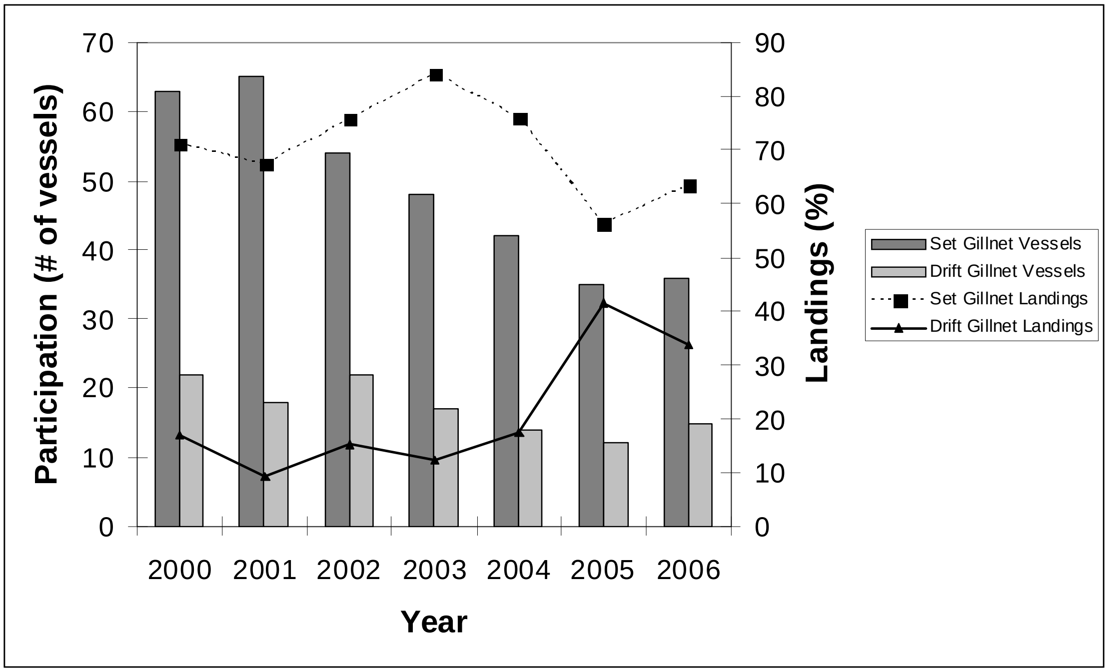


Figure 2. Vessel participation in the CA white seabass fishery and percent of landings by gear type (2000–2006). Set gillnets account for the majority of landings but are considered to have a greater impact on the marine environment than other gear types (derived from unpublished CDFG data).

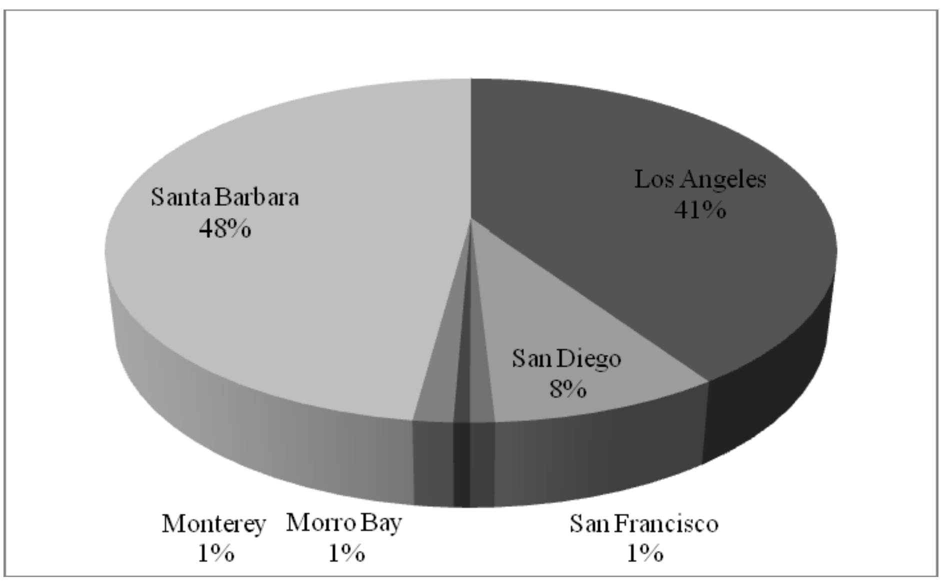


Figure 3: White seabass landings (pounds) in California by location (2006) (Data from CDFG 2007).

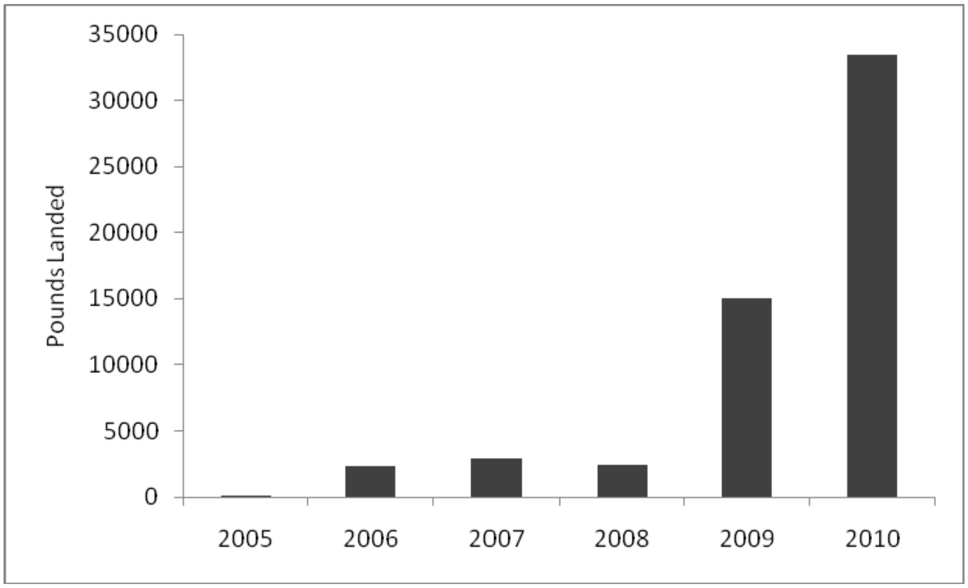


Figure 4. Total white seabass landings made at all Monterey Bay ports from 2005-2010.(includes: Monterey, Moss Landing, and Santa Cruz). Note: landings data from 2010 are from data entered as of November 2010 and are considered preliminary. Graph derived from unpublished CDFG database 2010.

Commercial landings of white seabass fluctuated widely during the twentieth century, in part due to area closures and reductions in fishing effort, despite which white seabass stocks have experienced periods of overfishing and collapse (CDFG 2002). Although commercial landings peaked in 1959 at 3.5 million pounds (1,588 metric tons), a subsequent decline led to landings of less than 200,000 pounds annually (Figure 5). By the 1980–1981 fishing season, the fishery had collapsed to 10 percent of its historic catch (Allen *et al.* 2007), and annual landings remained at this level for the next 15 years (Allen et al. 2008). In 1983, the California State Legislature passed legislation funding research into artificial propagation (aquaculture) for finfish species whose populations had become depleted. This research was initially focused on white seabass and California halibut. The Ocean Resources Enhancement and Hatchery Program (OREHP), managed by CDFG, chose white seabass as their primary species of focus due to the highly depressed condition of stocks and the large economic impact on recreational and commercial fishers. The OREHP raises white seabass fry to a length of 200–250 mm and releases them into the wild. Since 1986, the program has released 1.6 million white seabass juveniles into the ocean (Taylor, pers. comm., 2009), but the program is believed to have had little impact on natural populations (Allen, pers. comm., 2009). This program is discussed further in “Criterion 2: Status of Wild Stocks”.

Continued concern over white seabass and other commercial stocks as well as high levels of bycatch in associated coastal fisheries prompted the passage of State Proposition 132, which prohibited the use of gillnets within three nautical miles of shore (state waters) from Pt. Arguello to the U.S.-Mexico border as well as in waters shallower than 79 fathoms or within one nautical mile (whichever is less) of the Channel Islands (CDFG 2002). This ban went into effect in 1994 and data suggest that these closures have benefitted white seabass stocks (Allen et al. 2008). White seabass landings since 1999 have exceeded 200,000 pounds (91 metric tons) annually (CDFG 2002) and have risen dramatically in recent years to historic highs (Lynn, pers. comm.,

2009) (Figure 5). In 2008, 648,877 pounds of white seabass were landed in California with an ex-vessel value estimated at US $1,506,042 (Lynn, pers. comm., 2009).

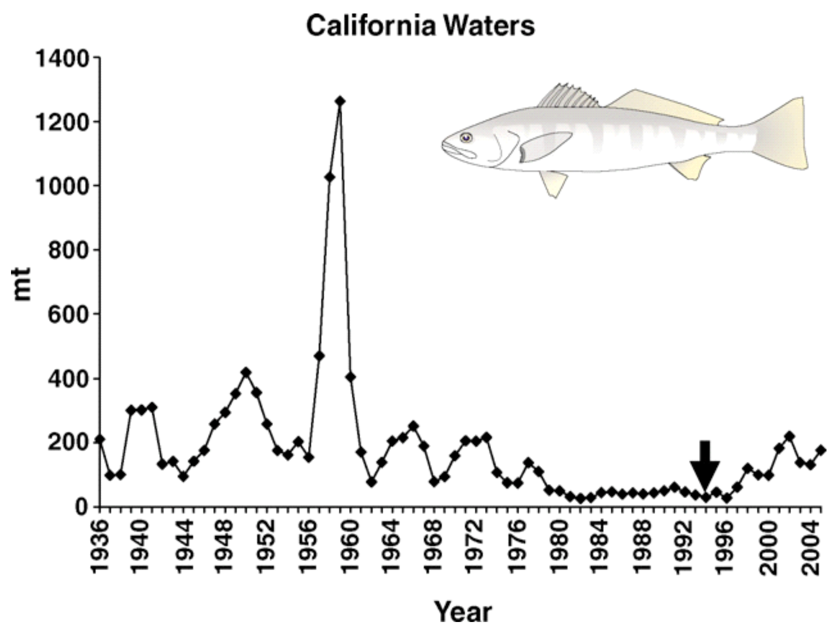


Figure 5. Commercial white seabass landings in California waters, 1936–2005 (Figure from Allen *et al.* 2007). The arrow indicates the passage of State Proposition 132, which enacted major area closures to gillnet fishing.

White seabass are managed by the Fish and Game Commission with management recommendations from the California Department of Fish and Game (CDFG). Currently, CDFG has conducted no formal stock assessment, and the majority of available data regarding stock status are fishery dependent. In 2002, CDFG completed a White Seabass Fishery Management Plan (WSFMP). Reviews of the WSFMP are required to be published annually in order to determine the status of the stock and whether any changes in management are necessary (CDFG 2002).

Scope of the analysis and the ensuing recommendation
This report encompasses white seabass caught north of the U.S.-Mexico border (specifically California). Information on the Mexican white seabass fishery is insufficient to conduct an adequate analysis.

Availability of Science

No formal stock assessment has been conducted for white seabass by CDFG. All data used by CDFG to assess the health of the stock are fishery dependent (log books, landings data, etc.). Fishery-independent sampling of juvenile white seabass was conducted from 1995–2008, funded by OREHP. Information is available about many life-history traits, bycatch and the potential habitat effects associated with the white seabass fishery.

Market Availability

Common/Market names
White seabass is also marketed as king croaker and white weakfish.
Seasonal Availability
White seabass is commercially available from mid-June to mid-March (due to a fishery closure). The recreational fishery is open year round.
Market Value (2008)
In 2008, white seabass were valued at approximately $3.14 per pound.
Product forms
White seabass is sold as fillets, both fresh and frozen.
Import/export statistics
White seabass exports are negligible. Mexico is the only potential foreign source of white seabass. Import data from the National Marine Fisheries Service (NMFS) Foreign Trade Database do not differentiate between various species of seabass. Therefore, precise import data for white seabass are unavailable.

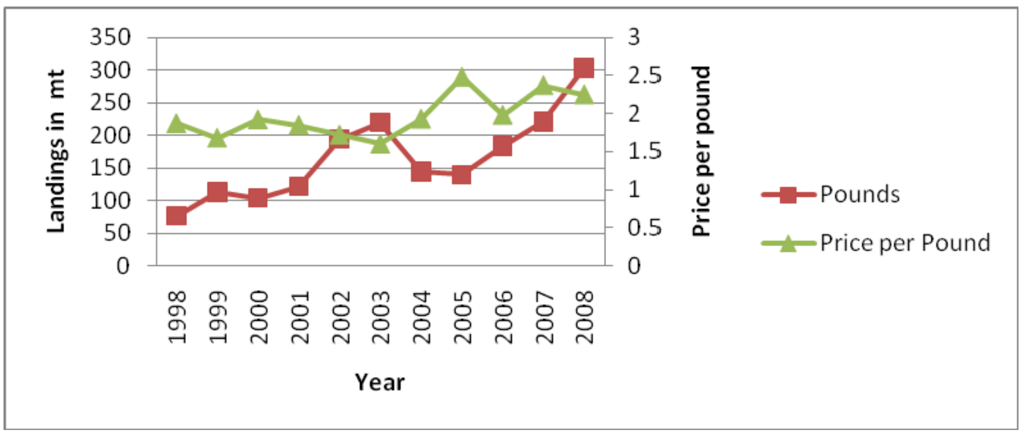


Figure 6. White seabass landings in California and annual price per pound from 1998 to 2008 (Data from PSMFC 2009).

III. Analysis of Seafood Watch® Sustainability Criteria for Wild-caught Species

Criterion 1: Inherent Vulnerability to Fishing Pressure

The intrinsic rate of increase for white seabass is unknown. Life history parameters differ slightly between male and female white seabass although both sexes reach sexual maturity quickly. Females reach maturity at four years of age (24 inches), while males reach maturity at three years of age (20 inches) (Vojkovich *et al.* 1992, 2001; CDFG 2002). White seabass grow moderately quickly as measured by the von Bertalanffy growth coefficient (k), a measure of growth widely used in fisheries science. White seabass have a moderate von Bertalanffy growth coefficient of k=0.1280 (Thomas 1968) and are moderately long lived with a maximum age of approximately 27 years (CDFG 2002).

White seabass aggregate to spawn from March to July with peak activity in early summer (Vojkovich *et al.* 1983, 1992; Donohoe 1997). During spawning events, adults aggregate in large groups near shore, usually over rocky bottoms or kelp beds (Thomas 1968). Vulnerability to fishing pressure is higher for species that aggregate to spawn. White seabass are iteroparous, meaning that individuals spawn multiple times during their lives. Fecundity is estimated at 760,000 to 1.5 million eggs per clutch, and many females spawn more than once a season (CDFG 2002).

White seabass are exclusive to the Pacific coast of North America, ranging from Juneau, AK to Magdalena Bay, Baja California, although they are not common north of Pt. Conception (Thomas 1968; Vojkovich *et al.* 2001). White seabass appear to migrate up the coast in response to unusually warm water as during El Niño Southern Oscillation (ENSO) events (CDFG 2002). It is during these years that white seabass are observed as far north as Juneau, AK (Vojkovich *et al.* 1983; 2001). Their somewhat limited geographic range increases the vulnerability of white seabass to fishing, habitat modification, pollution and disease.

White seabass are dependent on many different habitat types throughout their life cycle, including drift macrophytes, eel grass and kelp forests (Allen *et al.* 1992; Vojkovich 1992; Donohoe 1997; Airame *et al.* 2000). This dependency makes the health of a variety of habitats important to white seabass populations and could increase their vulnerability to habitat alteration. The nearshore areas that juveniles inhabit are currently experiencing record high levels of anthropogenic pollutants, many of which could be harmful to white seabass (CDFG 2002). Giant kelp and eel grass are relatively resistant to high levels of pollutants (Bay 2001; Kaldy 2006), reducing the risk of significant habitat loss. Nevertheless, many pollutants can affect these ecosystems indirectly (*e.g.*, via algal blooms and trophic magnification) (Bay 2001; CDFG 2002). White seabass juveniles are known to inhabit embayments and estuarine areas and could potentially be affected by the continued loss and degradation of coastal wetlands. Data provided by fishery-independent sampling indicates that white seabass are relatively independent of estuarine environments (Allen et al. 2007). This characteristic bodes well for white seabass, as estuarine and wetland habitats have been significantly altered and degraded in California. Since 1850, the extent of California's wetlands has decreased by 90 percent, and remaining areas face rising pollution, physical disturbances and the threat of further development (CDFG 2002).

Climate change may also potentially affect white seabass stocks. White seabass have a high affinity for warm water (19.0–22.0°C) (Allen *et al.* 1992; Vojkovich *et al.* 2001; CDFG 2002), and spikes in yearly recruitment coincide with ENSO events (CDFG 2002; Allen *et al.* 2007; Williams *et al.* 2007). However, both giant kelp (Edwards 2004) and eel grass (Rasmussen 1977), which provide important habitat for white seabass and their prey, are adversely affected by water temperature increases. For example, the 1997 ENSO coincided with an enormous die off of giant kelp forests, especially in Baja, California (Edwards 2004). Even though warmer waters caused by climate change may be beneficial to white seabass in the short term, long-term deleterious effects are possible due to habitat loss.

Table 1. Life history characteristics of white seabass (*Atractoscionnobilis*).

Intrinsic Rate of Increase (r)	Age at Maturity	Growth Rate	Max Age	Max Size	Fecundity	Species Range	Special Behaviors	Sources
Unknown	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	Thomas 1968; Vojkovich *et al.* 1992; Donohoe 1997; Vojkovich *et al.* 2001; CDFG 2002; Allen 2006

Synthesis
The intrinsic rate of increase for white seabass is unknown. White seabass have a low age at maturity (4 years for females, 3 years for males), and females are highly fecund, producing 760,000–1.5 million eggs per clutch with some individuals spawning more than once a year. As such, Seafood Watch® considers white seabass to be inherently resilient to fishing pressure.

Inherent Vulnerability Rank:

Resilient | Moderately Vulnerable | Highly Vulnerable

Criterion 2: Status of Wild Stocks

White seabass stocks are currently considered healthy by CDFG (Lynn, pers. comm., 2009). Historically, white seabass stocks experienced a long period of general decline (1960–1997) (CDFG 2002) and were on the verge of collapse as recently as 1994 (Allen *et al.* 2007). In response to the collapsed stocks of several nearshore species as well as concerns over bycatch, the state of California passed Proposition 132 in November 1990 to enact a ban on drift and set gillnet fishing in state waters south of Point Arguello. Since the passage of this ban, stocks have undergone a net population increase as measured by catch-per-unit-effort (CPUE) and fishery-independent sampling (CDFG 2002; Allen *et al.* 2007). From 1950 to 1970, CPUE for white seabass dropped by 50 percent. The decline in CPUE continued through 1980, but CDFG data indicate a net rise in CPUE in commercial fisheries from 1982 to 2002 (Figure 7) (CDFG 2002). This rise is potentially due to the decline in fishing effort for white seabass during much of this period. The number of white seabass sets made by set gillnet fisherman dropped from nearly 2000 in 1982 to less than 50 in 1994 (CDFG 2002). Thus, although CPUE was generally increasing throughout the 1980s and 1990s, annual landings remained low. More recent data on CPUE from CDFG is not available. CPUE information, other than landed catch per receipt submitted by commercial fishermen, is unavailable for any year for the Monterey Bay fishery (Oda pers. com., 2010). More recent fishery-independent data show fluctuations in juvenile CPUE between 1995 and 2008 (Figure 8) (Allen 2008).

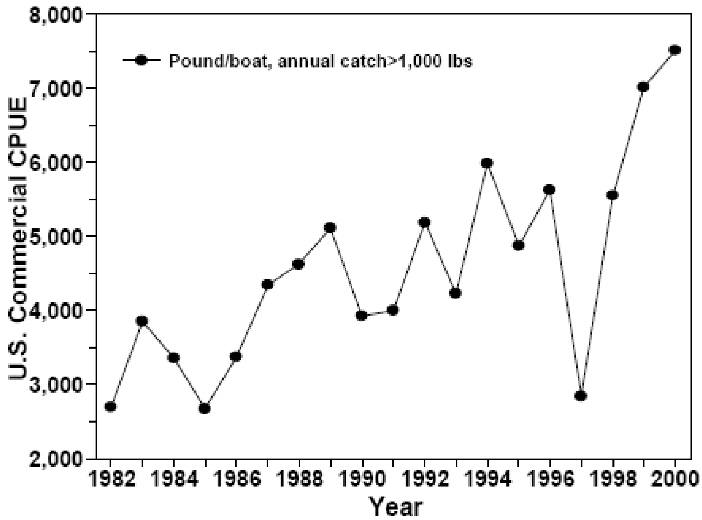


Figure 7. Catch per Unit Effort (CPUE) (pound/boat, annual catch>1,000 lbs) for the white seabass commercial fishery from 1982 to 2000 (Figure from CDFG 2002).

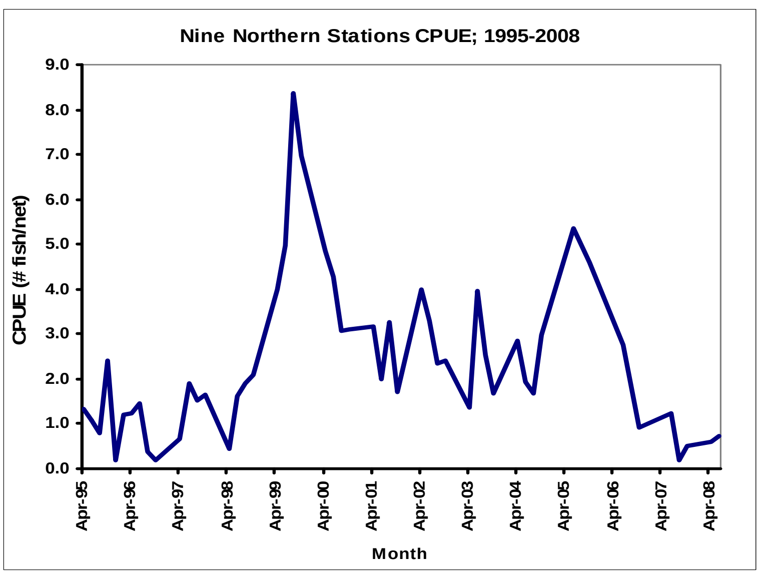


Figure 8. CPUE fluctuated significantly during a 13-year period of fishery-independent sampling of juvenile white seabass at nine coastal stations in southern California (Figure from Allen 2008).

White seabass biomass at maximum sustainable yield (B_{MSY}) is estimated at 16 million pounds (CDFG 2002). Based on this estimate of B_{MSY} and an estimated natural mortality rate of 0.1, the MSY proxy is 1.6 million pounds (CDFG 2002). An annual harvest quota, or optimum yield (OY), of 1.2 million pounds has been established (CDFG 2004a, 2005, 2006a, 2009a). The White Seabass Scientific and Constituent Advisory Panel (WSSCAP) acknowledges that there is no estimated stock size, but they concluded in 2002 that the stock was above B_{MSY} based on analyses of landing trends, recruitment and observations of white seabass in central California (CDFG 2002). Due to the unknown stock size, B/ B_{MSY} is deemed unknown by Seafood Watch®. Since there is no formal stock assessment for white seabass, the Fish and Game Commission established three criteria to determine if an overfishing condition exists or is imminent. These criteria are: (1) a 20 percent decline in total annual landings for the past two consecutive seasons compared to the prior five-season average observed in the commercial fishery, (2) a 20 percent decline in both the number of fish and the average weight of white seabass observed in the recreational fishery, and (3) a 30 percent decline in recruitment indices for juvenile white seabass compared with the prior five-season average (CDFG 2004a, 2005, 2006a). These criteria are reviewed annually, and the 2007–2008 annual review found that the juvenile recruitment index declined 52 percent relative to the five-year average. Although this meets one of the criteria for determining if an overfishing condition exists or is imminent, the CDFG and the WSSCAP determined that white seabass was not overfished or subject to overfishing (CDFG 2009c). Trends in stock abundance from 2001–2005 have been variable and ambiguous, indicative of a recovering species (CDFG 2006a). Positive trends are reinforced by fishery-independent data indicating a strong and growing stock of successfully breeding adults (Allen et al. 2007). Recent landings in California waters have increased substantially and are higher than they have been since the early 1980's despite continued area and seasonal closures of historically important fishing grounds (Figure 9) (CDFG 2006a; CDFG 2009b).

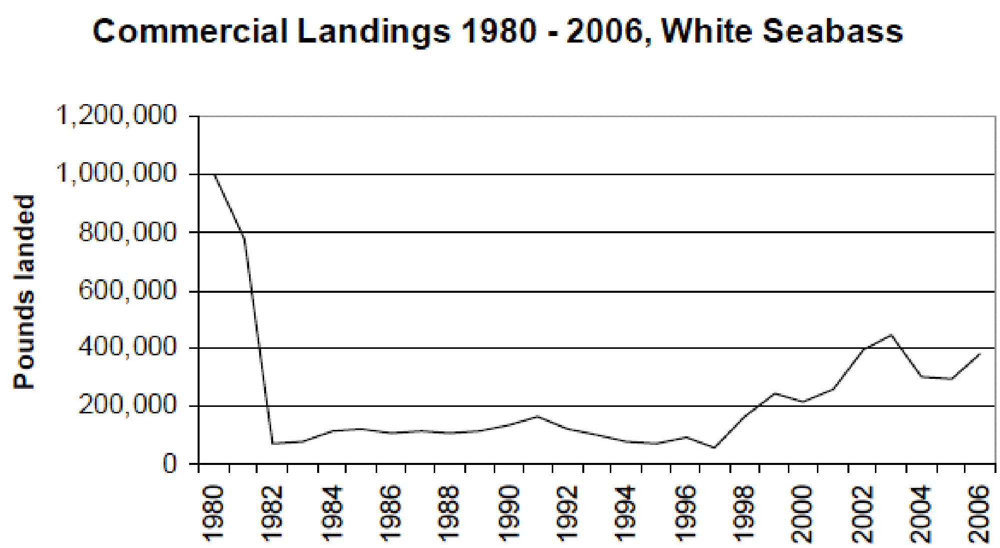


Figure 9. Commercial landings of white seabass in CA waters from 1980-2006 (Figure from CDFG 2006a).

Increases in white seabass stocks over the past decade have potentially been aided by the Ocean Resources Enhancement and Hatchery Program (OREHP). However, until a full evaluation of the OREHP is conducted, the contribution of this program will remain speculative (Taylor, pers. comm., 2009). In 1983, the California State Legislature established the OREHP for the purpose of augmenting depleted finfish populations, and white seabass were chosen for artificial population enhancement. Since 1986, the program has contributed over 1.6 million white seabass fry to wild stocks (HSWRI 2009).

Hatchery enhancement programs raise some concerns for the health of wild fish stocks. Studies have been conducted on the impacts of hatcheries to evolutionarily significant units (ESUs) of wild salmon. When hatchery fish are included in stock assessments, many ESUs that are otherwise failing appear to be in reasonable health. As such, high levels of hatchery releases can mask declines in wild populations. In addition, targeting hatchery fish can increase the harvest rates of wild fish. Myers *et al.* (2004) comment: "Including hatchery fish in an ESU confounds risk of extinction in the wild with ease of captive propagation and ignores important biological differences between wild and hatchery fish." Hatchery fish compete with wild populations for food and other resources. They can mask habitat degradation, enhance predator populations and allow for increased exploitation of the wild population. As a consequence, a high abundance of hatchery fish that might otherwise indicate a healthy stock has the potential to negatively affect survival rates and the long-term viability of wild fish. Hatchery fish also have the potential to erode the long-term health of wild ESUs by homogenizing their gene pools. Because they are exposed to a different set of environmental factors, hatchery-produced fish are inevitably domesticated with adaptations to the hatchery environment that generally reduce resilience in the wild (Myers et al. 2004).

The OREHP has management practices in place to reduce the risk of releasing infected individuals: (1) no white seabass are released unless approved by a CDFG fish pathologist; (2) if a novel disease is found, it is investigated to see if the disease already exists in the wild white seabass population; and (3) if the disease is not known to exist in the wild population, infected individuals are euthanized (Taylor, pers. comm., 2009). Despite these measures, the risk of infected individuals contacting wild populations remains. Very few white seabass caught in fishery-independent studies are hatchery raised (Allen pers. comm., 2009). Overall, the effect of hatcheries on the health of wild stocks is uncertain. In the white seabass fishery, because only a small number of wild-caught seabass are hatchery raised, the effects of hatcheries are not considered a major conservation concern. Consequently, this report focuses on trends in the health and abundance of wild fish. However, future stock assessments of white seabass should be designed to assess the abundance of wild fish only.

Commercial and recreational length-frequencies of white seabass were skewed towards smaller individuals during and immediately following years of overfishing. In recent years, however, populations have returned to the expected bell-shaped curve typical of a natural population (Figure 10) (CDFG 2005a, 2006a; Allen *et al.* 2007). Average length has also increased in recent years for commercial and recreational fisheries (Figure 10) (CDFG 2005, 2006). Length frequency analyses between 1995 and 2005 revealed an orderly progression of early year classes through successive sampling periods, resulting in a well-defined size structure trend for white seabass (Allen et al. 2007).

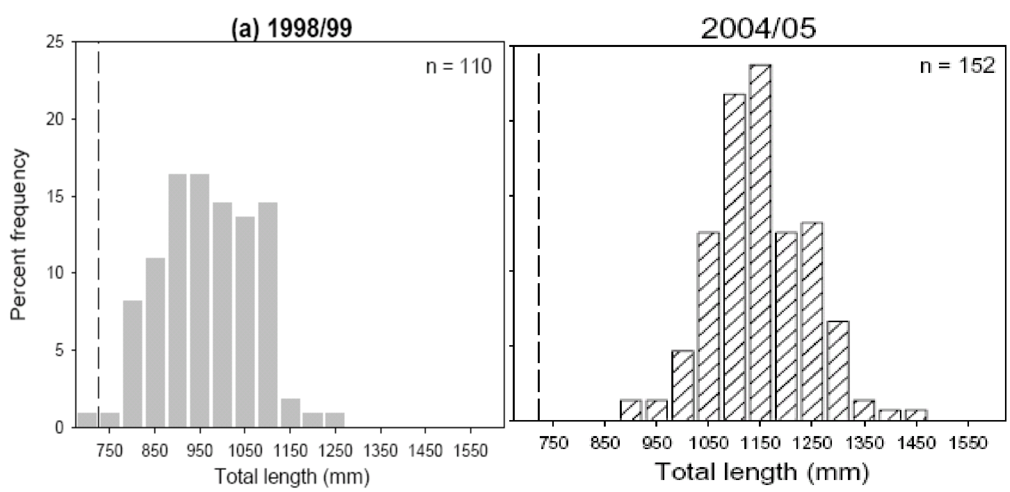


Figure 10. Commercial white seabass length-frequencies (1998–99 and 2004–05). Dashed lines represent minimum size limit of 28 inches (711 mm) (Figure from CDFG 2005a & 2006a).

Table 2. Stock status of white seabass.

Classification Status	B/B_{MSY}	Occurrence of Overfishing	F/F_{MSY}	Abundance Trends/ CPUE	Age/ Size/Sex Distr.	Degree of Uncertainty in Stock Status	Sources	SFW Rank
CDFG classifies stock as "healthy"; not overfished based on overfished criteria for the fishery.	Un-known	One of the three overfishing criteria for the fishery has been met.	Un-known	Long-term CPUE trend: variable. Short-term CPUE trend: up. Monterey Bay trend is unknown.	Size distribution functionally normal. Age and sex distribution unknown.	Moderate	CDFG 2002, 2004a, 2005, 2006a; Allen *et al.* 2007; Oda pers com. 2010	Moderate

Synthesis
CDFG classifies white seabass stocks as "healthy". The WSSCAP has concluded that stocks are neither overfished nor undergoing overfishing, based on fishery-dependent data. Fishery-independent sampling from 1995–2005 indicates that natural populations are increasing. Based on CDFG CPUE data, the white seabass population was in decline from 1960–1997, but experienced a gradual net increase from 1982–2000. There is an increasing long and short-term trend in CPUE data for the set and gillnet fisheries operating in Southern California.

Throughout California catch levels are up to historic levels despite closures to historically important fishing areas and seasons. However, biomass and fishing mortality rates are unknown, and in the most recent analysis one of the three criteria used to determine whether an overfishing condition exists or is imminent was met. In addition, there is uncertainty regarding the impacts of hatcheries. The size distribution of the stock is functionally normal relative to the natural condition. Because both stock abundance relative to B_{MSY} and fishing mortality are unknown, Seafood Watch® deems the white seabass stock to be a moderate conservation concern.

Status of Wild Stocks Rank:

Healthy | **Moderate/Rebuilding** | Poor | Critical

Criterion 3: Nature and Extent of Bycatch

Seafood Watch® defines sustainable wild-caught seafood as marine life captured using fishing techniques that successfully minimize the catch of unwanted and/or unmarketable species (i.e., bycatch). Bycatch is defined as species that are caught but subsequently discarded (injured or dead) for any reason. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, accounted for and managed in some way.

White seabass are commercially caught almost exclusively with set and drift gillnets, which accounted for 96% of commercial landings in 2007 and almost 98% in 2008 (Lynn, pers. comm., 2009). However, the Monterey Bay white seabass fishery is almost exclusively hook and line (multiple fishing rods with a double hook rig, Tanaka pers. com 2011; CDFG 2010). Set gillnets tend to be used more often than drift gillnets for the California fishery (CDFG 2002; 2009a). White seabass are part of a combined gillnet fishery with yellowtail (*Seriola lalandi*) and barracuda (*Sphyraena argentea*), and therefore, catches of these species are not considered bycatch.

Gillnet fisheries can impact seabirds via the capture of surface foragers (*e.g.*, gulls) as well as diving birds such as terns and cormorants. Seabird bycatch can be especially problematic for nearshore gillnet fisheries: seabird bycatch contributed to the ban on gillnets in a large portion of California state waters. The observer program implemented by CDFG in 1983–1989 recorded ten cormorant mortalities (*Phalacrocorax sp*.) out of 818 white seabass gillnet sets (gillnet type not specified) over 250 days (CDFG 2002). No other bird species suffered injuries or died during this observation period. From 1990–1993, observers documented 14 cormorant mortalities in southern California and 20 common murre entanglements in central California out of the 521 observed white seabass gillnet sets (CDFG 2002). Common murres are winter visitors to southern California, and thus interactions appear to be limited because the highest level of fishing effort occurs during the summer months in southern California. Further, many gillnets for white seabass are set after dark, which can reduce interaction with some seabird species. Low levels of seabird bycatch documented in logbook data and by onboard observers indicate that impacts on seabird populations are not expected to be significant (CDFG 2002).

The white seabass, yellowtail, and barracuda drift gillnet fishery is known to entangle marine mammals including California sea lions, long-beaked dolphins and short-beaked dolphins (NOAA 2007). From the start of an onboard observer program in 2002 through July 31, 2003, two California sea lion mortalities and one long-beaked common dolphin mortality were documented among the 42 sets observed (Carretta *et al.* 2004). In 2004, onboard observers documented one California sea lion and one long-beaked common dolphin mortality among the 22 sets observed (Carretta *et al.* 2005). Based on these observer documented interactions, mortality of long-beaked common dolphins associated with the yellowtail, barracuda and white seabass drift gillnet fishery was estimated at nine individuals per year (NMFS 2007). From 1999–2003, two harbor seal strandings and two mortalities were attributed to the halibut/angel shark or white seabass set gillnet fishery, but gear interactions were not actually witnessed. There are insufficient data to show a decline in the long-beaked common dolphin (NMFS 2003a) or California sea lion populations (NMFS 2003b). Data suggest that harbor seals are not in decline and may be stabilizing at the ecosystem's carrying capacity (NMFS 2005a). Therefore, bycatch of long-beaked common dolphins, California sea lions and harbor seals in the yellowtail, barracuda and white seabass drift gillnet fishery does not appear to be limiting the health of their populations.

More recently, in 2007, NMFS conducted an onboard observer program in the halibut and white seabass set gillnet fishery; the white seabass, yellowtail and barracuda gillnet fishery, and the white seabass drift gillnet fishery were not observed (Carretta and Enriquez 2009). Out of an estimated 1,387 sets fished by all set net vessels in the fishery, 248 sets were observed (17.8% observer coverage) (Table 3a). Observed bycatch included 34 California sea lions, two harbor seals (*Phoca vitulina*), one unidentified pinniped, four Brandt's cormorants (*Phalacrocorax* *penicillatus*) and one unidentified cormorant (Table 3b). Based on a ratio estimator, the marine mammal and seabird bycatch for the fishery was estimated at 190 California sea lions, 11 harbor seals, 5 unidentified pinnipeds, 22 Brandt's cormorants and one unidentified cormorant (Table 3b) (Carretta and Enriquez 2009). Mortality of California sea lions and harbor seals was at a low level relative to their respective potential biological removal levels (~8,500 for sea lions and ~1,900 for harbor seals) (Carretta and Enriquez 2009). Populations of California sea lions, harbor seals and Brandt cormorants are all stable or increasing, although the data for the California sea lion population are insufficient (NMFS 2003b). Further data suggest that harbor seals are not in decline and may be stabilizing at the ecosystem's carrying capacity (NMFS 2005a), while the Christmas Bird Count (CBC) showed increased numbers of Brandt cormorants (National Audubon Society 2010). Therefore, bycatch of these species in the white seabass set gillnet fishery does not appear to be limiting the health of their populations.

It appears that the total amount of marine mammal bycatch in the white seabass drift gillnet and set gillnet fisheries is decreasing. These fisheries have recently been upgraded under the Marine Mammal Protection Act (MMPA) from Category I fisheries (fisheries in which annual mortality and/or serious injury of a particular incidental bycatch species is "frequent"—*i.e.*, greater than or equal to 50% of its potential biological removal[1]) to Category II fisheries (fisheries in which annual mortality and/or serious injury of a particular incidental bycatch species is "occasional"—*i.e.*, between 1% and 50% of its potential biological removal) (NMFS 2009c).

Table 3a. Fishery observer and fishing effort summaries for calendar year 2007 for the California halibut and white seabass set gillnet fishery (Table from Caretta and Enriquez 2009).

Fishery	MMPA Fishery Category	Approximate number of active vessels	Estimated Number sets/trips fished	Observed sets/trips fished	Observer Coverage Rate	Observed Species Interactions (number killed or injured)
CA/OR swordfish and thresher shark large-mesh drift gillnet	Category I	40 (22 observed)	1,241 sets[a]	204 sets	16.4% (sets)	Common dolphin, short-beaked (9) Northern right whale dolphin (1) Pacific white-sided dolphin (1) CA sea lion (8) Northern elephant seal (1)
CA halibut and white seabass set gillnet	Category I	58	1,387 sets[b]	248 sets	17.8% (sets)	CA sea lion (34) Harbor seal (2) Unidentified pinniped (1) Brandt's Cormorant (4) Unidentified cormorant (1)
CA market squid purse seine fishery	Category II	84	2,448 trips[c]	32 trips, 83 sets,	1.3% (trips)	none
CA anchovy, mackerel, and sardine purse seine fishery	Category II	61	1,510 trips[c]	76 trips, 142 sets	5% (trips)	none

Note: The white seabass set gillnet fishery has been upgraded from a Category I fishery to a Category II fishery under the MMPA.

[1] Potential biological removal (PBR) is defined (50 CFR 229.2) as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (NMFS 2009c).

Table 3b. Summary of observed bycatch rates, estimates and statistical precision for the California halibut and white seabass set gillnet fishery in 2007. Bycatch rates and estimates are based on 2007 observer data and 2006 logbook effort (Table from Caretta and Enriquez 2009).

Fishery and Species	Observed Bycatch	Bycatch per Set	Bycatch per Set Variance	Bycatch Estimate	Bycatch Estimate CV
CA angel shark halibut and white seabass set gillnet					
California sea lion	34	0.14	8.7×10^{-3}	190	0.68
Harbor seal	2	0.008	3.4×10^{-5}	11	0.73
Unidentified pinniped	1	0.004	1.87×10^{-5}	5	1.20
Brandt's Cormorant	4	0.016	7.9×10^{-5}	22	0.56
Unidentified cormorant	1	0.004	1.75×10^{-5}	5	1.16

The California Department of Fish and Game has called for onboard observations of the white seabass fishery to document possible changes in bycatch composition as a result of Proposition 132, which moved the fleet further offshore in 1994 in part to decrease bycatch interactions (CDFG 2002). In 2000, further area closures banning gillnet fishing (including nearshore set net fishing) and trammel net fishing shallower than 60 fathoms from Pt. Reyes to Yankee Pt. (Monterey Bay) and from Pt. Arguello to Pt. Sal due to concerns over interactions with (*i.e.*, bycatch of) the common murre (*Uria aalge*) and California sea otter (*Enhydra lutris*)(CDF&G 2006b). These closures appear to have improved the stocks of several nearshore predatory fish, including white seabass, giant seabass, leopard shark and soupfin shark, which all appear to be rebounding (Pondella and Allen 2008). When the gillnet ban was implemented in 1994, all of the aforementioned species populations had collapsed or were in substantial decline. Though intensive fishing was largely responsible for the declines in these species, losses due to bycatch also likely contributed.

Pacific white sharks (*Carcharodon carcharias*), which are listed as vulnerable by the IUCN, inhabit the waters off the California coast (Jorgenson et al. 2009; IUCN 2010). As a result, commercial fisheries also incidentally catch white sharks. Lowe et al. (in press) presents data on white shark bycatch in a variety of California fisheries, including the commercial white seabass set gillnet and drift gillnet fisheries, from the early 1980s through 2009. There are years without any data, which represents gaps in the data. In the years with available data, there were a total of 38 instances of incidental capture of white sharks in the commercial set and drift gillnet fisheries (27 in the set gillnet fishery, 10 in the drift gillnet fishery, and 1 unknown) (Table 4). The majority of the incidental captures (30 of 38) were of young of the year white sharks. The remaining captures were of an unknown age class. The number of white sharks incidentally captured in the white seabass drift and set gillnet fisheries has somewhat varied over the years, reaching a high of 14 white sharks in 2008 but declining to three white sharks in 2009 (Table 4). All three white sharks caught in 2009 were young of the year. The disposition of the white sharks is unknown but we can assume that the majority were released alive (Lowe, pers. comm.). Because there is not much information available on the population structure, life history, and behaviors of white sharks (Jorgenson et al. 2009), it is unclear if the Pacific white shark population is increasing or decreasing, or if bycatch of these sharks in the white seabass set and drift gillnet fisheries is negatively impacting their population.

Table 4. Number of incidental white shark captures in the white seabass fishery from 1983 through 2009. Note that years not listed in the table represent gaps in the data (Data from Lowe et al. in press).

Year	Number caught in drift gillnet	Number caught in set gillnet	Number caught in unknown gear type
1983	0	6	0
1992	1	1	0
1997	0	1	0
2005	0	1	0
2006	1	6	0
2007	0	4	0
2008	6	7	1
2009	2	1	0
Total	**10**	**27**	**1**

Bycatch in the Monterey commercial hook and line fishery has not been documented, but is believed to be low (by the CDFG) due to where fishing occurs in the water column. The majority of the white seabass fishing occurs in the top 25-50 feet of the water column. However, fishing may also occur throughout the water column and some white seabass have recently been caught in up to 200 feet of water (Oda and Tanaka pers. com., 2010). Most fishermen dead drift fly lined whole squid without weight throughout the season (Tanaka, pers. com 2010). Monterey Bay fishermen use multiple fishing rods with a double hook rig. This rig puts a hook in the head and apex of the squid, reducing the chance of missed bites. Since white seabass are sensitive to noise, fishermen will not troll, but rather drift fish since it is a quieter method (Tanaka, pers. com 2011). Fishing activity also tends to be in a specific area, making trolling an ineffective method, especially if there are multiple boats around (Tanaka, pers. com 2011).

The fishing gear does not contact the bottom and if there are any species incidentally caught they would most likely be released alive (Tanaka pers. com 2010). A review by Chuenpagdee et al. (2003) found that hook and line fishing results in some of the lowest potential bycatch of a number of species and has minimal impacts on biogenic habitat when compared to other fishing methods (bottom trawling, bottom gillnet, etc.).

Synthesis

There is limited bycatch data in the white seabass set gillnet fishery—the focus has been only on seabird and marine mammal interactions. Based on observer data collected from 2002 through July 2003, mortality of long-beaked common dolphins associated with the yellowtail, barracuda and white seabass drift gillnet fishery was estimated at nine individuals per year, but there are insufficient data to show a decline in the long-beaked common dolphin (NMFS 2003a). In 2007, the halibut and white seabass set gillnet fishery incidentally caught California sea lions, harbor seals and Brandt coromorants. Evidence suggests that California sea lion and harbor seal populations are not declining and that the Brandt cormorant population is increasing. Regulations enacted by the State of California to ban gillnets and nearshore set nets in much of the state's waters have appeared to reduce interactions, although bycatch data is lacking. In addition, the white seabass set gillnet and drift gillnet fisheries have been upgraded from Category I fisheries to Category II fisheries under the MMPA. Pacific white sharks, which are listed as Vulnerable by the IUCN, are also incidentally caught in the white seabass set and drift gillnet fisheries. Because there is not much information available on the population structure, life history, and behaviors of white sharks, it is unclear if the Pacific white shark population is increasing or decreasing, or if bycatch of these sharks in the white seabass set and drift gillnet fisheries is negatively impacting their population.

Since the set and drift gillnet white seabass fisheries regularly catch juvenile Pacific white sharks, and it is unknown if the bycatch of Pacific white sharks is contributing to its decline or limiting its recovery, Seafood Watch® deems bycatch in the U.S. set gillnet and drift gillnet white seabass fisheries to be a high conservation concern.

Bycatch rates are suspected to be minimal in the Monterey Bay hook and line fishery, and hook and line gear is known to be a relatively benign fishing activity; therefore, Seafood Watch® deems bycatch in the Monterey Bay hook and line fishery to be a low conservation concern.

Nature of Bycatch Rank:

Set gillnet and Drift Gillnets:

Low Moderate **High** Critical

Monterey Bay Hook and Line:

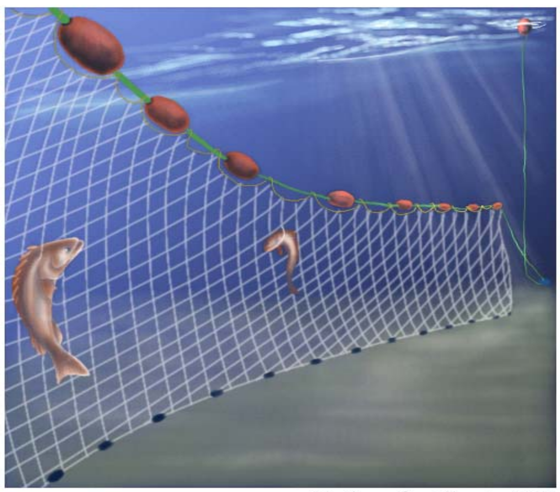
Low **Moderate** High Critical

<u>Criterion 4: Effect of Fishing Practices on Habitats and Ecosystems</u>

Habitat Effects

Habitat damage associated with set gillnet fisheries can include damage to living seafloor structures (*e.g.,* corals and sponges) as well as alterations to geologic structures (*e.g.*, boulders, cobbles, gravel, sand and mud) that serve as nursery areas, refuges and homes for fish and organisms living in, on or near the seafloor (Chuenpagdee *et al.* 2003). Drift gillnets have negligible effects on physical habitats since they are not intended to come in contact with the seafloor (Chuenpagdee *et al.* 2003; Morgan *et al.* 2004). Drift gillnets used in the white seabass fishery are up to 1,829 meters (6,000 feet) in length (NMFS 2007). These nets are usually set shortly before sunset and are pulled in two to three hours later, though they may be set for up to 12 hours near the Channel Islands (CDFG 2002). Impacts on habitat from drift gillnets are considered to be minimal according to Seafood Watch® because they do not contact the sea floor.

Set gillnets are commonly 274–366 meters (900–1,200 feet) long (Vojkovich, pers. comm., 2008) and are set for up to 16 hours (CDFG 2002). Set gillnets can cause physical habitat damage since they use weights to keep the bottom of the net close to the ocean floor (Figure 11) (Chuenpagdee *et al.* 2003; Morgan *et al.* 2004). These weights can damage or crush seafloor organisms and habitats as the nets are set. Additional damage can occur when a set gillnet is pulled in, which often involves dragging the net across the seafloor towards the fishing vessel, possibly snagging structure-forming biota. Adult seabass inhabit a variety of shallow water habitats (Airame *et al.* 2000; Vojkovich *et al.* 2001; Allen *et al.* 2006) that vary in their resilience to physical damage. Set gillnets are commonly deployed inside or adjacent to kelp forests (CDFG 2002) and near rocky headlands (Vojkovich *et al.* 1983). Damage to kelp caused by boat traffic is considered insignificant because of the very high growth rate of giant kelp (~2 ft/day) (CDFG 2002); however, kelp must attach to hard surfaces, suggesting that sets near kelp forests often take place over rocky substrates. Rocky bottoms, where white seabass also aggregate during spawning (Thomas 1968), show low resilience to disturbance from fishing gear (Chuenpagdee *et al.* 2003). Set gillnets can cause moderate physical habitat damage since they use weights to keep the bottom of the net close to the ocean floor and the nets can snag biological or physical structures. In the white seabass fishery, the fished habitat is of low to moderate resilience and the spatial extent of the fishery is moderate. When fished over a moderate spatial scale in habitats of low to moderate resilience, set gillnets are considered by Seafood Watch® to cause moderate habitat damage.



Mathew Squillante 2002

Figure 11. Diagram of a set gillnet (courtesy of Monterey Bay Aquarium).

"Ghost" fishing, the continued catch of organisms in abandoned fishing gear, is a major concern in gillnet fisheries (FAO 2009). Due to set gillnets' contact with the seafloor, there is a higher chance that a net will become entangled and lost, although drift gillnet losses also occur. Fishing gear was found to be the most common type of benthic anthropogenic debris in the region between Point Dume and Dana Point, CA (CDFG 2002). Gillnets are made of synthetic fibers that do not biodegrade, and therefore lost nets can continue to catch species for many years. The extent to which set gillnets are lost or contributing to ghost fishing in the white seabass fishery is unknown.

Hook and line gear (multiple rod and reels) used in the Monterey fishery does not contact the bottom (Tanaka pers. com, 2010). The majority of the white seabass catches occur in the top 25-50 feet of the water column in water depths of approximately 120-130 feet, although some recent catches have been as deep as 200 feet (Oda and Tanaka pers. com., 2010). A review by Chuenpagdee et al. (2003) found that hook and line fishing has minimal impacts on biogenic habitat and benthic species.

Ecosystem Effects

White seabass are substratum predators (Donohoe 1997; Allen *et al.* 2007) that feed on anchovies, herring, sardines, squid and pelagic crabs (Thomas 1968; Vojkovich *et al.* 1983). Juveniles are preyed on by a variety of larger fish, including larger juvenile white seabass (Margulies 1989). Sea lions and sharks have been observed preying on adult white seabass (Fitch and Lavenberg 1971 in CDFG 2002). The effects of removing white seabass from the food web are unknown. Since interspecific competition may exist between white seabass, yellowtail, California barracuda and bonito (*Sarda chiliensis*), it is possible that the niche left by white seabass would be quickly filled (CDFG 2002). It is unknown whether any ecosystem state changes can be attributed to the white seabass gillnet fisheries.

Synthesis

Drift gillnets and hook and line gear do not come into contact with the seafloor, and therefore have a negligible impact on physical habitats. Set gillnets can cause moderate physical habitat damage as they use weights to keep the bottom of the net close to the ocean floor, and the nets can snag biological or physical structures. White seabass occupy a variety of shallow water habitats including rocky substrates, which have low resilience to disturbance caused by fishing gear. The overall scale of this damage is deemed to be moderate due to the small scale of the commercial gillnet fishery and the variety of habitats that white seabass occupy, though data on the substrates where set gillnet fishing primarily occurs is not available. It is also unknown how the removal of white seabass impacts the food web or whether the fishery has caused any ecosystem state changes. Further, gear loss and the associated "ghost" fishing by lost set gillnets are potential concerns, although the extent of these phenomena is known. Because of the minimal physical and biogenic habitat damage caused by drift gillnets and hook and line, the white seabass drift gillnet and hook and line fisheries are considered benign according to Seafood Watch®. Set gillnets are deemed to be a moderate conservation concern by Seafood Watch® as they cause moderate physical and biogenic damage to habitats with low resilience.

Effect of Fishing Practices Rank:

Drift gillnet and Monterey Bay hook and line:

Benign Moderate Severe Critical

Set gillnet:

Benign **Moderate** Severe Critical

Criterion 5: Effectiveness of the Management Regime

The California white seabass fishery is managed by the Fish and Game Commission with management recommendations from CDFG. No formal stock assessments have been conducted for this species, but CDFG maintains such an assessment as a long-term goal (CDFG 2002). A fishery-independent juvenile stock assessment took place from 1995–2008 to determine the spatial and temporal patterns of abundance of juvenile white seabass from Santa Barbara to San

Diego (Allen *et al.* 2007; Allen 2008). In the 1980s and 1990s, concerns over declines in the white seabass stock prompted the California State Legislature to develop a White Seabass Fishery Management Plan (WSFMP). This WSFMP, drafted by scientists, consultants and shareholders was adopted by the Fish and Game Commission in 1996 and implemented in 1998 (CDFG 2002). This WSFMP was updated in 2002. Based on fishery-dependent data, CDFG concluded that the maximum sustainable yield (MSY) for the stock is 1.6 million pounds. An annual harvest quota (optimum yield) of 1.2 million pounds has been set based on 75% of the MSY (CDFG 2002). Management has a consistent record of enforcing the annual harvest quota (CDFG 2006a).

Each year CDFG is required to release an Annual Review of the WSFMP (CDFG 2002). The Annual Review provides a fishery-dependent stock assessment using data collected from September 1–August 31 of the previous year and recommends management changes based on six "points of concern and whether or not they are met." These points of concern are: (1) expectation of optimum yield (annual harvest quota) being exceeded, (2) changes in the biological characteristics of white seabass, (3) whether an overfishing condition exists or is imminent, (4) significant changes to the availability of a forage species upon which the white seabass depends, (5) new information on the status of white seabass, and (6) whether errors in data or stock assessments were found (CDFG 2004a, 2005, 2006a). To determine the third point of concern, the occurrence of overfishing, three additional criteria must be met. They are as follows: (1) a 20% decline in the total annual commercial landings of white seabass for the past two consecutive seasons compared to the prior five-season average (based on CFIS landing receipt data), (2) a 20% decline in both the number of fish and the average size of fish caught in the recreational fishery (data provided by the CPFV and the CRFS), and (3) a 30% decline in OREHP recruitment indices for juvenile white seabass compared to the prior five-season average (CDFG 2004a; 2005; 2006a). Dependence on fishery trends as a basis for determining stock health and method factors for setting annual quotas has a history of poor management outcomes (McEvoy 1986). Average catch data from a period when there is no evidence of a long-term decline in stock abundance is used in a number of California fisheries (*e.g.*, the California market squid) as a proxy for MSY. The problem with the proxy method of determining quotas is that it can be very hard to identify declines over a short period from fishery data, particularly for species that tend to fluctuate from year to year. If the stock is naturally depressed by biological factors and fishing occurs at a rate set based on several years of consistent harvests, the combination of pressures can reduce stocks substantially over a relatively short period. An official stock assessment can substantially reduce speculation about total stock size and help to better understand and manage annual fluctuations and biological factors.

As of the 2007–2008 Annual Review, there was a 52% decline in the juvenile recruitment index relative to the five-year average, thus fulfilling the third criterion for determining overfishing. However, CDFG and the White Seabass Scientific and Constituent Advisory Panel (WSSCAP) agreed that overall the overfishing criteria were not met, and therefore white seabass are not considered to be overfished or subject to overfishing (CDFG 2009c). An official stock assessment should be conducted to improve understanding of white seabass stock health and decrease speculation in management.

In addition to the WSFMP and the Annual Reviews, the Fish and Game Commission has enacted a series of regulations on the commercial and recreational fisheries in an attempt ensure the long-term stability of the stock. Gillnets are required to have a minimum mesh size of six inches.

White seabass less than 28 inches may not be taken commercially or recreationally. A commercial fishery closure takes place from March 15 to June 15, which coincides with the white seabass spawning period. During this period, a maximum of ten white seabass with a length of 28 inches or greater may be retained per load if taken incidentally to licensed gill or trammel net operations (FGC §8623). Fish with a length of 28 inches or greater may be taken from gill and trammel nets with meshes from 3.5–6 inches only if they account for no more than 20 percent of the total catch by number and are no more than 10 fish per load (CDFG 2009b). The practice of using purse seines and round haul nets in the white seabass commercial fishery has been outlawed since the early 1940s, and catch limits of 500 pounds per vessel and 1,000 pounds per person were eliminated in the early 1980s (CDFG 2002).

Other than the 2007 Marine Life Protection Act (MLPA) for California that created substantial marine protected areas for 204 square miles (18%) of central coast (includes Monterey Bay) waters (among other regions of California) there are no additional gear or catch restrictions for the Monterey Bay hook and line white seabass fishery (Tanaka, pers. com., 2010; CDFG 2010). In addition, there are no season, trip or landings limits set for the Monterey Bay hook and line fishery (Tanaka pers. com., 2010).

Both commercial gillnet fishers and commercial passenger fishing vessels are required to keep logbooks, but the Monterey Bay hook and line fishing vessels are not (CDFG 2002; Carretta *et al.* 2004; CDFG 2006a; Tanaka pers. com., 2010). In 2002, NMFS initiated a three-year observer program for the yellowtail, barracuda and white seabass drift gillnet fishery to document the occurrence of marine mammal mortality (Carretta *et al.* 2005). The program resulted in NMFS elevating the yellowtail, barracuda and white seabass gillnet fishery from a Category II to a Category I fishery due to estimated levels of mortality of long-beaked common dolphins (NMFS 2007). Currently, however, both the set and drift gillnet fisheries for white seabass are considered Category II fisheries under the Marine Mammal Protection Act (NMFS 2009c).

The state of California enacted regulations to protect collapsed nearshore fish stocks and to address concerns over the incidental bycatch of protected species with the passage of State Proposition 132 in 1990. This proposition prohibited gillnets, set nets and trammel nets within three nautical miles of shore (state waters) from Pt. Arguello to the U.S.-Mexico border as well as in waters shallower than 79 fathoms or within one nautical mile (whichever is less) of the Channel Islands. This ban went into effect in 1994 (Carretta *et al.* 2003). In September of 2000, CDFG issued emergency regulations banning gillnet fishing inshore of 60 fathoms from Pt. Reyes to Yankee Pt. (Monterey Bay) and from Pt. Arguello to Pt. Sal due to concerns over bycatch of the common murre (*Uria aalge*) and California sea otter (*Enhydra lutris*). A permanent ban was enacted from Point Reyes to Point Arguello in September of 2002 (CDFG 2002; Carretta *et al.* 2003; CDFG 2006b). Area closures have also been enacted at Point Año Nuevo State Reserve in northern California to protect elephant seal rookeries (CDFG 2002). These closures, however, appear to be working and stocks of several nearshore predatory fish, including white seabass, giant seabass, leopard shark and soupfin shark, all appear to be rebounding (Pondella and Allen 2008). When the gillnet ban was implemented in 1994, all of the aforementioned species had either collapsed or were in substantial decline. This ban has not negatively affected the commercial white seabass fishery, and it appears to be directly responsible for the apparent recovery of the species and the fishery (Pondella and Allen 2008). The effectiveness of these closures on levels of bycatch cannot be determined, however, as data on bycatch trends prior to these closures are lacking. All lost fishing nets must be reported no later than 72 hours after the boats return to port with the precise time, location, depth, and a description of the lost net including the mesh size, length, height, and target species and whether the anchors remain attached to the net, as well as the name and CDFG number of the vessel from which the lost net was being fished (FGC §8601.5).

Although some stock recovery has occurred under the WSFMP, management could be improved in several areas. Acoustic deterrent devices (pingers) are not required for white seabass fishery gillnets despite the accepted effectiveness of this technology in reducing marine mammal interactions. In recent years, warm temperatures and events like the 1997 ENSO have caused the white seabass stock to experience high recruitment and increased numbers. However, in the event of an unfavorable climate, significant declines in recruitment and subsequent stock levels could occur. In fact, the OREHP's October field survey for juvenile recruitment showed a 52% decrease in recruitment for the 2007–2008 season compared to the previous five-season average (CDFG 2009c). This variability highlights the continued importance of adaptive management strategies and annual data collection. Additionally, CDFG uses hatchery-raised juveniles to enhance the wild population (CDFG 2002, 2004a, 2005a, 2006a). Although this approach may be beneficial in the short-term, recent studies have shown that hatcheries may be problematic. The white seabass hatchery has experienced disease outbreaks such as nodavirus infection, a pathogen that attacks the central nervous systems of fish (Curtis et al. 2001), but such outbreaks are rare and a strict health management program is enforced. The OREHP has management practices in place to reduce the risk of releasing infected individuals: (1) no white seabass are released unless approved by the CDFG fish pathologist; (2) if a novel disease is found, it is investigated to determine whether the disease exists in the wild white seabass population; and (3) if the disease is not known to exist in the wild population, infected individuals are euthanized (Taylor, pers. comm., 2009). Despite these measures, the risk of infected individuals contacting wild populations remains. Hatcheries are nevertheless not considered a major concern in the white seabass fishery because, according to fisheries-independent data, only a small proportion of wild-caught fish were hatchery-raised (Allen pers. comm., 2009).

Table 4. Commercial harvest management measures for the white seabass fisheries.

Gear Type	Management Jurisdictions & Agencies	Total Allowable Landings	Size Limit	Gear Restrictions	Trip Limit	Area Closures	Sources
Drift and Set Gillnet	CDFG; NMFS (onboard observer coverage only)	Annual Harvest Quota established at 1.2 million	28 inches in length	Purse seines and round haul nets restricted. Gillnets have a minimum mesh size of six inches	No trip limit	Gillnets restricted inshore of three nautical miles from Pt. Arguello to the U.S.-Mexico border, shallower than 60 fathoms from Pt. Arguello to Pt. Reyes, and within one nautical mile or 70 fathoms inshore of the Channel Islands (whichever is less)	CDFG 2002, 2006b, 2009d; Carretta 2002, 2003
Monterey Bay hook and line	CDFG; No observer coverage; opportunistic catch sampling by CDFG	No set limits	28 inches in length	No gear restrictions for hook and line	No trip limits; no logbook reports required	Marine Life Protection Act closures	Tanaka pers. com. 2010

Synthesis

Although there is no current formal white seabass stock assessment completed, there are plans to conduct such an assessment in the future. The California Department of Fish and Game monitors the health of the white seabass stock using fishery-dependent data and a set of criteria to determine the status of the stock and whether management changes are needed. Management has set quotas below the determined MSY and has a good record of adhering to scientific advice. Sufficient enforcement is in place to ensure that quotas are not exceeded and to enforce area closures, and landings data show that the fishery has not exceeded quotas. Concerns over the incidental bycatch of protected species have been addressed by enacting sizeable area closures, and several species of concern have since rebounded. Nevertheless, the effectiveness of these closures on levels of bycatch cannot be definitively determined as data on bycatch trends prior to the closures are too few. Bycatch of protected species continues to be a concern with both the set and drift-gillnet fisheries. Commercial gillnet vessels and commercial passenger fishing vessels are required to keep logbooks; however, there is no observer program in place to monitor levels of bycatch of other species such as sharks and finfish. Because the Monterey Bay fishery is small and opportunistic when white seabass are abundant in the Bay, the hook and line fishery is not required to keep logbooks, and has no observer coverage or set season, trip or landings limits, but the CDFG does do opportunistic sampling of catch. In recent years, white seabass stocks have recovered from historic declines, exhibiting a net increase over the past 20 years. At this point it is unclear if this recovery is the result of effective management or favorable short-term climatic conditions. Given all of the information available, Seafood Watch® deems management of the U.S. white seabass fishery to be highly effective.

Effectiveness of Management Rank:

Highly Effective	**Moderately Effective**	Ineffective	Critical

IV. Overall Evaluation and Seafood Recommendation

White seabass have characteristics that make them inherently resilient to fishing pressure, particularly their early age at first maturity and high fecundity. Although the stock is classified as not overfished and not subject to overfishing, biomass and fishing mortality are unknown, resulting in a stock status that is of moderate conservation concern. Incidental bycatch associated with the white seabass fisheries is mostly unknown. Bycatch rates and trends are mostly unknown but the set and drift gillnet fisheries do have documented mortality of protected species, such as Pacific white sharks, long-beaked bottlenose dolphins, California sea lions, and cormorants. There is no evidence that bycatch of long-beaked bottlenose dolphins, California sea lions, and cormorants is contributing to their decline or limiting recovery. However, it is unknown whether the bycatch of Pacific white sharks is contributing to its decline or limiting its recovery. Therefore, bycatch in the white seabass set and drift gillnet fisheries is a high conservation concern according to Seafood Watch®. Bycatch in the Monterey Bay hook and line fishery is thought to be low, because hook and line fisheries have been shown to have negligible bycatch rates; therefore, it is a low conservation concern according to Seafood Watch®. Drift gillnets and hook and line gear do not contact the seafloor and have low habitat and ecosystem impacts. Set gillnets have moderate habitat and ecosystem effects because they can damage rocky substrate habitats and marine organisms on the seafloor. Management consistently follows scientific advice, enforces regulations and has maintained stock productivity. Although only fishery-dependent assessments have been conducted, and further regulations could be implemented to increase the use of acoustic deterrent devices to reduce marine mammal interactions, management is deemed to be highly effective. Overall, the U.S. drift and set gillnet white seabass fisheries receive a recommendation of **Good Alternative** due to moderate stock status, effective management, and high bycatch concerns. The Monterey Bay hook and line fishery receives a recommendation of **Best Choice** due to moderate stock status, effective management, low bycatch, and low overall ecosystem impacts.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherent Vulnerability	√			
Status of Stocks		√		
Nature of Bycatch	√ **(Monterey Bay hook and line)**		√ **Set and drift gillnets**	
Habitat & Ecosystem Effects	√ **(Drift gillnet; Monterey Bay hook and line)**	√ **(Set gillnet)**		
Management Effectiveness	√			

Overall Seafood Recommendation:

U.S. (drift gillnet, set gillnet):

Best Choice | **Good Alternative** | Avoid

Monterey Bay Hook and Line

Best Choice | Good Alternative | **Avoid**

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Seafood Watch thanks Valerie Taylor and Kirk Lynn of the California Department of Fish and Game, and Larry Allen of California State University, Northridge, for graciously reviewing this report for scientific accuracy.

Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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VI. Appendices

Appendix I. Wild-capture fisheries evaluation

MONTEREY BAY AQUARIUM Seafood WATCH

Capture Fisheries Evaluation

Species: *White Seabass*	**Region:** *California*
Analyst: *Melissa Stevens, Jesse Bausell, Ben Botkin, Wendy Norden*	**Date:** *January 2011*

Seafood Watch™ defines sustainable seafood as originating from sources, whether fished[2] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

The following **guiding principles** illustrate the qualities that capture fisheries must possess to be considered sustainable by the Seafood Watch program. Species from sustainable capture fisheries:

- have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics;
- have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity;
- are captured using techniques that minimize the catch of unwanted and/or unmarketable species;
- are captured in ways that maintain natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and do not result in irreversible ecosystem state changes; and
- have a management regime that implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

Seafood Watch has developed a set of five sustainability **criteria,** corresponding to these guiding principles, to evaluate capture fisheries for the purpose of developing a seafood recommendation for consumers and businesses. These criteria are:

1. Inherent vulnerability to fishing pressure
2. Status of wild stocks
3. Nature and extent of discarded bycatch
4. Effect of fishing practices on habitats and ecosystems
5. Effectiveness of the management regime

Each criterion includes:

- Primary factors to evaluate and rank
- Secondary factors to evaluate and rank
- Evaluation guidelines[3] to synthesize these factors
- A resulting **rank** for that criterion

[2] "Fish" is used throughout this document to refer to finfish, shellfish and other wild-caught invertebrates.
[3] Evaluation Guidelines throughout this document reflect common combinations of primary and secondary factors that result in a given level of conservation concern. Not all possible combinations are shown – other combinations should be matched as closely as possible to the existing guidelines.

Once a rank has been assigned to each criterion, an **overall seafood recommendation** for the species in question is developed based on additional evaluation guidelines. The ranks for each criterion, and the resulting overall seafood recommendation, are summarized in a table. Criterion ranks and the overall seafood recommendation are color-coded to correspond to the categories of the Seafood Watch pocket guide:

Best Choices/Green: Consumers are strongly encouraged to purchase seafood in this category. The wild-caught species is sustainable as defined by Seafood Watch.

Good Alternatives/Yellow: Consumers are encouraged to purchase seafood in this category, as they are better choices than seafood in the Avoid category. However there are some concerns with how this species is fished and thus it does not demonstrate all of the qualities of a sustainable fishery as defined by Seafood Watch.

Avoid/Red: Consumers are encouraged to avoid seafood in this category, at least for now. Species in this category do not demonstrate enough qualities to be defined as sustainable by Seafood Watch.

CRITERION 1: INHERENT VULNERABILITY TO FISHING PRESSURE

Guiding Principle: Sustainable wild-caught species have a low vulnerability to fishing pressure, and hence a low probability of being overfished, because of their inherent life history characteristics.

Primary Factors[4] to evaluate

Intrinsic rate of increase ('r')

- High (> 0.16)
- Medium (0.05 - 0.16)
- Low (< 0.05)
- Unavailable/Unknown

Age at 1st maturity

- Low (< 5 years) **4 years- female, 3 years- male**
- Medium (5 - 10 years)
- High (> 10 years)
- Unavailable/Unknown

Von Bertalanffy growth coefficient ('k')

- High (> 0.16)
- Medium (0.05 - 0.15) **k=0.1280**
- Low (< 0.05)
- Unavailable/Unknown

Maximum age

- Low (< 11 years)
- Medium (11 - 30 years) **27 years**
- High (> 30 years)
- Unavailable/Unknown

[4] These primary factors and evaluation guidelines follow the recommendations of Musick et al. (2000). Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). Fisheries 25:6-30.

Reproductive potential (fecundity)

- High (> 100 inds./year) **760,000-1.5 eggs/clutch**
- Moderate (10 – 100 inds./year)
- Low (< 10 inds./year)
- Unavailable/Unknown

Secondary Factors to evaluate

Species range

- Broad (e.g. species exists in multiple ocean basins, has multiple intermixing stocks or is highly migratory)
- Limited (e.g. species exists in one ocean basin)
- Narrow (e.g. endemism or numerous evolutionary significant units or restricted to one coastline) **West Coast of North America from Juneau, AK-Baja, CA**

Special Behaviors or Requirements: Existence of special behaviors that increase ease or population consequences of capture (e.g. migratory bottlenecks, spawning aggregations, site fidelity, unusual attraction to gear, sequential hermaphrodites, segregation by sex, etc., OR specific and limited habitat requirements within the species' range).

- No known behaviors or requirements OR behaviors that decrease vulnerability (e.g. widely dispersed during spawning)
- Some (i.e. 1 - 2) behaviors or requirements **Adults aggregate during spawning**
- Many (i.e. > 2) behaviors or requirements

Quality of Habitat: Degradation from non-fishery impacts

- Habitat is robust
- Habitat has been moderately altered by non-fishery impacts **Habitat is moderately impacted, but resilient**
- Habitat has been substantially compromised from non-fishery impacts and thus has reduced capacity to support this species (e.g. from dams, pollution, or coastal development)

Evaluation Guidelines

1) Primary Factors
   a) If 'r' is known, use it as the basis for the rank of the Primary Factors.
   b) If 'r' is unknown, then the rank from the remaining Primary Factors (in order of importance, as listed) is the basis for the rank.

2) Secondary Factors
   a) If a majority (2 out of 3) of the Secondary Factors rank as Red, reclassify the species into the next lower rank (i.e. Green becomes Yellow, Yellow becomes Red). No other combination of Secondary Factors can modify the rank from the Primary Factors.
   b) No combination of primary and secondary factors can result in a Critical Conservation Concern for this criterion.

Conservation Concern: Inherent Vulnerability

- Low (Inherently Resilient)
- Moderate (Moderately Vulnerable)
- High (Highly Vulnerable)

CRITERION 2: STATUS OF WILD STOCKS

Guiding Principle: Sustainable wild-caught species have stock structure and abundance sufficient to maintain or enhance long-term fishery productivity.

Primary Factors to evaluate

Management classification status

- Underutilized OR close to virgin biomass **"healthy" according to CDF&G**
- Fully fished OR recovering from overfished OR unknown
- Recruitment or growth overfished, overexploited, depleted or "threatened"

Current population abundance relative to B_{MSY}

- At or above B_{MSY} (> 100%)
- Moderately Below B_{MSY} (50 – 100%) OR **unknown**
- Substantially below B_{MSY} (< 50%)

Occurrence of overfishing (current level of fishing mortality relative to overfishing threshold)

- Overfishing not occurring ($F_{curr}/F_{msy} < 1.0$) **(1/3 overfishing criteria have been met; management classifies as not subject to overfishing)**
- Overfishing is likely/probable OR fishing effort is increasing with poor understanding of stock status OR Unknown
- Overfishing occurring ($F_{curr}/F_{msy} > 1.0$)

Overall degree of uncertainty in status of stock

- Low (i.e. current stock assessment and other fishery-independent data are robust OR reliable long-term fishery-dependent data available)
- Medium (i.e. **limited, fishery-dependent data and one fishery independent assessment on stock status are available**)
- High (i.e. little or no current fishery-dependent or independent information on stock status OR models/estimates broadly disputed or otherwise out-of-date)

Long-term trend (relative to species' generation time) in population abundance as measured by either fishery-independent (stock assessment) or **fishery-dependent (standardized CPUE)** measures

- Trend is up
- Trend is flat or **variable** (among areas, over time or among methods) OR Unknown

Overall decrease in CPUE from 1960-1997, net increase in CPUE from 1982-present

Trend is unknown for Monterey Bay

- Trend is down

Short-term trend in population abundance as measured by either fishery-independent (stock assessment) or fishery-dependent (standardized CPUE) measures

- Trend is up

Net increase in commercial CPUE from 1982-present and net CPUE increase in fishery-independent assessment 1995-2005.

- Trend is flat or variable (among areas, over time or among methods) OR Unknown
- Trend is down

Current age, size or sex distribution of the stock relative to natural condition

- ➤ Distribution(s) is(are) functionally normal

Functionally normal distributions observed in fishery independent assessment 1995-2005.

- ➤ Distribution(s) unknown
- ➤ Distribution(s) is(are) skewed

Evaluation Guidelines

A "Healthy" Stock:

1) Is underutilized (near virgin biomass)
2) Has a biomass at or above BMSY AND overfishing is not occurring AND distribution parameters are functionally normal AND stock uncertainty is not high

A "Moderate" Stock:

1) Has a biomass at 50-100% of BMSY AND overfishing is not occurring
2) Is recovering from overfishing AND short-term trend in abundance is up AND overfishing not occurring AND stock uncertainty is low
3) **Has an Unknown status because the majority of primary factors are unknown.**

A "Poor" Stock:

1) Is fully fished AND trend in abundance is down AND distribution parameters are skewed
2) Is overfished, overexploited or depleted AND trends in abundance and CPUE are up.
3) Overfishing is occurring AND stock is not currently overfished.

A stock is considered a **Critical Conservation Concern** and the species is ranked "Avoid", regardless of other criteria, if it is:

1) Overfished, overexploited or depleted AND trend in abundance is flat or down
2) Overfished AND overfishing is occurring
3) Listed as a "threatened species" or similar proxy by national or international bodies

Conservation Concern: Status of Stocks

- ➤ Low (Stock Healthy)
- ➤ Moderate (Stock Moderate or Unknown)
- ➤ High (Stock Poor)
- ➤ Stock Critical

CRITERION 3: NATURE AND EXTENT OF DISCARDED BYCATCH[5]

Guiding Principle: A sustainable wild-caught species is captured using techniques that minimize the catch of unwanted and/or unmarketable species.

Primary Factors to evaluate

Quantity of bycatch, including any species of "special concern" (i.e. those identified as "endangered", "threatened" or "protected" under state, federal or international law)

- Quantity of bycatch is low (< 10% of targeted landings on a per number basis) AND does not regularly include species of special concern **Monterey Bay hook and line**
- Quantity of bycatch is moderate (10-100% of targeted landings on a per number basis) AND does not regularly include species of special concern OR Unknown
- Quantity of bycatch is high (> 100% of targeted landings on a per number basis) OR **bycatch regularly includes threatened, endangered or protected species gillnet**

Population consequences of bycatch

- Low: **Evidence indicates quantity of bycatch has little or no impact on population levels Monterey Bay hook and line**
- Moderate: Conflicting evidence of population consequences of bycatch OR **Unknown Impacts on white shark populations are unknown**
- Severe: Evidence indicates quantity of bycatch is a contributing factor in driving one or more bycatch species toward extinction OR is a contributing factor in limiting the recovery of a species of "special concern"

Trend in bycatch interaction rates (adjusting for changes in abundance of bycatch species) as a result of management measures (including fishing seasons, protected areas and gear innovations):

- Trend in bycatch interaction rates is down
- Trend in bycatch interaction rates is flat OR **Unknown (trends in marine mammal bycatch are down but overall bycatch trends are unknown)**
- Trend in bycatch interaction rates is up
- Not applicable because quantity of bycatch is low **Monterey Bay Hook and Line**

[5] Bycatch is defined as species that are caught but subsequently discarded because they are of undesirable size, sex or species composition. Unobserved fishing mortality associated with fishing gear (e.g. animals passing through nets, breaking free of hooks or lines, ghost fishing, illegal harvest and under or misreporting) is also considered bycatch. Bycatch does not include incidental catch (non-targeted catch) if it is utilized, is accounted for, and is managed in some way.

Secondary Factor to evaluate

Evidence that the ecosystem has been or likely will be substantially altered (relative to natural variability) in response to the continued discard of the bycatch species

- Studies show no evidence of ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **Unknown**
- Studies show evidence of substantial ecosystem impacts

Evaluation Guidelines

Bycatch is "**Minimal**" if:

1) **Quantity of bycatch is <10% of targeted landings AND bycatch has little or no impact on population levels.**

Bycatch is "**Moderate**" if:

1) Quantity of bycatch is 10 - 100% of targeted landings
2) Bycatch regularly includes species of "special concern" AND bycatch has little or no impact on the bycatch population levels AND the trend in bycatch interaction rates is not up.

Bycatch is "Severe" if:

1) Quantity of bycatch is > 100% of targeted landings
2) **Bycatch regularly includes species of "special concern" AND evidence indicates bycatch rate is a contributing factor toward extinction or limiting recovery AND trend in bycatch is down.**

Bycatch is considered a **Critical Conservation Concern** and the species is ranked "Avoid", regardless of other criteria, if:

1) Bycatch regularly includes species of special concern AND evidence indicates bycatch rate is a factor contributing to extinction or limiting recovery AND trend in bycatch interaction rates is not down.
2) Quantity of bycatch is high AND studies show evidence of substantial ecosystem impacts.

Conservation Concern: Nature and Extent of Discarded Bycatch

- Low (Bycatch Minimal) **Monterey Bay hook and line**
- Moderate (Bycatch Moderate)
- High (Bycatch Severe) **Set and drift gillnet**
- Bycatch Critical

CRITERION 4: EFFECT OF FISHING PRACTICES ON HABITATS AND ECOSYSTEMS

Guiding Principle: Capture of a sustainable wild-caught species maintains natural functional relationships among species in the ecosystem, conserves the diversity and productivity of the surrounding ecosystem, and does not result in irreversible ecosystem state changes.

Primary Habitat Factors to evaluate

Known (or inferred from other studies) effect of fishing gear on physical and biogenic habitats

- Minimal damage: (i.e., pelagic longline, midwater gillnet, midwater trawl, purse seine, hook and line, or spear/harpoon) **drift gillnets and hook and line**
- Moderate damage: (i.e, bottom gillnet, bottom longline, or some pots/traps) **set gillnets**
- Great damage (i.e. bottom trawl or dredge)

For specific fishery being evaluated, resilience of physical and biogenic habitats to disturbance by fishing method

- High (shallow water, sandy habitats)
- Moderate (e.g. shallow or deep water mud bottoms, or deep water sandy habitats)
- Low (rocky bottoms) **set gillnets**
- Not applicable because gear damage is minimal **drift gillnets and hook and line**

If gear impacts are moderate or great, spatial scale of the impact

- Small scale (e.g. small, artisanal fishery or sensitive habitats are strongly protected)
- Moderate scale (e.g. modern fishery but of limited geographic scope) **set gillnets**
- Large scale (e.g. industrialized fishery over large geographic areas)
- Not applicable because gear damage is minimal **drift gillnets and hook and line**

Primary Ecosystem Factors to evaluate

Evidence that the removal of the targeted species or the removal/deployment of baitfish has or will likely substantially disrupt the food web

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **Unknown**
- Ecosystem impacts of targeted species removal demonstrated

Evidence that the fishing method has caused or is likely to cause substantial ecosystem state changes, including alternate stable states

- The fishery and its ecosystem have been thoroughly studied, and studies show no evidence of substantial ecosystem impacts
- Conflicting evidence of ecosystem impacts OR **Unknown**
- Ecosystem impacts from fishing method demonstrated

Evaluation Guidelines

The effect of fishing practices is **"Benign"** if:

1) Damage from gear is minimal AND resilience to disturbance is high AND neither Ecosystem Factor is red.

The effect of fishing practices is **"Moderate"** if:

1) Gear effects are moderate AND resilience to disturbance is moderate or high AND neither Ecosystem Factor is red.
2) Gear results in great damage AND resilience to disturbance is high OR impacts are small scale AND neither Ecosystem Factor is red.
3) Damage from gear is minimal and one Ecosystem factor is red.

The effect of fishing practices **is "Severe"** if:

1) Gear results in great damage AND the resilience of physical and biogenic habitats to disturbance is moderate or low.
2) Both Ecosystem Factors are red.

Habitat effects are considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid"**, regardless of other criteria if:

- Four or more of the Habitat and Ecosystem factors rank red.

Conservation Concern: Effect of Fishing Practices on Habitats and Ecosystems

- Low (Fishing Effects Benign) **Drift Gillnets and hook and line**
- Moderate (Fishing Effects Moderate) **Set Gillnets**
- High (Fishing Effects Severe)
- Critical Fishing Effects

CRITERION 5: EFFECTIVENESS OF THE MANAGEMENT REGIME

Guiding Principle: The management regime of a sustainable wild-caught species implements and enforces all local, national and international laws and utilizes a precautionary approach to ensure the long-term productivity of the resource and integrity of the ecosystem.

Primary Factors to evaluate

Stock Status: Management process utilizes an independent scientific stock assessment that seeks knowledge related to the status of the stock

- Stock assessment complete and robust
- Stock assessment is planned or underway but is incomplete OR stock assessment complete but out-of-date or otherwise uncertain
- No stock assessment available now and none is planned in the near future

Scientific Monitoring: Management process involves regular collection and analysis of data with respect to the short and long-term abundance of the stock

- Regular collection and assessment of both fishery-dependent and independent data
- Regular collection of fishery-dependent data only
- No regular collection or analysis of data

Scientific Advice: Management has a well-known track record of consistently setting or exceeding catch quotas beyond those recommended by its scientific advisors and other external scientists:

- No
- Yes
- Not enough information available to evaluate OR not applicable because little or no scientific information is collected

Bycatch: Management implements an effective bycatch reduction plan

- Bycatch plan in place and reaching its conservation goals (deemed effective)
- Bycatch plan in place but effectiveness is not yet demonstrated or is under debate **(Gillnet fishery)**
- No bycatch plan implemented or bycatch plan implemented but not meeting its conservation goals (deemed ineffective)
- Not applicable because bycatch is "low"

  Bycatch is thought to be low in the Monterey Bay hook and line fishery

Fishing practices: Management addresses the effect of the fishing method(s) on habitats and ecosystems

- Mitigative measures in place and deemed effective
- Mitigative measures in place but effectiveness is not yet demonstrated or is under debate
- No mitigative measures in place or measures in place but deemed ineffective
- Not applicable because fishing method is moderate or benign

Enforcement: Management and appropriate government bodies enforce fishery regulations

- Regulations regularly enforced by independent bodies, including logbook reports, observer coverage, dockside monitoring and similar measures
- Regulations enforced by fishing industry or by voluntary/honor system
- Regulations not regularly and consistently enforced

Management Track Record: Conservation measures enacted by management have resulted in the long-term maintenance of stock abundance and ecosystem integrity

- Management has maintained stock productivity over time OR has fully recovered the stock from an overfished condition
- Stock productivity has varied and management has responded quickly OR stock has not varied but management has not been in place long enough to evaluate its effectiveness OR Unknown
- Measures have not maintained stock productivity OR were implemented only after significant declines and stock has not yet fully recovered

Evaluation Guidelines

Management is deemed to be "**Highly Effective**" if the majority of management factors are green AND the remaining factors are not red.

Management is deemed to be "**Moderately Effective**" if:

1) Management factors "average" to yellow
2) Management factors include one or two red factors

Management is deemed to be "**Ineffective**" if three individual management factors are red, including especially those for Stock Status and Bycatch.

Management is considered a **Critical Conservation Concern** and a species receives a recommendation of "**Avoid**", regardless of other criteria if:

1) There is no management in place
2) The majority of the management factors rank red.

Conservation Concern: Effectiveness of Management

- Low (Management Highly Effective)
- Moderate (Management Moderately Effective)
- High (Management Ineffective)
- Critical (Management Critically Ineffective)

Overall Seafood Recommendation

Overall Guiding Principle: Sustainable wild-caught seafood originates from sources that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Evaluation Guidelines

A species receives a recommendation of "**Best Choice**" if:

1) It has three or more green criteria and the remaining criteria are not red.

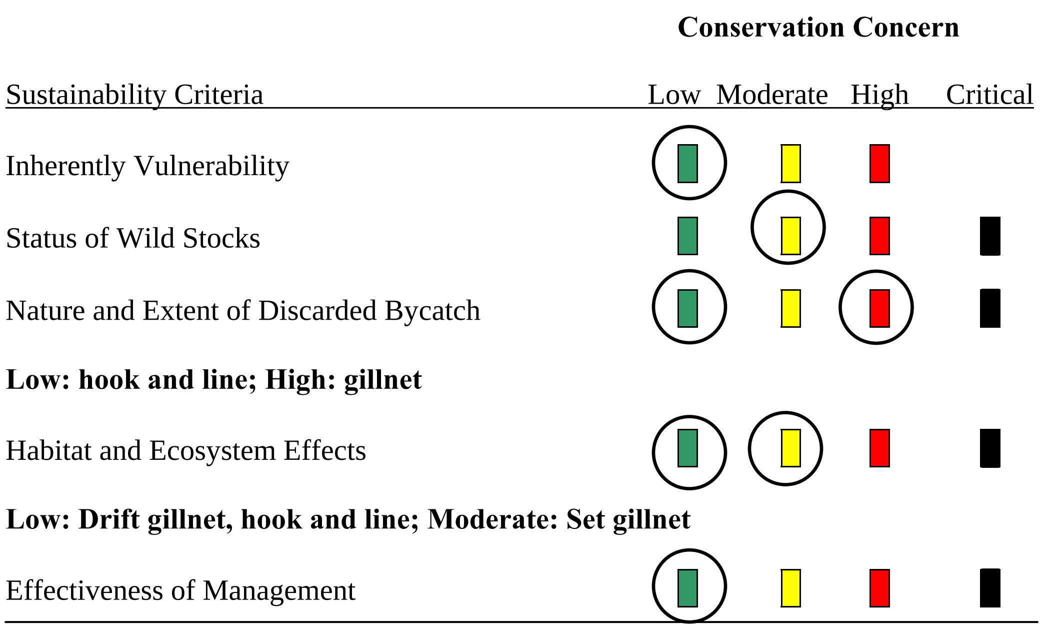
A species receives a recommendation of "**Good Alternative**" if:

1) Criteria "average" to yellow
2) There are four green criteria and one red criteria
3) Stock Status and Management criteria are both ranked yellow and remaining criteria are not red.

A species receives a recommendation of "**Avoid**" if:

1) It has a total of two or more red criteria
2) It has one or more Critical Conservation Concerns.

Summary of Criteria Ranks



Overall Seafood Recommendation

Best Choice (Monterey Bay hook and line)

Good Alternative (Gillnet)

Avoid