Appendix 6

# MARINE PROTECTED AREAS AND POTENTIAL BENEFITS TO SELECTED SPECIES

A Response to the California Fish and Game Commission

Prepared by the California Department of Fish & Game
Marine Region
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Introduction

In a letter to the Department (dated January 1, 2002, attached), Commission President Mike Chrisman requested that the Department provide information on selected species and the projected benefits for each of those species that would result from their inclusion in Marine Protected Areas (MPAs). For the species listed below, the Department was asked to evaluate and describe a) the status of the population and, if known, the Department's best professional opinion as to whether the population is stable, increasing, or decreasing, and why it may require additional protections; b) the traditional fishery management measure enacted at the state and federal levels that have been implemented for the species, including all size and possession limits, quotas, optimum yields, trip limits, seasonal closures, gear restrictions, effort reductions or permit limitations, for both commercial and recreational fisheries, and why these measures are inadequate; and c) exactly what other benefits MPAs are expected to afford the species. Examples of MPAs in the state that have demonstrated effects (such as a larger population inside than outside the reserve) were also requested.

This information was requested for the following species:

1. Kelp and sand bass
2. Abalone
3. Black seabass
4. White seabass
5. Shelf rockfish
6. Nearshore rockfish
7. Sheephead, cabezon, greenling (kelp and rock)
8. Garibaldi
9. Sea urchins
10. Lobster
11. Corbina/surfperches
12. Crabs
13. Halibut
14. Ocean whitefish
15. Kelp

This report provides information in response to this request from the Commission. Where possible, the Department used information contained in the recently published "California's Living Marine Resources: A Status Report" (Leet et al. 2001), since this publication represents current information available on these species, including status, fishery related information, and in some cases, suitability for inclusion in marine reserves. Additional details requested by the Commission were added for each species as necessary and available. In addition to this report, the Environmental Document for the Channel Islands Marine Reserves process also details information about these and other species relative to their population status, fishery information, and benefits and costs associated with the establishment of marine protected areas, primarily marine reserves, in that area.

General Background on Marine Protected Areas

There is increasing evidence of a wide range of benefits associated within Marine Protected Areas (MPAs) including increased numbers of species (biodiversity), increased fish sizes, higher reproductive potential, and protection of stocks from sequential depletion. Although most studies show that the benefits occur primarily within the boundaries of the MPAs, several studies have demonstrated benefits to adjacent fished areas. While much of this evidence comes from tropical systems, many studies of reserves in temperate systems, similar to those in California, are available. The most compelling example of the benefits of a large no-take reserve comes from the closures on the Georges Bank and vicinity (Murawski et al. 2000). A closure designed to protect between 17 percent and 29 percent of the area occupied by cod, haddock, and yellowtail flounder was established following stock declines. The latest stock assessments indicate significant increases in spawning stock biomass, attributed to increased adult survival. The closed areas also protect young cod and haddock, as well as unfished species. An unexpected benefit was an increase in scallop abundance both within and nearby the closed areas, with associated increases in catch.

In a West Coast example, reproductive potential of copper rockfish was 55 times greater in a 27-year-old reserve in the Puget Sound than in nearby fished areas. This enhanced reproductive potential was attributed to greater densities and larger sizes of rockfish inside the reserve (Palsson 1998). Similar increases in size and density were seen in a very small reserve in the San Juan Islands compared to adjacent unprotected areas (Palsson and Pacunski 1995). In California, reproductive potential for black-and-yellow rockfish inside two small reserves in Monterey Bay was 2 times greater in one reserve and 10 times greater in the second, as compared to fished areas immediately outside the reserves (Paddack 1996). Even a relatively new reserve (the Big Creek State Marine Reserve, established in 1994) appears to have significantly greater size distributions of several economically important rockfishes (M. Yoklavich, R. Lea, and G. Cailliet, unpublished data).

Similar benefits are reported for species associated with natural refugia (areas that are protected by the nature of the environment, such as depth or inaccessibility) and other unintentional protected areas. Abalone populations are greater in water depths beyond the range of free divers in northern California (Tegner et al. 1992). Regulations prohibiting the use of SCUBA to take abalone in this area form a de-facto deep water reserve. High numbers of large rockfishes are locally associated with isolated rock outcrops in deep water submarine canyons that are less accessible to fishing (Yoklavich et al. 2000). Density, diversity, and size of economically valuable fishes have increased within two unfished areas near the Kennedy Space Center at Cape Canaveral, Florida compared to nearby fished areas, and tagging studies have demonstrated movement of fishes from the protected areas into fished areas (Bohnsack 1998; Johnson et al. 1999). In this same area, the number of recreational fishing records is significantly higher in the areas adjacent to the protected area than in the rest of Florida (Roberts et al. 2001).

MPAs may also provide benefits beyond their boundaries, such as exporting of larvae and "spillover" of adults to fishing areas, though there is less empirical evidence that shows this. The lack of evidence, however, is primarily due to the lack of research on this effect and the lack of appropriate MPAs that would be expected to show this effect. The example of increased numbers of record-size fish in areas adjacent to a protected area is one piece of evidence. Another example is shown in St. Lucia, a coral reef system, where nearly 35 percent of the fishing grounds were closed to all take in 1995. Within five years of creation, this network of five small reserves increased adjacent catches of artisanal fishermen by between 46 percent and 90 percent, depending on the type of gear used (Roberts et al. 2001).

A major benefit afforded to fisheries management through the use of MPAs is insurance against uncertainty. Many State managed populations are considered to be in what are called "data poor situations", with little information available on population size, population status, life history, and the magnitude of fishing mortality. This lack of information on basic life history and population status could lead to incorrect assumptions when making management decisions. Establishing MPAs that protect a portion of these populations could offer a buffer against uncertainties due to natural environmental fluctuations or the limited availability of biological information. MPAs are also useful areas to perform studies on basic life history or organisms and as comparison sites to determine the difference between natural and human-caused effects on marine populations.

The insurance provided by protecting a portion of populations within MPAs could help sustain local marine populations and provide a reproductive source to assist with rebuilding depleted stocks. By reducing mortality rates within MPAs, the average density, size, and age of previously fished species may increase. For many species, larger organisms are known to produce significantly more young, because the number of eggs the number of eggs produced by an individual increases dramatically with size. Populations with relatively sedentary adults will be more likely to benefit from MPA protection. Production outside an MPA will be due primarily or in larger part to larval export. In contrast, the density, size, age, and fecundity of relatively mobile species within an MPA will likely increase less compared with a sedentary species because of their movement in and outside MPA boundaries.

Environmental fluctuations play a large role in affecting the reproductive success of many marine species. These natural fluctuations affect the ability of a stock to sustain exploitation. A network of MPAs could provide a buffer against sporadic reproductive success of many species due to environmental fluctuations. The protected portion of stocks might help sustain populations in years of poor reproductive success.

The following table summarizes potential expected benefits to populations that could be gained from a network of MPAs , based on the life history parameters of the species listed below (e.g. growth rates, reproductive strategies, life span, home range, etc.). To gain the fullest range of potential expected benefits, the network of MPAs

would need to encompass a representative portion of a species habitat as well as a significant portion of a species lifecycle within individual MPA boundaries.

Table 1. Potential benefits of MPAs for a variety of species.

| Potential Benefits | Habitat / Ecosystem Protection[1] | Insurance against Uncertainty[2] | Fisheries Benefits[3] | Protection when Aggregated[4] | Assist with Recovery[5] |
|---|---|---|---|---|---|
| Kelp bass | X | | | | |
| Barred sand bass | X | | | X | |
| Abalone | X | X | X | X | X |
| Giant sea bass | X | X | | X | X |
| White seabass | X | | | X | |
| Nearshore rockfishes | X | X | X | X | X |
| Shelf rockfishes | X | X | X | X | X |
| Sheephead | X | X | | | |
| Cabezon and greenlings | X | X | X | X | |
| Garibaldi | X | | | | |
| Sea urchins | X | X | | X | |
| Lobster | X | | | | |
| California corbina | X | | | | |
| Surfperches | X | X | X | X | |
| Crabs | X | | X | | |
| California halibut | X | | | X | |
| Ocean whitefish | X | | | | |
| Kelp | X | | | | |

[1] Critical habitats are protected in MPAs. These habitats may play an important role in various life history stages, from settling to adult. By protecting habitat, ecological interactions with other species are allowed (ecosystem protection). Might be more important for a sedentary species or for a particular life stage of an individual species.

[2] MPAs may protect a portion of residential stocks from accidental overfishing and uncertainty inherent in fisheries management, especially in fisheries that are data poor. By protecting a portion of a stock from any take, at least that portion may be sustained over time. This would provide for long term availability of adults, protecting against sporadic reproductive success (common among many marine organisms) as well as insurance for uncertain population estimates. Transient stocks could also gain intermittent protection throughout State waters via a network. Garibaldi are currently protected from all take; they are very residential and appear to fully occupy their expected range. MPAs likely would not offer much protection for lobster populations since adults in California apparently are not the source of much spawning success here.

[3] Fisheries benefits outside MPAs may occur through larval export or adult migration. Based on knowledge of life history, it is expected that some species will migrate out of

MPAs (spillover) or be actively transported out as larvae. Either of these occurrences could benefit populations and therefore fisheries outside MPA boundaries.

[4] MPAs may protect spawning, nursery, and aggregation areas. Protection during these critical periods provides significant benefit through increased success in recruitment and spawning. This protection includes times when individuals are guarding nests.

[5] MPAs may aide in the recovery of over-exploited populations. Certain species require minimum densities in order to successfully reproduce. These densities are more likely to be reached in MPAs than in areas where some limited take or even bycatch occurs. In addition, increases in reproductive success described above could help support recovery.

## Kelp (Calico) Bass (*Paralabrax clathratus*)

Status of the Population:

Kelp bass are taken only by sport anglers. Since the 1960's, the catch has fluctuated greatly. In the 1970s and 1980s, the kelp bass was among the top three species taken by the average angler per hour of fishing (along with barred sand bass and Pacific mackerel) (Oliphant et al. 1990). In 1986 and 1989, kelp bass were the most commonly taken species in the Commercial Passenger Fishing Vessel (CPFV) fleet. Throughout the 1980s, kelp bass have consistently ranked among the top five fishes caught by CPFV anglers (Oliphant et al. 1990). Department surveys indicate the estimated total catches of kelp bass have increased since the mid-1970s. Low periods of kelp bass landings in the mid-1970s and early-1980s may be attributed to El Niño events that provide anglers with alternative species to catch. Peak landings have followed each El Niño event. Department surveys of the CPFV industry in the 1970s and 1980s indicated a stable spawning population was being maintained because of the large number of age classes that are caught and kept by anglers (Ally et al. 1991). The recent Federal Marine Recreational Fishery Statistics Survey estimated that since 1990 the catch from shore, pier, and private boat anglers averages about 900,000 kelp bass per year which exceeds that of CPFV fishermen (about 800,000 fish per year). The CPFV landings of kelp bass fluctuated, with a general declining trend from 1993 to 1999. In 2000 and 2001 landings rebounded to previous levels. While this is not a direct measure of abundance, catches trends offer some insight into the overall health of a stock. Kelp bass stocks are believed to be stable. The current regulations appear to be maintaining adequate recruitment. However, heavy fishing pressure results in few fish surviving beyond the 12 inch size limit, such that "trophy" sized fish are rare in most areas.

Home Range/Migratory Patterns:

Kelp bass have ranged historically as far north as the mouth of the Columbia River and south to Bahia Magdalena, Baja California. However, they are rare north of Point Conception. They are abundant in southern California waters including all the Channel Islands. They are typically found in shallow water to 150 feet, and are closely associated with high relief structure, including kelp beds. Recent studies have shown that some kelp bass may move in excess of 50 miles (Love et al. 1996).

Current Regulations:

No commercial is take allowed.
Recreational minimum size limit is 12" total length, Possession limit is 10 in combination of kelp bass, barred sand bass and spotted sand bass.

Current regulations appear generally effective in maintaining a stable population.

How MPAs May Help:

The kelp bass is a top predator in the nearshore reef/kelp community. The effect of removing larger individuals from this nearshore ecosystem is not fully understood, but is likely significant. The abundances and balance of other species in this system might change in ways we cannot presently predict with any certainty. Since such reserves would protect other exploited species as well, the ecosystem functions of kelp bass might be altered as a result of more intense competition and predator/prey interactions. Similarly, reserves would also protect habitats valuable to kelp bass from a variety of potential fishing activity related impacts.

Studies on kelp bass in existing small MPAs at Catalina and Anacapa Islands, and La Jolla have shown that size and abundance of kelp bass are higher inside the reserves than outside (Beers and Ambrose In Prep). It can be anticipated that relatively large reserves will allow for an increase in numbers and sizes of kelp bass within the reserves.

Relatively large sized reserves can act to assure the continuing health of the kelp bass population if changes in exploitation levels occur, or if unforeseen environmental fluctuations result in a significant decline and sustainability of stocks. This insurance scenario would require that some significant portion of the stock is placed under reserve protection.

It would be expected that large MPAs would protect populations of large adult kelp bass that have significantly higher reproductive potential than smaller individuals. However, since there does not appear to be a deficit in recruitment potential under present management, any potential benefit through increased larval reproduction might be outweighed by the loss to the fishery from closing large areas of fishing grounds.

Studies have indicated that kelp bass may travel as far as 50 miles. This would suggest that while a large reserve would be needed to protect all members of an intact population, some portion of the population might be expected to occasionally move outside the reserve, providing added kelp bass to the fishery in adjacent areas.

**Barred Sand Bass (*Paralabrax nebulifer*)**

Status of the Population:

Barred sand bass are targeted exclusively by sport anglers; the commercial take of this species, like kelp bass has been illegal since 1953. Throughout the 1930s and early 1940s, sand bass, as well as kelp bass, were not considered to be quality angling fare but gained tremendously in popularity as game fishes by the mid-1950s (Leet et al. 2001). At that time, concern about the resource by sport fishermen and fishery managers resulted in the initiation of life history studies and the formulation of conservation measures. By 1959, a 10-fish bag limit and a 12-inch minimum size limit had been imposed on all three kelp and sand bass species; these measures were designed to counteract the declining numbers and shrinking size composition of the bass catches.

In 1985, 1987 and 1988, barred sand bass was the leading bass species in the CPFV catch, exceeding kelp bass landings for the first time since 1961 when kelp bass and sand bass landings were first reported separately (Leet et al. 2001). Beginning in 1994, and continuing through 2000, reported CPFV catches of barred sand bass have far exceeded kelp bass. Over 736,000 fish were taken during 2000, the all-time annual high catch for a bass species taken on CPFVs. Estimates of annual barred sand bass landings from the Marine Recreational Fisheries Statistics Survey (MRFSS) for all sport fishing activities (shore, pier, private boat, CPFVs, etc.) ranged as high as 1,940,000 in 1988 (Leet et al. 2001). Data from the MRFSS shows landings of barred sand bass in all modes during the 1990s were about 40 percent lower (30 percent lower for CPFVs) than those in the 1980s (Leet et al. 2001). Paradoxically, the Department's CPFV logs show a 40 percent increase in barred sand bass landings during the same period. Since the statistical way in which field samples are drawn in the MRFSS is based on previous years effort estimates, this survey may miss or over sample fisheries, as was probably the case in the 1980s and 1990s. CPFV data presents a more accurate picture of changes in the barred sand bass fishery since it represents a census of all vessels reporting and is not based on previous year's behavior.

Home Range/Migratory Patterns:

Although nothing is known about home range or migration patterns, tagging studies have shown barred sand bass are capable of movements of 5 to 40 miles. Anecdotal evidence suggests barred sand bass may occur in discreet groups which move up and down the coast as the water warms and cools.

Current Regulations:

No commercial take is allowed.
Recreational size limit is 12" total length
Possession limit is 10 in combination with kelp bass and spotted sand bass.

Current regulations generally appear effective in maintaining the barred sand bass population. Biological data collected from the MRFSS for the past 9 years shows the average weight has varied from 1.3 pounds to 2.0 pounds, with an average for the last 5 years of 1.5 pounds. The same data set shows the mode (the most frequently caught size fish) in length frequency distributions for 1993 through 1999 versus 2000 and 2001 has actually shifted to fish 1 inch larger (13 in. vs. 14 in.). Given that barred sand bass are managed on a yield-per-recruit basis, the current regulations are adequately protecting the resource.

How MPAs May Help:

Barred sand bass tend to aggregate on inshore sandy bottom areas during spawning events, where they also become vulnerable to the heaviest fishing pressure. Using reserves as a management tool would be effective by setting aside large sandy bottom areas along the coast as harvest refugia. Generally speaking, these sandy bottom areas have not been considered high priority areas to protect, as species biodiversity and overall fish densities tend to be low compared with reef areas. Other than the protection of spawning aggregations, traditional fishery management tools (size limits, bag limits, and seasonal closures) appear to offer more protection for barred sand bass than MPAs.

## Abalone

Seven species of abalones are found in California. Abalones attach with a large foot to rocky substrate, and feed primarily on drift algae. Five species of abalones (black, green, pink, red, and white) were popular sport and commercial species until southern California populations experienced severe declines during the 1960s, 1970s, 1980s and 1990s. A valuable red abalone recreational fishery still remains in northern California. These declines likely resulted from a combination of overharvest, disease, and a long-term warming trend leading to poor recruitment coincident with enhanced storm activity, reduced kelp abundance, and increased competition with sea urchins (Leet et al. 1992; Engle 1994). One species, the white abalone, has been listed as endangered under the general Endangered Species Act (ESA) and another, the black abalone, is a candidate species for such listing.

### Black abalone (*Haliotis cracherodii*)

Status of the Population:

Black abalone populations in southern California have suffered catastrophic declines since the mid-1980s that have resulted in a nearly complete disappearance of black abalone along mainland shores south of Point Conception (Miller and Lawrence-Miller 1993), as well as at many of the Channel Islands (Lafferty and Kuris 1993; Richards and Davis 1993). Mortality was associated with "withering syndrome" (WS), in which the foot shrinks and weakened individuals lose their grip on rock surfaces (Antonio et al. 2000; Friedman et al. 1997; Gardner et al.,1995). Withering syndrome has been observed in abalone north of Point Conception in recent years; however the disease is not widespread (Altstatt et al. 1996). Because of low recruitment, slow growth, and already reduced reproductive populations, black abalone are currently proposed for Federal listing under the ESA.

### Green abalone (*Haliotis fulgens*)

Status of the Population:

Green abalone supported an important fishery in California, with landings peaking in 1971 and rapidly declining thereafter (Leet et al. 1992). They were most common along the far southern mainland coast and at the southern Channel Islands, and were present at the northern Channel Islands, but are now rarely encountered. The green abalone commercial and sport fisheries are currently closed. Populations appear to be extremely low.

**Pink abalone (*Haliotis corrugata*)**

Status of the Population:

In the early 1950s, pink abalone comprised the largest segment (about 75 percent) of the abalone fishery and were a significant component of the total abalone landings. Commercial landings originated at the eastern northern Channel Islands (Anacapa and Santa Cruz), and the southern Channel Islands (San Nicolas, Catalina Island, Santa Barbara, and San Clemente). Because pink abalone are more fragile than other abalone and grow more slowly, the level of take could not continue (Leet et al. 2001). On Department research cruises to San Clemente, Catalina Island, and Santa Barbara Islands in 1996 and 1997, the number of abalones sighted per unit of time was used to quantify stocks, and a factor was applied to estimate the number of commercially legal pink abalone that could be collected per hour. Estimates ranged from about one to 1.5 abalone per hour (Leet et al. 2001). Similar cruises conducted in 1999 estimated only 0.28 commercially legal pink abalone per hour (Leet et al. 2001). At Catalina Island, no commercial-sized pink abalone were found (Leet et al. 2001).

**Red abalone (*Haliotis rufescens*)**

Status of the Population:

Red abalone was previously an important fishery in California, with landings peaking in 1967 and steadily declining thereafter (Leet et al. 1992). In central and southern California, red abalone had declined the least of all five species by the time the fishery was closed in 1997 (Leet et al. 2001). Combined landings of red abalone declined during the period from 1969 to1982 stabilizing at 1/10 their historic average during the 14-year period before the 1997 closure (Leet et al. 2001). Detailed examination of catch by area and fishery independent assessments revealed that the stability in landings masked ongoing reductions of local populations, as successive areas declined by over two orders of magnitude. From 1952 to1968 most red abalone were caught in central California, followed by southern mainland, Santa Cruz, Santa Rosa and San Miguel Islands (Leet et al. 2001). Catches declined first along the central coast under the combined effects of expanding sea otters and fishing pressure. Outside the sea otter range catches declined more slowly along the southern mainland than at Santa Rosa, Santa Cruz, and San Nicolas Islands. From 1983 to1996, catches decreased off these three islands to three percent for Santa Rosa and less than one percent for Santa Cruz and San Nicolas, of their respective peak catches by the 1997 closure (Leet et al. 2001). San Miguel Island and the north coast were the exceptions to this pattern. Catches from San Miguel Island, the farthest and most northern of the Channel Islands, and the north coast comprised 71 of the 87 tons landed in 1996 prior to the fishery closure in 1997 (Leet et al. 2001).

A successful red abalone sport-only fishery continues to the north of San Francisco County, where SCUBA has always been prohibited and commercial take was only allowed for a three year period during World War II. Beginning in the 1960s, breath hold

diving effort has increased in relation to shore picking (Leet et al. 2001). In 1960, an estimated 11,000 diver-days were expended to take 118,000 pounds of red and black abalone, compared with 29,000 diver-days to take 192,000 pounds in 1972 (Leet et al. 2001). By 1985 to 1989, average diver-days and shore picker-days per year were focused on red abalone in central and northern California. Estimated landings of red abalone in central and northern California for combined divers and shore pickers reached a high of 3,472,000 pounds in 1986 and had decreased to 1,161,000 pounds by 1989 (Leet et al. 2001). In 1998 an abalone stamp was first sold to generate revenues for stock assessments. In 1998 and 1999 an average 33,000 stamps were sold showing effort levels are comparable to those estimated for the 1985 to 1989 period (Leet et al. 2001).

**White abalone (*Haliotis sorenseni*)**

Status of the Population:

The white abalone fishery developed late due to their deep habitats, with the first reported commercial landings in1968. However, this species was popular for their tender meat. Abundances were highest at the southern and northeastern Channel Islands. Peak landings occurred in 1972 and decreased thereafter (Leet et al. 1992). Average density during periods of peak take in the 1970s was one abalone per square meter. Density has dramatically decreased since to 0.002 per square meter (Carlton et al. 1999). Surveys in the Channel Islands area found that density may have further decreased to 0.0001 per square meter (Davis et al. 1998). Since females must be within a few meters of a male during spawning for fertilization to occur, present population densities in the area may preclude successful spawning. The entire white abalone fishery has been closed since 1993, though densities have continued to fall (Carlton et al. 1999; Davis et al. 1998). Sub-threshold breeding density and continued predation (by fish, octopus, sea stars and other species) suggest that recovery without significant human intervention is unlikely. Submersible surveys were carried out to further evaluate population status and to explore possibilities for collection of specimens for a captive breeding program. The rarity of this species prompted the National Marine Fisheries Service (NMFS) to list it as a candidate species under the federal ESA in 1997. This action required a status review, which concluded that overexploitation was the major cause of the decline. Subsequently, in May 2001 the white abalone became the first marine invertebrate to receive Federal protection as an endangered species.

**All Abalone Species**

Home Range/Migratory Patterns:

All abalones are benthic rock dwellers, moving relatively short distances throughout their lives. Some species may migrate from deep to shallow depths in search for food. Others may spend years on the same home location. Each species of abalone has a different depth and latitudinal distribution. Three species (red, black, and pinto) occur throughout California. Pink, green, and white abalone occur in southern California and

into Mexico. Flat abalone occur from central California northward. The depth distributions are: black, high intertidal; red, intertidal to 80 feet; green, subtidal to about 20 feet; pink, subtidal to 120 feet, white, subtidal to depth of 200 feet; flat sub tidal to 70 feet, and pinto, subtidal to 70 feet.

Current Regulations:

No commercial take is allowed.

Recreational take is prohibited south of a line drawn due west from the center of the mouth of San Francisco Bay. Only red abalone may be taken north of that line. Red abalone must be seven inches or greater along the longest shell diameter. No more than three red abalone may be possessed at any time and no more than 24 may be taken in any calendar year. No scuba or surface-supplied air may be used in taking abalone.

How MPAs May Help:

There is empirical evidence that the establishment of marine reserves benefits fished invertebrates such as abalones (Dugan and Davis, 1993). It is clear that populations protected from fishing will achieve larger sizes, live longer, and produce more offspring over their lifetime than counterparts in fished areas. Size is critical for abalone reproduction and the largest abalone have many more (4-8 times) eggs than intermediate size animals (Tegner 1989). Increased densities observed in protected areas are important for reproductive success. Abalones that are close together have an 80 percent chance of successful fertilization, but this value rapidly declines if individuals are farther apart. Abalone farther than 4 meters from their nearest neighbor have little chance of successful fertilization because of dilution of the eggs and sperms (Babcock and Keesing 1999).

Abalone stocks that have produced sustained yields over time have been ones in which a part of the population was protected, either in actual or de facto reserves where fishermen did not have access to the resources (Karpov et al. 1998, Walters and McGuire 1996). In California, pink abalone inside the Anacapa Island reserve at Landing Cove were larger in size and as a consequence had increased spawning potential, compared with a fished site (Admiral's Reef) and an unprotected reserve (Cathedral Cove) (Rogers-Bennett et al. In press).

Pinto abalone (*H. kamtschatkana*) inside a reserve in British Columbia had larger individuals (greater than 130 millimeters) and higher abundances compared with unprotected closed areas (Wallace 1999). Despite the total closure of the abalone fishery in British Columbia enacted in 1990, only the closed area neighboring a prison with a 24-hour armed guard had more and larger abalone, suggesting widespread illegal fishing (Wallace 1999). Likewise, the potential reproductive output, estimated by multiplying the number of abalone by the mean fecundity of the site, was also greatest in the heavily protected closed area. Abalone populations in British Columbia have not

rebounded despite the fishery closure suggesting the need for restoration (Campbell 2000) and better compliance with the provincial closure.

Abalone have provided some of the best examples of how important interactions between members of the marine community may be facilitated by no-take reserves. Researchers have determined a link between the presence of adult red sea urchins and juvenile abalone. Juvenile abalone find shelter under the spines of adult sea urchins and use this as protection from predation and wave sheer. More juvenile red and the rare flat abalone were found inside red sea urchin reserves compared to areas where red sea urchins had been fished in northern California (Rogers-Bennett and Pearse 2001). This interaction was first described in central and southern California red abalone (Tegner and Dayton 1977). Similar results have been found in Japan (Kojima 1981) and South Africa (Day and Branch 2002). In South Africa, experimental removals of sea urchins dramatically decreased local densities of juvenile abalone (Day 1998).

It has been suggested that just the moratorium on the take of abalones south of San Francisco Bay alone is sufficient to lead to recovery of California abalone resources because now most of California is an "abalone reserve". The closure is a first step toward recovery, but it has not brought individuals closer together to facilitate reproduction and it has not provided any actual increased protection to the remaining stocks. The southern California abalone closure, established in 1977, prohibited abalone take along parts of the Los Angeles and Orange County coasts, but was not successful in recovering stocks (Tegner 1993). It was too far from existing stocks for recolonization to take place and did not afford sufficient protection from poaching to be effective.

Additionally, for high value species like abalone that need aggregations of adults to successfully recruit, protection is facilitated by establishment of no-take reserves. In such areas there is no question about whether a species is allowed to be taken, and possession of any species is a violation. Such protected areas will be necessary before aggregating of the remaining stocks, and translocations operations can be conducted.

**Giant Sea Bass (*Stereolepis gigas*)**

Status of the Population:

In 1981, a law was passed that prohibited the take of giant sea bass for any purpose, with the exception that commercial fishermen could retain and sell two fish per trip if caught incidentally in a gillnet or trammel net. This law also limited the amount of giant sea bass that could be taken in Mexican waters and landed in California. A vessel could land up to 1,000 pounds of Mexican giant sea bass per trip but could not land more than 3,000 pounds in a calendar year. The law was amended in 1988, reducing the incidental take to one fish in California waters. Although this law may have prevented commercial fishermen from selling giant sea bass in California, it did not prohibit fishing over habitats occupied by this species and probably did little to reduce the incidental mortality of giant sea bass, as giant sea bass that were entangled in the nets were discarded at sea. The 1981 rule changes were more effective in protecting giant sea bass in Mexico, since large landings had been historically made by hook-and-line fishermen targeting grouper, cabrilla, and giant sea bass off the Pacific coast of Baja California. Since the banning of inshore gillnets displaced the California fishery from the majority of areas inhabited by giant sea bass, it is reasonable to assume that this closure significantly reduced the incidental mortality of giant sea bass in California. Even so, given the slow growth and reproduction of the species, the California population of giant sea bass remains below historical highs. Anecdotal information suggests that numbers may be beginning to rebound under current measures (Leet et al. 2001). No hard data exist that provide actual or relative numbers of giant sea bass (Leet et al. 2001).

Home Range/Migratory Patterns:

Little is known about the home range of giant sea bass and even less is known about migratory patterns. We do know that giant sea bass aggregate at specific sites early in the summer and disperse in the fall. This is thought to be associated with spawning but fish taken during this period usually display little evidence of spawning. Where fish disperse to after leaving the aggregating areas is unknown. It is unusual to catch an adult giant sea bass when they are not aggregated together.

Current Regulations:

Giant sea bass may not be taken commercially, except that not more than one fish per vessel may be possessed or sold if taken incidentally by gill or trammel net.

Giant sea bass may not be taken by recreational anglers. Incidentally taken fish must be immediately returned to the water.

While these regulations prohibit directed take, they do not prevent incidental take. Giant sea bass inhabit areas where many popular sport and commercial species are taken and are prone to incidental take. While numbers may be increasing, this also increases

the risk of incidental take. Aggregations of giant sea bass can be severely impacted by such interactions. These large fish tend to experience overexpansion trauma to their gas bladder when brought to the surface and are difficult for most recreational anglers to release unharmed.

How MPAs May Help:

Reserves in appropriate locations could protect spawning aggregations of giant sea bass. Recent incidents of illegal take by spearfishermen have been documented at both Anacapa and Catalina Islands. These incidents show that though this is already a protected species, take could be further prevented in totally protected MPAs. MPAs would also eliminate the potentially harmful incidental take by hook and line and net gears. They would offer little or no protection to fish when they are not aggregated since they would leave the area protected by the MPA.

## White Seabass (*Atractoscion nobilis*)

Status of the Population:

White seabass population estimates have not been made (Leet et al. 2001). Fishery biologists have been concerned about the decline in landings since the late 1920s. Human-induced changes, such as pollution, overfishing, and habitat destruction, have probably contributed to this long-term population decline (Leet et al. 2001). However, natural environmental changes can also influence the population. The large numbers of small white seabass caught in recent years suggests that the warm water period beginning with the 1982-1983 El Niño helped to increase young fish survival (Leet et al. 2001).

There are indications that the white seabass population off California is recovering from low levels seen in the 1970s, 1980s, and most of the 1990s. Recent landings by sport and commercial fishermen have increased substantially and are approaching levels seen in the late 1940s and early 1950s; total landings for 2000 and 2001 each approached 1,000,000 pounds. In addition, recruitment of white seabass has increased significantly in the Southern California Bight in recent years. Young fish surveys conducted in southern California, as part of the Ocean Resources Enhancement and Hatchery Program (OREHP), showed a dramatic increase in the number of fish taken in research gillnet sets. During research work in 1997, over 600 juvenile fish were captured; in 1998 approximately 700 fish were taken, and in 1999 slightly over 1,300 juveniles were captured (Leet et al. 2001). The final OREHP sampling report for 2000-2001 showed 1,845 juvenile fish were captured during calendar year 2000, continuing the dramatic increase in juvenile white seabass. Anecdotal evidence from commercial and sport fishers also confirms this dramatic increase in juvenile white seabass. It is unknown whether this increase in juveniles will continue to enhance the adult spawning population (Leet et al. 2001).

Home Range/Migratory Patterns:

Nothing is known about the home range of white seabass. Information obtained from OREHP tagged and released juvenile fish shows that the fish are capable of moving at least 70 miles along the coast in a year. Releases of fish at Catalina Island and subsequent recoveries along the coast show they will move between the islands and the coast. The recent recovery at Catalina Island of a wild fish tagged along the coast shows movement is also possible offshore. Based on tag recoveries, it is apparent white seabass move considerable distances and this is probably the norm.

Current Regulations:

The Commission recently adopted and certified the White Seabass Fishery Management Plan (WSFMP) and adopted White Seabass implementing regulations, which became effective August 30, 2002. These implementing regulations include several new provisions intended to ensure sustainable management of white seabass

stocks off California. The WSFMP and regulations provide for an annual assessment and review process that involves both Department fisheries managers and scientific and industry advisors working together to fashion management recommendations for consideration by the Commission. The WSFMP provides a framework approach to management that enables the Commission to make quick adjustments to management measures if needed. The WSFMP also sets a total harvest limit (sport and commercial) of 1.2 million pounds to help ensure stocks are managed at sustainable levels and lists several trigger mechanisms aimed at identifying when overfishing of the white seabass stock occurs. Implementation of the WSFMP does not change regulations for white seabass that are currently in place.

Under current regulations, it is unlawful to commercially take white seabass between March 15th and June 15th south of Point Conception. Commercially taken white seabass must be at least 28 inches long. Gill net vessels are allowed to land one fish per day if taken incidentally during the closed season, and gill net mesh size must be a minimum of 6 inches in length.

The recreational size limit is also 28 inches total length. Three fish may be taken except that only one fish may be taken between March 15th and June 15th south of Pt. Conception.

Current regulations, along with augmentation of white seabass from OREHP, appear to be adequately protecting white seabass, especially when ocean conditions are appropriate for successful reproduction. The seasonal commercial closure and recreational limit reduction attempts to protect spawning fish. It has been noted, however, that many undersized fish are incidentally killed when released in the recreational fishery, and that “high-grading” (continuing to fish once a limit is reached in order to get larger fish) may also occur. This practice appears to be declining substantially on CPFVs due to peer pressure to avoid waste. Private boat anglers also appear to be less inclined to continue fishing after a limit is reached.

The recently adopted WSFMP will also protect white seabass stocks. However, the WSFMP cautions that more data and a formal stock assessment are needed to yield a more accurate harvest limit and a better defined harvest control rule. The Commission will review the WSFMP annually.

How MPAs May Help:

It could be expected that MPAs might protect populations of white seabass in areas which may be habitat identified as ideal for enhancing other populations of marine fin fish. It has been suggested that white seabass spawn around rocky nearshore areas or near kelp beds (Thomas 1968), however, more current information from sport and commercial fishermen indicate that white seabass aggregate on inshore sandy bottom areas during spawning events where they become vulnerable to the heaviest fishing pressure. Therefore, to effectively provide some protection to these fish utilizing reserves as a management tool would require setting aside sandy bottom areas at the

offshore islands. When not aggregated, traditional fishery management tools (size limits, bag limits, and seasonal closures) appear to offer more protection to white seabass than MPAs.

## Nearshore Rockfishes (Genus *Sebastes*)

Thirteen fishes of the genus *Sebastes* (rockfish) are included in the State's list of nearshore species defined in Title 50, Code of Federal Regulations, Parts 600 and 660 as Nearshore Rockfish. These are: black, black-and-yellow, blue, brown, calico, China, copper, gopher, grass, kelp, olive, and quillback rockfishes, and treefish.

## Black Rockfish (*Sebastes melanops*)

Status of the Population:

Although no fishery-independent population estimates have ever been made of black rockfish stocks in California, substantial information exists on relative abundance and length frequency from fishery-dependent surveys. Black rockfish are a component of both commercial and recreational fisheries, with increasing importance from San Francisco northward. Data from the 1981-1986 Marine Recreational Fishery Statistics Survey (MRFSS) survey showed a 23 percent decline in the average weight of black rockfish taken compared with fish taken between 1958 through 1961. Onboard observations from CPFVs in the San Francisco area documented a significant change in the length frequency of the sampled catch from 1989 to 1990. During that period, the occurrence of larger adult black rockfish (greater than 15 inches) declined precipitously. This occurred during a time when nearshore commercial hook-and-line fishing effort and landings were expanding. Mean length in the sampled catch from the San Francisco area declined from 14.3 inches in 1988-1989 to 12.1 inches in 1990-1991, and has ranged from 11.4 to 12.6 inches annually from 1993 to 1998. This is well below the average length at 50 percent sexual maturity. Since 1993, all other CPFV port areas from Fort Bragg south to Morro Bay have yielded similar low mean lengths. Results from commercial fishery sampling are consistent with the above; 296 black rockfish sampled from the Morro Bay area commercial nearshore fishery from 1993 to 1997 averaged 12.2 inches. Coincident with these observed declines in mean length were increased catch rates (catch-per-angler-hour) observed in the CPFV fishery in central California, particularly from 1994 to 1997. Thus, the observed decline in mean length maybe partially related to strong recruitment, and, in spite of increased fishing effort on black rockfish in recent decades, localized populations of adults still must be present in California to provide this recruitment.

## Black-and-Yellow Rockfish (*Sebastes chrysomelas*)

Status of the Population:

While there have been several studies of local abundance for black-and-yellow rockfish, there is no comprehensive assessment of their population.

**Blue Rockfish (*Sebastes mystinus*)**

Status of the Population:

The blue rockfish is one of the most important recreational species in California (Leet et al. 2002). It is usually the more frequently caught rockfish north of Point Conception for anglers fishing from CPFVs and skiffs, is also important to divers, and is occasionally caught by shore anglers. Only a small portion of blue rockfish are from commercial landings, however, they have become a minor component of the live fish fishery (Leet et al. 2002) Although no fishery-independent population estimates have ever been made of blue rockfish stocks, it appears that they have withstood considerable fishing pressure over the last four decades and continue to be healthy north of Point Conception. However, there is evidence of a decline in blue rockfish stocks off southern California since the 1970s.

There is a well-documented difference in the population structure between northern and central California stocks. Northern stocks are generally characterized by a wider size range of adults, a higher proportion of adults greater than 15 inches and a correspondingly greater mean length, less variability in annual recruitment, and most likely a higher growth rate. These attributes are likely a result of a combination of greater fishing pressure and a greater influence of anomalous oceanic conditions such as El Niño events in central California. Greater variability in annual recruitment results in occasional strong year classes that cause strong length-frequency modes in the population; this occurred four times in recreational fishery samples obtained from 1959 to 1983 in central California. It is believed that the last exceptionally strong year class of blue rockfish in central California occurred in 1988, which is cause for concern. However, a relatively strong year class also was observed in 1999. In 1993, when the majority of the 1988 year class had become available to recreational anglers, mean lengths in the sampled catch declined substantially in central California. For example, mean length of blue rockfish sampled from Monterey area CPFVs declined from 11.9 inches in 1992 to 11.0 inches in 1993. In heavily fished and well-sampled populations of rockfish, changes in annual mean length from one year to the next are commonly less than 0.5 inches. The total number of blue rockfish caught in recreational fisheries increased substantially from the late 1950s to the mid-1980s, concurrent with increased effort. However in the past 15 years recreational fishing effort has been variable but has not shown a consistent increase; the recreational catch of blue rockfish has shown the same pattern. However, increased commercial fishing in the nearshore area during the same period has put additional stress on blue rockfish populations.

**Brown Rockfish (*Sebastes auriculatus*),**

Status of the Population:

While there have been studies of local abundance in certain coastal areas and within bays, the population size and structure of this species has not been comprehensively assessed. Evidence of stress on brown rockfish stocks in California exists, however,

and some relative changes in the population have been identified. Commercial and recreational catches have steadily increased during the last 40 years, while the average length and weight of brown rockfish in landings have declined. When recreational statistics collected during the last 20 years were compared to results from a 1958 through 1961 recreational survey, brown rockfish showed a 49 percent decrease in average weight per fish over 30 years. Mean length of brown rockfish obtained from CPFVs and private recreational boats in northern California declined by 18 percent and 21 percent, respectively, over 40 years. In southern California, mean length in the CPFV catches declined by 31 percent during the same period. In relation to the length at which 50 percent of males and females are mature, recreational landings data indicate that from 1958 to 1961 most brown rockfish taken had reached sexual maturity. By the 1980s, however, few fish taken from shore or from bays, and about half taken from private recreational boats were sexually mature. Lengths of brown rockfish sampled from commercial landings during the last decade also reflect that half of the fish were at or below the size at which 50 percent of the population is sexually mature, and few larger adult fish were being landed compared to historic values. The decline in size of fish in these fisheries does not seem to be associated with incoming year classes, but instead with a depletion of larger adults due to fishing pressure. Although nearly half of the fish landed statewide are adults that can replenish the population, there are now few large adults above the length of the median-sized fish recorded in the 1958 through 1961 survey (Leet et al. 2002). The brown rockfish has been identified as a species vulnerable to severe localized depletions in other geographic areas; in Washington State, the Puget Sound stock of brown rockfish was recommended for listing as a threatened species in 1999 (Leet et al. 2002).

**Calico Rockfish (*Sebastes dallii*)**

Status of the Population:

There are currently no estimates of abundance for calico rockfish in California. There were more calico rockfish landed annually by sport anglers in the 1980s than in the 1990s, which may have reflected the abundance of that species during two strong El Niño events that occurred in the 1980s. Whether the reduced calico rockfish catch during the 1990s was a result of changing oceanic conditions or was due to actual depletion of calico rockfish stocks by sport and commercial fisheries is not known. Because of the relatively small size of adult calico rockfish, they are not usually targeted by either sport or commercial fishermen. Calico rockfish appear as bycatch in prawn trawls and other nearshore fisheries in southern California and are caught by sport anglers on CPFVs and private boats when they are fishing for other, larger benthic species.

**China Rockfish (*Sebastes nebulosus*)**

Status of the Population:

While there have been several studies of local abundance for China rockfish, there is no comprehensive assessment of their population.

**Copper Rockfish (*Sebastes caurinus*)**

Status of the Population:

Over the past 20 years, copper rockfish have become a less frequent component in the nearshore environment (Leet et al. 2001). There has been no stock assessment of copper rockfish in California (Leet et al. 2001). However, there is compelling evidence that copper rockfish populations have severely declined in many areas and large individuals are noticeably less common than in past decades. Department research cruise data and diving observations have noted fewer copper rockfish and smaller average sizes in areas where they were previously abundant. Fishery dependent data show significant decreases in recreational catch between the periods of 1958 to 1961 and 1981 to 1986 (Karpov et al. 1995). Catches in spearfishing competitions have similarly declined, with fewer fish landed and smaller average sizes. Due to their solitary nature, high habitat specificity, and the size (juveniles) at which they can enter the fishery, the copper rockfish is a prime candidate for local depletion (Leet et al. 2001).

**Gopher Rockfish (*Sebastes carnatus*)**

Status of the Population:

While there have been several studies of local abundance for gopher rockfish, there is no comprehensive assessment of their population.

**Grass Rockfish (*Sebastes rastrelliger*)**

Status of the Population:

While there have been several studies of local abundance for grass rockfish, there is no comprehensive assessment of their population.

**Kelp Rockfish (*Sebastes atrovirens*)**

Status of the Population:

While there have been several studies of local abundance for kelp rockfish, there is no comprehensive assessment of their population.

**Olive Rockfish (*Sebastes serranoides*)**

Status of the Population:

Historically, olive rockfish have been common in the recreational fishery as far north as Fort Bragg and were particularly important from central California to the northern Channel Islands (Leet et al. 2001). As late as the 1980s, olive rockfish were a very important recreational species throughout much of southern California. However, a combination of overfishing and poor recruitment brought about by changes in oceanographic conditions led to a steep decline (83 percent) in southern CPFV catches between 1980 and 1996 (Leet et al. 2001). There has been no stock assessment of this species. However, there is clear evidence that olive rockfish have declined in abundance south of Point Conception (Leet et al. 2001) and most likely also off central California.

**Quillback Rockfish (*Sebastes maliger*)**

Status of the Population:

While no stock assessment has been done for quillback rockfish in California, length-frequency data exist on their occurrence in the recreational fishery in northern and central California, as well as in the commercial fishery from the same region (Leet et al. 2001). Between the late 1980s and mid-1990s, quillback rockfish experienced increased take by the commercial fishery as the market demand for premium, live fish increased, yet no significant trend was noted in the average size of fish. Fishing pressure has relaxed somewhat in recent years because of restrictions placed on the fishery. Concern over sustainability of the commercial and recreational nearshore fishery has made this species of particular interest to fishery managers (Leet et al. 2001).

**Treefish (*Sebastes serriceps*)**

Status of the Population:

While there have been several studies of local abundance for black-and-yellow rockfish, there is no comprehensive assessment of their population.

**Nearshore Rockfish**

Current Regulations

Nearshore rockfish are a complex of 13 species of rockfish subject to both federal and state laws and regulations. These species are managed pursuant to the Federal Pacific Coast Groundfish Fishery Management Plan (Groundfish Plan) adopted by the Pacific Fishery Management Council (PFMC) and under laws and regulations adopted by the California Legislature and Commission. Council management and regulation of

nearshore rockfish includes an annual harvest guideline for the entire minor nearshore rockfish complex that is allocated between recreational and commercial fishery sectors, and two-month cumulative catch limits for segments of the commercial fishery. California has enacted laws [Marine Life Management Act (Chap. 1052, Stats. 1998) and Nearshore Fishery Management Act (Chap. 1053, Stats. 1998)] and Commission regulations to protect the juveniles of some nearshore rockfish, and to develop more comprehensive and sustainable management of these and other important nearshore fishes. Foremost in these efforts is the development of a Nearshore Fishery Management Plan (Nearshore FMP). The Nearshore FMP along with implementing regulations has been submitted to the Commission for their review and consideration, with final adoption and certification expected in October 2002.

Commercial Fishery: The commercial fishery for nearshore rockfish is regulated using a combination of minimum sizes, reporting requirements, season and area restrictions, and catch limits as follows:

- Commercial fishermen must posses a “nearshore fishery” permit to take ten species of nearshore fishes, including five species of nearshore rockfish (black-and-yellow, China, copper, gopher, grass, and kelp).
- The minimum commercial size limit for black-and-yellow, gopher, and kelp rockfishes is 10 inches total length, and for China and grass rockfishes is 12 inches total length.
- Regulation changes adopted in June 2002 by the Council prohibit fishing for minor nearshore rockfish outside 20 fathoms south of 40 degrees, 10 minutes North Latitude, near Cape Mendocino, Humboldt County.
- Fishing for nearshore rockfish is authorized in waters less than 20 fathoms south of 40 degrees, 10 minutes North Latitude.
- Two-month cumulative catch limits exist on minor nearshore rockfish between Cape Mendocino and Point Conception, Santa Barbara County, and between Point Conception and the U.S.-Mexico border.
- Nearshore rockfish for which there are size limits must be measured immediately on being brought aboard and released immediately if not in compliance with the size limit.
- Nearshore rockfish must be sorted by species prior to weighing and the weight reported separately on the Department receipt.

Recreational Fishery: The recreational fishery for nearshore rockfish is regulated principally with a bag limit, hook limit, and area and season closures as follows:

- The bag limit for rockfish is ten rockfish per day in combination of species (includes nearshore, shelf, and slope species).
- Not more than two hooks and one line may be used when sport fishing for rockfish.
- Rockfish fillets must have the entire skin attached; and brown skinned rockfish fillets must be a minimum of six and one-half inches in length, and bocaccio fillets must be a minimum of five inches in length.

- Regulation changes adopted in June 2002 by the Council prohibit fishing for rockfish, including nearshore rockfishes, outside 20 fathoms south of 40 degrees, 10 minutes North Latitude, near Cape Mendocino, Humboldt County.
- Fishing for rockfish, including nearshore rockfish, is closed in waters less than 20 fathoms deep during November and December 2002 south of Cape Mendocino as a result of Council action taken in 2001. A seasonal closure on take of rockfish, including nearshore rockfish, between Point Conception and 40 degrees10 minutes North Latitude is in effect from March through April
- During rockfish closures specific to waters 20 fathoms or greater, fishing and possession of rockfish is authorized in waters less than 20 fathoms in depth along the mainland coast and around offshore islands and rocks (excluding reefs and banks) (including nearshore rockfish, but not more than two shelf rockfish other than bocaccio, canary, cowcod, and yelloweye rockfish).

How MPAs May Help:

Nearshore rockfishes appear to be excellent candidates for enhancement of populations using an MPA management approach. In addition to being highly residential and moderate to long-lived, they are extremely fecund (with older, larger individuals producing the majority of sperm and eggs) and generally have a lengthy larval life stage. Marine protected areas would protect critical spawning stock biomass and potentially ensure a continual recruitment supply to fished areas via larval dispersal. A system of MPAs would allow scientists and resource managers to compare habitats and ecological communities in fished and unfished areas and determine if observed changes are caused by human activity or environmental change. To gain the fullest range of potential expected benefits, the network of MPAs would need to encompass a representative portion of a species habitat.

As noted in the introduction, examples of beneficial effects of MPAs on rockfish size, population structure, and reproductive potential exist (Palsson 1998; Palsson and Pacunski 1995; Paddack 1996). These examples specifically show that within MPAs rockfish reach larger sizes and have significantly higher potential for producing larvae. Based on the larval behavior, this production has a definite potential to influence areas outside MPAs.

## Shelf Rockfishes (Genus *Sebastes*)

Thirty-two fish of the genus *Sebastes* are defined as shelf rockfish in Title 50, Code of Federal Regulations, Parts 600 and 660. They are: bocaccio, bronzespotted, canary, chameleon, chilipepper, cowcod, dwarf-red, flag, freckled, greenblotched/pink, greenspotted, greenstripe, halfbanded, honeycomb, Mexican, pinkrose, pygmy, redstripe, rosethorn, rosy, shortbelly, silvergray, speckled, squarespot, starry, stripetail, swordspine, tiger, vermillion , widow, yelloweye, and yellowtail rockfish.

Status of the Population:

The current status of many rockfishes off the west coast is poor, and significant changes in the groundfish fishery have been necessary to address this situation. There are over 60 different species of rockfish in California. Formal assessments of these fish populations are challenging, due to the number of species and the large commitment of time and effort to conduct the necessary research and analysis. To date, 15 shelf rockfish species have been formally assessed, and the results are not encouraging. Nearly all of these species are currently below optimal abundance levels. Six shelf rockfish species, including four that are important to California anglers and commercial fishermen (bocaccio, canary rockfish, widow rockfish and cowcod), are at such low levels (estimated at or below 25 percent of the unfished population of each species) that they have been declared overfished by the Pacific Fishery Management Council (PFMC). Federal law requires that steps be taken to rebuild overfished stocks under strict guidelines that place an emphasis on a reasonable likelihood of achieving success within specified time periods for each species.

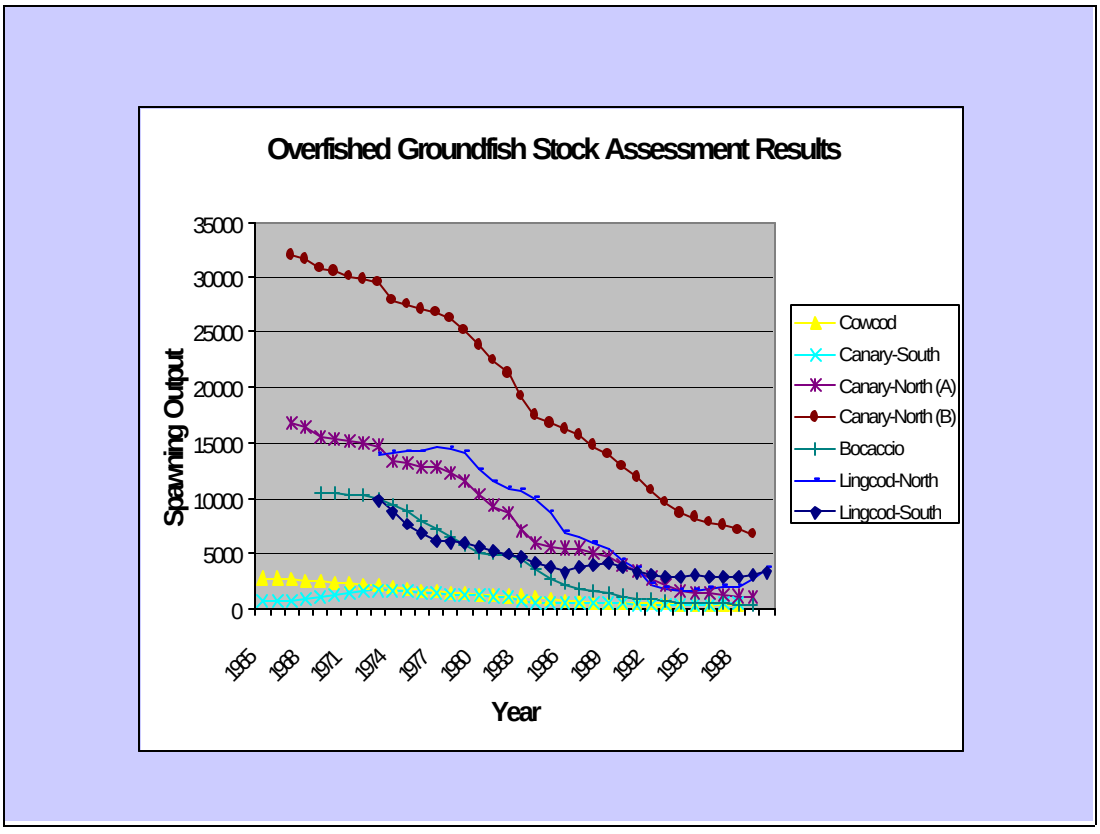
Several factors affect the abundance of rockfishes and the ability to manage them effectively. Recent analyses have shown that rockfish stocks are not as productive as previously thought. This is due in part to improved information about rockfish life history (such as age, growth, and reproduction), better stock assessments and poor environmental conditions that generally have not been favorable to rockfish reproduction or survival since the 1980s. As a result, rockfishes cannot support harvest rates as high as previously thought. Management is further complicated because the habitats and ranges of many rockfish species overlap, so that it is difficult to catch one species without catching other species at the same time. Fishing must be reduced for an entire group of rockfish with similar life histories and habitat preferences in order to realize lower catches that are necessary to rebuild overfished species. For example, although a few shelf rockfish species such as chilipepper and yellowtail appear to be comparatively healthy, their allowable take has been set at levels below the potential yield to protect the weaker species of shelf rockfish that tend to be caught with them, such as bocaccio and canary.

Prior to 2000, the allowable catch of all rockfish in the PFMC's southern management area for rockfish (most of California) was combined into a single quota. To better align fishing opportunities with the resources that support them, fishery managers grouped rockfish into three new categories in 2001: nearshore, shelf, and slope. In addition,

management has been refined by setting individual quotas for a few species, which reduces the aggregate quota for other remaining rockfish species.

In order to return depressed rockfish and lingcod stocks to a healthy condition, all fisheries must share in the conservation measures needed for recovery. For the recreational fishery, bag limits have been reduced, gear restrictions imposed, seasons closed, and minimum size limits established. In the commercial fishery, the aggregate rockfish quota for 2001 was reduced by about 57 percent compared to 1997. Rockfish rebuilding plans call for decades of ongoing special efforts to allow the overfished species to recover. Federal rebuilding plans generally call for at least a 50 percent probability of rebuilding within the allotted time. Establishment of an MPA network would increase the probability of successful rebuilding under conditions where all other aspects of rebuilding remain as specified under the proposed plans.

Following is a depiction of trends in abundance for several overfished shelf groundfish species from recent stock assessments:



Current Regulations for Shelf Rockfish:

In order to prevent overfishing and achieve the lower catches necessary to rebuild cowcod, bocaccio, yelloweye, widow, and canary rockfishes, the following west coast Optimum Yields (OYs) were established by the PFMC for shelf rockfish during 2002:

| **Species/Group** | **Allowable Catch - MT (OY)** | **Area** |
|---|---|---|
| Widow Rockfish | 856 | Coastwide |
| Canary Rockfish | 93 | Coastwide |
| Chilipepper Rockfish | 2000 | South of C. Mendocino |
| Bocaccio | 100 | South of C. Mendocino |
| Yellowtail Rockfish | 3146 | North of C. Mendocino |
| Cowcod | 5 | South of C. Mendocino |
| Yelloweye Rockfish | 14 | North of Pt. Conception |
| **Other Shelf Rockfish** | | |
| North | 978 | North of C. Mendocino |
| South | 914 | South of C. Mendocino |

Several new regulations were imposed on the recreational fishery for 2002, and a number of other recent restrictions were continued:

- Four-month season closures are imposed during January-February and November-December for lingcod and rockfish, in waters south of Point Conception.
- Between Point Conception and Cape Mendocino, fishing for shelf rockfish and lingcod is only permitted during January-February and July-August.
- Between Point Conception and Cape Mendocino, fishing for nearshore rockfish is only permitted during January-February and May-October, with incidental allowance (2 fish) of shelf species (excluding bocaccio, cowcod, canary and yelloweye rockfish) during May-June and September-October.
- The overall combined rockfish daily bag limit remains at 10 fish.
- The lingcod minimum size limit is reduced to 24 inches.
- Within the overall rockfish bag limit, only 2 fish may be bocaccio, and 1 may be canary, or yelloweye rockfish.
- A minimum size of 10 inches is continued for bocaccio.
- Retention of cowcod is prohibited.
- No more than one line and 2 hooks may be used when fishing for rockfish and lingcod.
-

Commercial fishing for shelf rockfish has been greatly restricted in recent years, and targeting by trawl gear has been virtually eliminated. In order to remain within the optimum yields that have been established by the PFMC for 2002, a complex set of bi-monthly cumulative trip limits were established for the various species and species groups of rockfish. In addition to the trip limits, four month closures south of Point Conception (January-February and November-December), and eight month closures

between Cape Mendocino and Point Conception (March-June and September-December) were established to prohibit commercial fishing for shelf rockfish during those periods.

Special MPAs known as the Cowcod Conservation Areas (CCAs) were established in the southern California Bight in 2001 to achieve rebuilding yields for cowcod. Bocaccio rebuilding will also benefit from the CCAs. Fishing for shelf and slope groundfish and prawn trawling is prohibited within the closures, because those fishing activities have unavoidable bycatch of cowcod. The closures are expected to reduce cowcod landings by 55 percent, which is necessary to lower overall catches in the area to the rebuilding target of 2.4 mt south of Point Conception. It is anticipated that the closures will remain in effect throughout the cowcod rebuilding period which may take as long as 97 years.

How MPAs May Help:

As demonstrated by the CCAs (above), MPAs may be well-suited for rebuilding overfished shelf rockfish species in certain circumstances. In addition, MPAs have the potential to prevent catastrophic population collapse due to inadvertent overfishing such as has occurred for cowcod, bocaccio, yelloweye, widow, and canary rockfishes, providing a network of MPAs is established before the populations become overfished. Since the threshold for declaring a population as overfished is 25 percent of the unfished abundance, a network of MPAs that protect a significant fraction of the population from fishing pressure (greater than 10 percent of the population and associated habitat) would significantly reduce the risk that the overall population would drop below the overfished threshold. For instance, if 25 percent of an unfished population were protected from fishing inside MPAs, there would be almost no chance that the overall population could be described as overfished using the Federal definition, even under data-poor management conditions. If 25 percent of a stock population is protected, then the overall abundance would be unlikely to drop below 25 percent.

The recent track record shows that even data-rich stocks such as bocaccio and canary rockfish have become overfished, and actively managed and well-studied species such as these would also benefit from the reduced risk of management mistakes provided by an MPA network. This is one of the clearest examples of the insurance factor provided by MPAs against management uncertainty. Preventing stocks from becoming classified as overfished is an important consideration in weighing the costs and benefits of establishing an MPA network.

Reproductive output from protected portions of spawning populations found within the boundaries of MPAs may be dispersed by currents during the larval life phase, and then recruit to fishing grounds outside the MPAs. This potential enhancement of fisheries may lead to higher catches than would otherwise be allowable. Despite the potential for insurance against management mistakes, it is important to recognize that MPAs would not eliminate the need for active management in fishing grounds that remain open in order to maintain healthy populations and ecosystems throughout the marine environment.

## California Sheephead (*Semicossyphus pulcher*)

Status of the Population:

Compared to some nearshore species, California sheephead have supported relatively minor sport and commercial fisheries. Sport landings through the 1980's and 1990s have consistently averaged between 40,000 and 70,000 fish annually. Most of this was from southern California. Commercial landings increased rapidly during the 1990s with the development of the live fish trap fishery. Landings reached a peak in 1997 at 366,000 pounds and declined through 1999, though value remained high. Since then landings have fluctuated annually around 150,000 pounds.

Long-term studies at two localities in southern California, Palos Verdes Point and the King Harbor breakwater, have shown that the species was not abundant in the cool period of the early 1970s (Leet et al. 2001). The population increased at both sites with the onset of the little El Niño of 1977-1978. At King Harbor, the population peaked in 1978, decreased through the end of the great El Niño of 1982-1983, and remained low until the early 1990s when it again reached a large size (1994 and 1998) (Leet et al. 2001). With the exception of 1982-1983 El Niño, the population seems to increase during El Niño conditions and this is reflected in increased recruitment. At Palos Verdes, the population peaked in 1981, then declined until 1983, but has remained relatively stable since (Leet et al. 2001). At maximum, the density of sheephead at the Palos Verdes kelp bed was three times that of the King Harbor breakwater. There is no evidence from these very limited data that the population is threatened by existing fishery practices (Leet et al. 2001).

Home Range/Migratory Patterns:

Sheephead are a common inhabitant of reef/kelp areas. They can be found from shallow water to a depth of at least 280 feet, although they are most abundant in kelp bed depths. They range from Monterey Bay to the Gulf of California, but are not common north of Point Conception (Love, 1991). They are not migratory and are believed to be territorial and do not move far from their home reef.

Current Regulations:

Commercial fishermen must possess a nearshore finfish permit to take California sheephead. The minimum size limit is 13 inches total length. Sheephead may not be taken commercially north of Point Conception in March and April and south of that point in January and February.

The recreational minimum size limit is 12 inches total length. Five fish per day may be taken except that no fish may be taken in waters greater than 20 fathoms in the Cowcod Conservation Areas.

The Commission has established a combined recreational and commercial optimum yield for sheephead at 50 percent of recent catches as an interim precautionary measure because of the current data poor status of sheephead and to provide protection against overfishing. The optimum yield was set at 223,483 pounds for total allowable catches, with 135,524 pounds allocated to the recreational fishery and 87,959 pounds allocated to the commercial fishery. California sheephead is included in the Nearshore Fishery Management Plan. As noted above, the little data available suggest that current regulations are sufficient to protect California sheephead. Concern exists, however, for localized reductions of large individuals.

How MPAs May Help:

Sheephead may live for 50 or more years and attain a weight of 36 pounds. Few large individuals are found today due to fishing pressure. The California sheephead is a major predator of urchins and other invertebrates in the kelp bed community. Over-population of urchins has resulted in the loss of kelp in some areas. The protection of larger sheephead in MPAs might alter the relationship between urchins and kelp, resulting in significant changes to the dynamics of the local ecosystem. Since such reserves would protect other exploited species as well, the ecosystem functions of sheephead might be altered as a result of more intense competition and predator/prey interactions. Similarly, reserves would also protect habitats valuable to sheephead from a variety of potential fishing activity related impacts.

Studies on sheephead in the existing MPAs at Catalina and Anacapa Islands, and La Jolla have shown that size and abundance of sheephead are higher inside these reserves than outside (Beers and Ambrose In Prep.). It can be anticipated that relatively large reserves would allow for an increase in numbers and sizes of sheephead within the reserves.

Relatively large sized reserves can act to assure the continuing health of the sheephead population if changes in the exploitation levels occur, or if unforeseen environmental fluctuation results in a significant decline and sustainability of stocks. This insurance scenario would require that some significant portion of the stock is placed under reserve protection.

Sheephead are protogynous hermaphrodites; they begin life as females, with older, larger females developing into males. Female maturity occurs at three to six years, and fish may remain as females up to fifteen years. Timing of transformation involves population sex ratios as well as size of available males and sometimes does not occur at all (Leet et al. 2002). It would be expected that large MPAs would protect populations of large adult sheephead and delay the metamorphosis of females to males. These larger individuals have significantly higher reproductive potential than smaller individuals. However, since there does not appear to be a deficit in recruitment potential under the present management, any potential benefit through increased larval reproduction might be outweighed by the loss to the fishery from closing large areas of fishing grounds.

Since sheephead are primarily territorial and do not display significant movement, movements of individuals outside of reserves should not be expected to contribute significantly to fishery catches in areas adjacent to reserves.

## Cabezon (*Scorpaenichthys marmoratus*)

Status of the Population:

Limited information is available on population biology or changes in biomass over time (Leet et al. 2001); this is considered a data-poor situation. Recent increases in commercial fishing pressure on cabezon have intensified efforts to learn more about their life history characteristics, population biology, and to assess stock size. As a primarily recreational fishery for many years, catches from the CPFV fishery from 1947 to 1980 indicate that catches of cabezon were declining (Leet et al. 2001). Recreational landings have further declined concurrent with the increase in commercial fishing efforts and reported commercial landings. As fishing effort increases, it is likely that populations living in heavily utilized areas will decline further (Leet et al. 2001). Furthermore, as one of the nest-guarding species, cabezon are particularly vulnerable to spear divers and fishermen alike.

Home Range/Migratory Patterns:

Although not known, it is likely cabezon are residential and non-migratory. Cabezon normally occur nearshore, except as larvae. As fish get older, and larger they tend to migrate to deeper water. In shallower water, they migrate in and out with the tide to feed. Many California sculpin (Family Cottidae) species are highly territorial, which suggests cabezon may also be.

Current Regulations:

Commercial fishermen must possess a nearshore finfish permit to take cabezon. The minimum size limit is 15 inches total length. The commercial take of cabezon is prohibited from Thursday through Sunday, inclusive. Cabezon may not be taken commercially north of Point Conception to 40 degrees, 10 minutes north latitude (near Cape Mendocino) in March and April. They also may not be taken commercially south of Point Conception to the Mexican border during January and February.

The recreational minimum size limit is 15 inches total length. Recreational fishermen may possess no more than 10 cabezon.

Cabezon may not be taken in waters equal to or greater than 20 fathoms in the Cowcod Conservation Areas.

The Commission has established a combined recreational and commercial Optimum Yield for cabezon at 50 percent of recent catches as an interim precautionary measure because of the current data poor status of cabezon and to provide protection against overfishing. The Optimum Yield was set at 178,000 pounds for total allowable catches, with 84,000 pounds allocated to the recreational fishery and 94,000 pounds allocated to the commercial fishery. Cabezon is included in the Nearshore Fishery Management Plan.

How MPAs May Help:

Benefits most likely to accrue to cabezon are protection of a portion of the stock from localized depletion, protection of a portion of the available spawning biomass, protection of nest-guarding males and nests, and contribution to neighboring fished areas from the "export" of juveniles and to more remote areas via the transport of larvae. These benefits can best be realized when MPA sizes are commensurate with the movement patterns of cabezon. If the MPA is not large enough to protect some individuals completely then the chances of success are greatly diminished. Additionally, if MPAs are so far apart that larval transport does not result in larvae being deposited inside closed areas, there will be limited replacement of adult fish except by larval transport and movement of fish from fished areas. It is suggested that MPAs established for this species also include intertidal areas because newly settled cabezon recruit there, and larger fish often move up to feed in the intertidal. These benefits are based on the assumptions that cabezon are residential and not migratory, possess a home range comparable to other nearshore species being protected, and that their major prey items (such as crabs, lobster, and abalone) are protected as well (e.g., crabs, lobster, and abalone).

**Kelp Greenling (*Hexagrammos decagrammus*)**

Status of the Population:

There are no estimates of abundance for kelp greenling in California. The yearly sport catch remained relatively constant during the first ten years (1980-1989) it was surveyed, but has declined steadily from 1993 to 1999 (Leet et al. 2001). Since decline in catch may be one symptom of overfishing, this could be an indication that current levels of fishing are having adverse effects on the population, although no population data are available at present to confirm this. Spear fishermen could overfish local populations, however, because they can select individual targets, and greenlings are particularly vulnerable to spears when guarding their nests. Also, although commercial catch has been traditionally very low compared to recreational catch, the increased fishing pressure in recent years by the nearshore live fish fishery could have a much broader impact on the kelp greenling population in California (Leet et al. 2001).

Home Range/Migratory Patterns:

Kelp greenling are solitary, territorial fish. Not much is known about their home range or migratory patterns.

Current Regulations:

While kelp greenling are currently listed in the Federal Groundfish Plan for Pacific coast groundfish, they are not actively managed by the Pacific Fishery Management Council and are managed instead by the state. Many of the current regulations applying to kelp greenling also include a similar species, the rock greenling (*Hexagrammos lagocephalus*).

Commercial fishermen must possess a "nearshore finfish" permit to take kelp greenling and rock greenling. The minimum size limit is 12 inches total length for greenlings. The commercial take of greenlings is prohibited from Thursday through Sunday, inclusive. Greenling may not be taken commercially north of Point Conception to 40 degrees, 10 minutes North Latitude (near Cape Mendocino) in March and April. They also may not be taken commercially south of Point Conception to the Mexican border during January and February.

The recreational minimum size limit is 12 inches total length. Recreational fishermen may possess no more than 10 kelp greenling.

Kelp and rock greenlings may not be taken in waters equal to or greater than 20 fathoms in the Cowcod Conservation Areas.

The Commission has established a combined recreational and commercial Optimum Yield for greenlings of the genus *Hexagrammos* at 50 percent of recent catches as an interim precautionary measure because of the current data poor status of greenlings

and to provide protection against overfishing. The Optimum Yield was set at 39,800 pounds for total allowable catches, with 26,400 pounds allocated to the recreational fishery and 13,400 pounds allocated to the commercial fishery. Greenlings are included in the Nearshore Fishery Management Plan.

How MPAs Might Help:

There is no information specifically identifying benefits of MPAs for kelp greenling. As a solitary, territorial species, MPAs would likely protect individuals within their boundaries from take by fishing. It is expected that because of the similarities in life history between kelp greenling and cabezon that many of the same benefits which could accrue to cabezon would also apply to kelp greenling, such as potential to increase spawning biomass). It is suggested that MPAs established for this species also include intertidal areas because kelp greenling utilize intertidal as well as nearshore habitat.

**Garibaldi (*Hypsypops rubicundus*)**

Status of the Population:

There has never been any significant sport fishery for garibaldi (Oliphant et al. 1990). During the 1990s a commercial aquarium trade developed for juvenile garibaldi. At its peak, over 800 pounds were recorded. Although not substantial in terms of weight, because the fish were juveniles, these landings represented a large number of individuals. Since most of this take focused on one area, Catalina Island, there was concern for local depletion. In 1995 the California Legislature designated the Garibaldi as the Official State Marine Fish and banned any further commercial take. Garibaldi populations have rebounded from the local effects of commercial take and are in good condition throughout their range in southern California.

Home Range/Migratory Patterns:

Garibaldi range from Monterey Bay to Guadalupe Island, Baja California. In California they are rare above Point Conception, but larvae and juveniles are transported to the north during El Niño events. They are very territorial on rocky reefs, ranging from shallow sub-tidal to a depth of 95 feet (Love, 1991). Males build and defend nests, attending the eggs until they hatch. An individual may utilize the same nest site for many years.

Current Regulations:

No commercial or recreational take is allowed.

How MPAs May Help:

Since garibaldi is a protected species throughout California, adults of all sizes are already common. Accordingly, no significant population benefits can be expected to result from the full range of size classes afforded by the establishment of reserves. However, since such reserves would protect other exploited species as well, the ecosystem functions of garibaldi might change. Similarly, reserves would protect habitats valuable to garibaldi from a variety of potential fishing activity related impacts. Garibaldi are territorial and do not appear to migrate. Protection in MPAs would not be expected to provide for spillover of adult fish and it is likely that garibaldi are already at maximum densities. Some larval transport to distant areas would be expected, however this would not be expected to have significant impacts on populations as the garibaldi is already protected and at good population levels.

## Sea Urchins

### Red urchin (*Strongylocentrotus franciscanus*).

Status of the Population:

The relative abundance of red urchins has declined since the 1970s (e.g., Carroll et al. 2000). In southern California, the red sea urchin resource now produces about 10 million pounds annually, with harvestable stocks (defined as exceeding the minimum legal size and containing marketable gonads) in decline since 1990 (Leet et al. 2001). Between 1985 and 1995, the percentage of legal-sized red sea urchins at survey sites in the northern Channel Islands declined from 15 percent to 7.2 percent (Leet et al. 2001). Although fishing has significantly reduced density in many areas and catch-per-unit of effort has decreased, localized juvenile recruitment has, thus far, somewhat mitigated fishing pressure (Leet et al. 2001). Consistent recruitment has been noted on artificial settlement substrates and along subtidal transects over the last decade at monitoring stations along the southern California mainland coast and the northern Channel Islands (Leet et al. 2001). This may be partly due to ocean current patterns in the Southern California Bight, where water retention may increase the chances for larvae to encounter habitat suitable for settlement. Continued recruitment at present levels, however, is not guaranteed; in fact, intensive sea urchin take in northern California and Baja California could result in a decrease in sea urchin larvae in southern California in the future.

The northern California fishery has been characterized by rapid growth to 30 million pounds in 1988 and decline to less than five million pounds in the late 1990s (Leet et al. 2001). Fishery dependent modeling of the sea urchin fishery during the period of rapid decline estimated that the 50,800 tons of red urchins taken between 1988 and 1994 represented about 67 percent of the fishable stock available at the start of 1988 (Leet et al. 2001). Effort declined during this period as the 126 divers who had worked exclusively in northern California during 1991 had dwindled to 69 by 1995 (Leet et al. 2001). Annual catch per permittee declined by 57 percent from 1990 to 1995. Densities of fishable stocks continue to be depressed at subtidal survey sites examined in the Fort Bragg area since 1988. From 1988 to 1997, legal-sized red urchins surveyed outside of reserves, declined from 47 percent to 20 percent of the population, and from 0.8 per square meter to 0.2 per square meter surveyed (Leet et al. 2001). In contrast, during this period densities in two area reserves averaged over 3.0 red urchins per square meter (Leet et al. 2001). These patterns were observed to continue during northern California surveys in 1999 and 2000 (Leet et al. 2001). Episodic and infrequent recruitment combined with intensive take on the north coast have had a serious impact upon catches, as the fishery has evolved into a recruitment fishery, with fishermen targeting newly recruited sea urchins (Leet et al. 2001).

**Purple urchin (*Strongylocentrotus purpuratus*).**

Status of the Population:

Coincident with the decline of competing red urchins, purple urchins populations have increased tremendously at many island sites, creating vast areas denuded of macroalgae (Harold and Reed 1985; Ambrose et al. 1993; Engle 1994; Richards et al. 1997; Carroll et al., 2000, Lafferty and Kushner 2000). A small fishery has existed sporadically for this species which peaked in 1992 at 400,000 pounds and then declined to less than 50,000 pounds in 1999 (Leet et al. 2001). Larval settlement rates monitored at a number of locations in southern and northern California over the past 10 years do not indicate a change in larval production and recruitment patterns, which indicates that the status of this species appears to be stable (Leet et al. 2001).

**Sea Urchins**

Home Range/Migratory Patterns:

Purple and red sea urchins are found all along the west coast, from Mexico to Alaska. Purples are the most abundant on California's coast and occur in large numbers in intertidal regions. Reds inhabit the low intertidal to depths of 125 meters.

Sea urchin movements appear to be primarily in response to food shortages, such as occur during El Niño events when kelp beds can die off; urchins may aggregate and move in front denuding the remaining kelp forests. Sea urchins apparently do not make other movements or migrations.

Current Regulations:

The dive fishery for sea urchins is restricted access with 385 permittees. The current capacity goal, established in the early 1990s, is 300 divers. There is an annual urchin lottery to allow new participants into the fishery if any permits are available. There are closed days and weeks in April through October when red sea urchins may not be taken. Purple urchins may be taken at any time. In southern California, no red urchin between 1-1/2 and 3-1/4 inches shell diameter may be taken. In northern California no red urchin between 1-1/2 and 3-1/2 inches shell diameter may be taken. Additionally, there is a 20-landing requirement for renewal of the annual permit, and logbooks are required.

Recreational fishermen may take up to 35 urchins (in combination of species) of any size.

In the Master Plan required by the Marine Life Management Act, sea urchins were ranked in the top three fisheries in need of a fishery management plan. The Department is planning to develop research protocols in the coming year, and to proceed with an urchin FMP in the future. The red sea urchin fishery appears to be fully

exploited in California, and evidence from a variety of sources suggests overfished conditions in northern and portions of southern California. Various management actions could be applied to improve this situation including increased fishery- dependent and fishery-independent monitoring programs; monitoring of settlement patterns; a review of the capacity goal of the restricted access program; expanded collaboration with industry with research and monitoring; and consideration of MPAs in urchin management. Interim measures could include a size limit, management zones, and annual quotas.

How MPAs May Help:

Reserves in northern California could improve red urchin density which would have two positive effects on the population. Fertilization success would be improved in this broadcast breeder (their sexual products are released into the ocean) because of larger aggregations of red urchins; and juvenile survival would be increased due to protection of the young by the increased availability of adult spine canopy. Reserves could also protect a portion of the large, fecund breeders of both sexes. This stable population would help provide insurance against years of poor recruitment and thus provide a stable base of spawning adults.

Red sea urchin densities are known to increase inside MPAs. In a study of red sea urchins in the San Juan Islands, Tuya et al. (2000) found that abundance and size were significantly affected by the presence of established marine reserves. They found 60 times more large urchins than small urchins within marine reserves in the San Juan Islands that have been closed to take since 1970.

In northern California red urchin populations are significantly denser inside MPAs compared with fished sites (Rogers-Bennett et al. In Prep.). Densities outside the reserves in some areas in the north are far below that needed for fertilization success (less than 0.2 per square meter at Fort Ross) which has been estimated to be 4 per square meter (Levitan et al. 1992). These low densities were measured in 1999 and 2000 despite a major red sea urchin recruitment event which resulted in high densities of legal size urchin inside the MPAs (greater than 5 urchins per square meter) (Rogers-Bennett et al. In Prep.).

In southern California reserves could protect the stability of the ecosystem by not allowing purple urchins to proliferate when their larger relative, the red urchin, was removed by the fishery. Fertilization success and juvenile survival could also be affected positively. Reserves could protect large, fecund urchins of both sexes.

**Spiny lobster (*Panulirus interruptus*)**

Status of the Population:

Population size is unknown for the California spiny lobster (Leet et al. 2001). Commercial landings have fluctuated through the years and are influenced by some factors that are independent of the health of the population (such as water temperature, oceanographic patterns, weather and the export market). The closed season protects egg-carrying and molting female lobsters. The size limit ensures that there will be several year classes of broodstock, even if all legal-size lobsters are caught each season. The escape port has been effective in reducing the capture and handling of juvenile lobster. The Department has had a commercial logbook system in place since 1973. Catch effort, the numbers of legal and short lobsters taken, number of traps fished, and depths where the traps are fished are required information on the logs. The consistent presence of lobsters under legal size is generally a good indicator of a healthy fishery and population (Leet et al. 2001).

Home Range/Migratory Patterns:

A large portion of the lobster population makes an annual offshore-onshore migration that is stimulated by water temperature. During winter months they are found offshore at depths of 50 feet or greater. In late March through May lobsters move into shallow, warmer on shore waters less than 30 feet. In late October and November declining water temperatures and storm surge will move the lobsters offshore again. The spiny lobster is a southern California species with the majority of the population found in rocky areas between Point Conception and Magdalena Bay, Baja California, Mexico.

Current Regulations:

The commercial spiny lobster trap fishery is restricted access with 246 permittees. The current capacity goal is 225 trappers. There is an annual lobster lottery for lobster crewmembers if any new permits are available. The closed season is mid-March through September, the opening being the first Wednesday in October for commercial and the first Saturday before that for recreational take. All traps must be marked with a buoy bearing a P and the permittee's license number, have lobster escape ports, and trap destruct devices. Logbooks are required. The minimum size of lobster is 3 1/4 inches carapace length for both commercial and sport take.

Recreational divers may only use their hands to take lobsters, and their bag limit is seven a day.

Current regulations appear to be effective at managing the lobster fishery and resource.

How MPAs May Help:

Reserves could protect the shallow surf grass beds that are the required nursery areas for juvenile lobster. Trophy-size lobster of both sexes, which are also the most fecund, are becoming scarce, and a network of reserves would protect these individuals and allow them to reproduce. The absence of these large adults also has ecosystem effects, as they are predators on species like mussels and urchins. Lobster have extremely long and complex larval stages. It is thought, based on plankton surveys and ocean currents, that most of the lobster settling in California are produced in Mexico. Thus it is unclear whether lobster within MPAs in California would add to the population outside MPAs.

**California Corbina (*Menticirrhus undulatus*)**

Status of the Population:

Population estimates have not been made for California corbina. Beach seine hauls along the open coast in the mid-1990s yielded slightly lower but similar numbers of corbina to those obtained during a similar study in the mid-1950s. In addition, angler catch-per-unit efforts during the 1980s and the 1990s were similar to those in the mid-1960s, although annual catch estimates were much lower in the 1990s than in the 1980s. Annual catch per unit effort generally increases following increases in water temperature, such as during El-Niño/Southern Oscillation events. The population appears to be sustaining itself under present catch levels.

Home Range/Migratory Patterns:

Very little is known about the home range and migratory patterns of corbina. Limited tagging studies indicate that corbina do not move around much and they have no discernible migratory pattern. The greatest distance traveled was 51 miles. However, there is speculation that they seek warmer water in the winter by moving south, into bays or perhaps offshore.

Current Regulations:

No commercial take is allowed. It has been illegal to take corbina with nets since 1909, and illegal to buy or sell them since 1915.

California corbina are reserved for the recreational fishery. The recreational daily bag limit for corbina is 10, and there is no size limit.

Although the population appears to be sustaining itself under current regulations, continued colder water in the Southern California Bight may result in a reduction of the local corbina population. The current daily bag limit of 10 fish per angler does not increase protection for this species since most anglers rarely catch five or more corbina per trip. Marine Recreational Fisheries Statistical Survey and anecdotal data indicate that many smaller, immature corbina are caught and kept by anglers. A size limit may help to ensure adequate numbers of sexually mature fish.

How MPAs May Help:

Due to limited knowledge regarding movements and other life history parameters, it is unclear how reserves would help corbina. Corbina are mostly found in groups of several individuals, with larger fish being more solitary. Reserves would need to encompass large shallow, sandy areas since most corbina are found in this habitat. However, this may not protect spawning individuals since it is believed that they spawn farther offshore.

## Surfperches and Seaperches (Family Embiotocidae)

Annual commercial landings of surfperches have been highly variable. While the market for fresh "perch" fillets is relatively small, the total catch for the fishery was 49,000 pounds in 1999 (Leet et al. 2001). The Department did not distinguish between species in catch statistics until 1987, simply listing the category as surfperch. Currently, there is a large commercial fishery for various surfperches in southern California and a moderate fishery focusing on redtail surfperch in northern California (Leet et al. 2001).

The sport fishery is enjoyed by anglers who fish for surfperch from piers, jetties, sandy beaches, and boats. The recreational catch of surfperch for 1999 totaled 489,000 fish, with the majority being caught in central and northern California (Leet et al. 2001). The average sport catch for 1993 through 1999 was 864,000 fish with a high of 1,119,000 fish in 1998 (Leet et al. 2001). Most of the California coastal species taken in the sport catch are taken when spawning aggregations are present. Female surfperches are intentionally targeted by sport anglers because they are larger than males (Leet et al. 2001). Sport anglers also grade their catch, which probably results in an even greater take of mature females, contributing to a decline in the fishery (Leet et al. 2001).

The redtail and barred surfperches are the most notable in the commercial catch and may be important to local economies (Leet et al. 2001). Total commercial surfperch landings have fluctuated over the years, but over the long-term have declined by 25 percent since the 1950s (Leet et al. 2001). Recent research has indicated that some of the decline is associated with the increases in water temperature (Leet et al. 2001). Surfperch habitats have been, and will continue to be, areas of conflict. As humans develop the shoreline, areas inhabited by surfperches may become polluted or destroyed. Although surfperches may adapt to structures such as jetties and piers, it should not be assumed that they can continue to adapt to all the changes from human activities (Leet et al. 2001).

### Barred Surfperch (*Amphistichus argenteus*)

Status of the Population:

During the last seven years, the sport fishery in southern California has yielded up to 306,000 barred surfperch (1998), while central and northern California together produced upwards of 252,000 fish annually. No estimates have been made of the size or current status of the barred surfperch population (Leet et al. 2001).

Home Range/Migratory Patterns:

Barred surfperch are found in small schools along sandy beaches and near jetties, piers, and other sources of food and cover. They range from Bodega Bay in northern California to north central Baja California.

**Calico Surfperch (*Amphistichus koelzi*)**

Status of the Population:

The mean sport catch from 1993 to 1999 was 16,000 fish. There is no targeted commercial catch, but small numbers are taken in the directed redtail surfperch fishery. At this time, little information is available on the population status of the calico surfperch (Leet et al. 2001).

Home Range/Migratory Patterns:

The range of the calico surfperch is from north central Washington to northern Baja California. The primary habitat of the calico is sandy beaches, although they can occasionally be found over rocky substrate. The vertical distribution of the calico includes depths from the surface down to 30 feet.

**Pile Perch (*Damalichthys vacca*)**

Status of the Population:

Pile perch sustain a limited commercial fishery in Del Mar, California but do not contribute substantially to annual commercial landings in the state. They are of interest as a sport fish throughout the state, with an average of 16,000 perch caught between 1993 and 1999 (Leet et al. 2001). Because accurate landings data for pile perch are lacking, little can be concluded about the current population status in California.

Home Range/Migratory Patterns:

Pile perch are found between southeastern Alaska and northern Baja California, including Guadalupe Island. They usually live along rocky shores, from the surface down to 150 feet.

**Redtail Surfperch (*Amphistichus rhodoterus*)**

Status of the Population:

The annual commercial take averaged 37,000 pounds over the last 10 years, with a high catch in 1990 in excess of 62,000 pounds and a low catch of around 27,000 pounds in 1998. There are no estimates of the size of the redtail surfperch stocks in California coastal waters. The commercial catch averaged 50,000 pounds during the 1970s, 48,000 pounds during the 1980s and 38,000 pounds during the 1990s, which suggests a decreasing population. Another indicator of problems with the population is the decrease in weight from an average per fish weight of 1.8 pounds during the late 1950s and early 1960s to 0.9 pounds during the 1990s (Leet et al. 2001). The sport catch since 1993 has ranged from a low of 10,000 fish in 1998 to a high of 56,000 in 1994.

Home Range/Migratory Patterns:

Redtail surfperch are found from Vancouver Island, Canada, to Monterey Bay, California, but the fishery is centered north of the San Francisco Bay area. They support a commercial fishery only in northern California, especially in the inshore waters of the Eureka/Crescent City area where over 99 percent of the catch is taken. These fish are taken primarily from sandy beaches or the mouths of rivers and streams entering the sea, but also can be caught from jetties and piers inside harbors and bays. The best catches are in March and April when the fish aggregate for spawning.

**Rubberlip Seaperch (*Rhacochilus toxotes*)**

Status of the Population:

The sport catch over the last seven years ranged from 13,000 fish in 1993 to 44,000 fish in 1997 with an average of 19,000. The commercial fishery is very small with landings of less than 1,000 pounds annually from southern California (Leet et al. 2001). No recent estimates have been made of the rubberlip perch population and its status is unknown at this time.

Home Range/Migratory Patterns:

Rubberlip surfperch are found from Russian Gulch State Beach (Mendocino County), California, to central Baja California, including Guadalupe Island. These fish range from inshore waters to depths of 150 feet.

**Striped Seaperch (*Embiotoca lateralis*)**

Status of the Population:

Striped seaperch is one of the eight to ten species that make up the small commercial "perch" fishery. However, it is a minor component when compared to such species as the barred or redtail surfperch. Conversely, striped seaperch do comprise a substantial portion of the state's sport fishery. The mean take of striped seaperch for the last seven years was 65,000 fish, almost entirely from central and northern California. Population estimates of striped seaperch have not been made, but recent landing figures indicate that this species should be able to sustain a healthy sport catch (Leet et al. 2001).

Home Range/Migratory Patterns:

Striped seaperch are found from southeastern Alaska to northern Baja California.

**Walleye Surfperch (*Hyperprosopon argenteum*)**

Status of the Population:

The commercial take is very minor with less than 6,000 pounds being landed since 1984. The recent sport take has averaged 112,000 fish per year. However, the total stock size is unknown at this time.

Home Range/Migratory Patterns:

Walleye surfperch are found in large schools along sandy beaches, jetties, kelp beds and other habitats with rich invertebrate life. They range from Vancouver Island, British Columbia, to central Baja California, including Guadalupe Island (Leet et al. 2001). They are found from the surface to a depth of 60 feet.

**Surfperches**

Current Regulations:

The recreational bag and possession limit is 5 surfperch in combination of species. There is a 10 ½ inch minimum size limit on the sport take of redtail surfperch, and there is a closed season on the sport take of surfperch in San Francisco Bay and San Pablo Bay (bays) during the period April 1 through July 31, inclusive. However, during the closure in the bays, shiner surfperch may be taken and possessed under emergency regulations adopted during 2002 by the Commission. The Commission recently adopted the exemption to the closure in the bays for shiner surfperch on a permanent basis. Also, a requirement, that vessels entering the bays with surfperch aboard remain underway without fishing gear in the water until arriving at their home port or launch site was repealed through regulations adopted in June 2002 by the Commission.

Surfperch may be taken commercially only between July 16 and April 30 (season is closed from May 1 through July 15), except shiner perch may be taken at any time. Surfperch may be sold or purchased only between July 16 and May 10. South of Point Arguello, Santa Barbara County, barred, redtail, and calico surfperch may not be taken; however, during the open season for these species north of Point Arguello, these surfperch species may be shipped south of Point Arguello and sold if fish are individually tagged by the permanent attachment of tags as directed by regulations adopted by the Commission. There is no size limit for surfperch taken commercially.

How MPAs May Help:

Surfperch fecundity (the number of offspring produced by an individual female) increases with age and size. If the average size increases in a reserve then the reproductive potential would be greater. As live-bearers surfperch in general produce very few young. For species where fecundity is known, large females produce between 2 and 6 times as many offspring than younger, smaller, ones. In MPAs it would be

expected that more surfperch would be larger, thus significantly increasing the local reproductive output. This increase could lead to young surfperch replenishing nearby areas as they move out of the MPAs. Because some surfperch aggregate to spawn, MPAs in the appropriate locations could help protect spawning adults. This protection could provide for increased spawning success and thus more potential recruitment.

## Crabs

### Dungeness Crab (*Cancer magister*)

Status of the Population:

Dungeness crab populations in California have been fully exploited for at least 40 years and fishing intensity is extreme (Leet et al. 2001). In most years, between 80 to 90 percent of all available legal-sized male crabs are taken (Leet et al. 2001). Although such high exploitation rates on adult males might give rise to concerns that female mating success might be reduced as a consequence, recent studies have shown that essentially all molting females receive attention from males in northern California (Leet et al. 2001). Usually one, and no more than two year-classes of male crabs dominate annual landings. Thus, since about 1960, annual landings provide a reasonable notion of abundance of legal-sized males and also provide a strong signal of variation in year class strength of recruited crabs (Leet et al. 2001).

The dramatic decline in Dungeness crab catches in the central California fishery during the late 1950s focused considerable research attention on this resource during the 1970s. No definitive cause for the decline in the central California fishery has been established although researchers have assessed the possible effects of changes in ocean climate on survival and development of crabs eggs and larvae, the role of nemertean worm predation on egg survival, the effects of pollution on survival of juvenile crabs in San Francisco Bay, and possibly unstable internal population dynamics (Leet et al. 2001). Of these possible causes, a shift to warmer waters during and following the decline during the late 1950s seems the most plausible (Leet et al. 2001). If correct, the abundance of crabs in the central California fishery may improve over the next two decades if California coastal water temperatures remain cooler as a consequence of apparent ocean regime shifts (Leet et al. 2001). There seems little doubt that crab populations, with their extremely fecundities and vulnerable early larvae stages, are prone to large natural fluctuations in abundance. Variable oceanographic factors (temperature, wind, currents) have important impacts on survival (Leet et al. 2000)

Home Range/Migratory Patterns:

Dungeness crabs range from the Aleutian Islands to Point Conception. They prefer sandy to sandy-mud bottoms and can be found from the intertidal zone to depths of at least 750 feet but are most abundant in depths less than 300 feet. The resource off California consists of five subpopulations in the following areas: Avila-Morro Bay, Monterey, San Francisco, Fort Bragg and Eureka-Crescent City. Movement patterns by individuals of both sexes appear to be random with males moving more than females. At times, inshore or offshore migrations have been noted. Most movements are less than 10 miles, but some individuals have moved up to 100 miles. Dungeness crab larvae are planktonic for up to 125 days and go through six larval stages, first being transported offshore then onshore before transforming to the benthic adult stage.

Estuaries such as San Francisco and Humboldt Bays are important nursery areas for young crabs but, given the limited availability of such habitats, most Dungeness crabs develop and grow in nearshore coastal waters.

Current Regulations:

The commercial fishery is managed under a restrictive permit system which is generally open only to prior Dungeness crab permit holders and designed to eventually reduce the number of fishery participants. In 2001 there were 586 resident and 66 non-resident permittees which represents a decrease of 46 permits since the system was implemented in 1995. The fishery is closed from July 16 through November 30 north of Sonoma County and from July 1 through November 14 elsewhere. In addition, certain estuaries and areas near river mouths are closed to commercial take. Only male crabs with a minimum size of 6¼ inches carapace width may be taken. Traps must have at least two 4¼ inch diameter escape openings to allow females and undersize males to leave the trap. Traps must also be fitted with a destruct devise to allow them to open and crabs to escape if the trap is lost or not retrieved. Incidental take by trawl vessels is prohibited south of Point Reyes and limited to 500 pounds north of that point. No vessel may take crabs for commercial and recreational purposes on the same day.

Recreational closed seasons are from August 1 to the Saturday before December 1 north of Sonoma County and from July 1 to the Saturday before the second Tuesday in November elsewhere. The general daily bag limit is 10 crabs per person with a minimum size limit of 5 ¾ inches carapace width. In Sonoma, Marin, San Francisco, San Mateo, Santa Cruz and Monterey counties when onboard a commercial passenger fishing vessel (CPFV), the daily bag limit is six crabs per person with a minimum size of 6 inches carapace width. In addition, no more than a total of 60 traps may be used by a CPFV to take crabs. San Francisco and San Pablo Bays from the Golden Gate Bridge to the Carquinez Bridge are closed to crab fishing.

Although Dungeness crab populations have produce landings that have fluctuated around a fairly stable long term mean for more than thirty years, current fishery regulations generally appear effective in maintaining the population at productive levels and the resource might be considered healthy. However, no formal fishery management plan or stock assessments have been produced for west coast population.

How MPAs May Help:

Establishing relatively large reserves in Dungeness crab habitat might result in higher overall abundances, larger individuals and the presence of more age classes, primarily for male crabs, as a result of the elimination of fishing pressure within those areas. Since crabs move randomly over moderate distances, some would be expected to become available to the fishery outside the reserves. Because crab larvae are planktonic and transported over large distances, most of those produced inside the reserves are expected to be exported to other areas. Whether more larvae would be

produced in the reserves is questionable since female crabs are already protected from take and more of the reserve population is likely to be composed of males. Since such reserves would protect other exploited species as well, the ecosystem functions of crabs might be altered as a result of more intense competition and predator/prey interactions. Similarly, reserves would also protect habitats valuable to Dungeness crabs from a variety of potential fishing activity related impacts.

**Rock crabs: Brown rock crab (*Cancer antennarius*), yellow rock crab (*C. anthonyi*), and red rock crab (*C. productus*)**

Status of the Population:

Information is not available on stock sizes, recruitment and mortality rates, the effects of different oceanographic regimes, or potential yield of rock crab populations (Leet et al. 2001). The commercial fishery, however, has had a localized effect on crab abundance and size (Leet et al. 2001). Fishing areas intensively exploited over an extended period show a lower catch-per-trap and a reduced size-frequency distribution compared to lightly exploited areas (Leet et al. 2001). In Santa Monica Bay, an area closed to commercial crab fishing for decades, experimental catch rates were higher, crab sizes larger and size-frequencies broader than in adjacent areas open to commercial trapping (Leet et al. 2001). Future research should be aimed at a better understanding of fishery-related rock crab population parameters.

Home Range/Migratory Patterns:

These three species have overlapping distributions with the yellow rock crab ranging from Humboldt Bay into southern Baja California, the brown rock crab from northern Washington to central Baja California and the red rock crab from Kodiak Island to central Baja California. All three species occur in depths from the low intertidal zone to over 300 feet. Yellow rock crabs prefer sandy or soft bottom habitat, while brown and red rock crabs appear to prefer rockier or reef type substrates. These species do not appear to migrate or undertake large-scale movements. Tagged crabs have moved several miles, but with no apparent patterns. The planktonic larvae undergo at least seven developmental stages before transforming to the adult stage and settling to the bottom.

Current Regulations:

A general trap permit is required to take rock crabs commercially. All crabs must be at least 4¼ inches in carapace width. Traps must have at least one 3¼ inch diameter escape opening to allow undersize crabs to leave the trap. Certain areas, primarily portions of Humboldt Bay, Santa Monica Bay, Catalina Island and San Pedro Bay, are closed to commercial rock crab fishing.

The recreational rock crab daily bag limit is 35 crabs, in combination of species, per person with a minimum size limit of 4 inches carapace width.

How MPAs May Help:

Establishing relatively large reserves in rock crab habitats could be expected to result in higher overall abundances, larger individuals and the presence of more age classes as a result of the elimination of fishing pressure within those areas. A large area closed to the commercial fishery has shown these characteristics. Since crabs may move randomly over moderate distances, some would be expected to become available to the fishery outside the reserves. Because crab larvae are planktonic and transported over relatively large distances, most of those produced inside the reserves are expected to be exported to other areas. More rock crab larvae may be produced in these reserves since both sexes of rock crabs are subject to take and are expected to be in higher abundance inside reserves. Since such reserves would protect other exploited species as well, the ecosystem functions of crabs might be altered as a result of more intense competition and predator/prey interactions. Similarly, reserves would also protect habitats valuable to rock crabs from a variety of potential impacts related to fishing activity.

**California Halibut (*Paralichthys californicus*)**

Status of the Population:

Abundance of larval California halibut in plankton surveys is correlated with commercial landings of halibut, suggesting that this species has a cycle of abundance approximately 20 years in length (Moser and Watson 1990). However, the size of the halibut population may be limited by the amount of available nursery habitat, as juvenile halibut appear to be dependent on shallow water bays as nursery areas. The overall decline in California halibut landings corresponds to a decline in shallow water habitats in southern California associated with dredging and filling of bays and wetlands (Kramer and Sunada 1992). The total California biomass of the halibut resource obtained from virtual population analysis (VPA) estimate in the late 1980s was 5.7 to 13.2 million pounds, with annual recruitment of fish at age one estimated to be between 0.45 and 1.0 million fish (Reed and MacCall 1988). The number of juvenile halibut emigrating from southern California bays to the open coast (age one) estimated from beam trawl surveys ranged between 250,000 and 400,000 in the late 1980s (Kramer 1990 and 1991). In the early 1990s, a swept-area trawl survey was conducted by the Department to better understand California halibut population dynamics. This fishery-independent survey produced a biomass and population estimate for halibut in southern and central California. The survey results indicated a halibut biomass of 6.9 million pounds for southern California and 2.3 million pounds for central California, while the population estimate was 3.9 million halibut for southern California, and 700,000 halibut for central California (Wertz 2001).

Home Range/Migratory Patterns:

California halibut are found in nearshore waters on the west coast of North America from Almejas Bay, Baja California Sur (Oda 1991), to the Quillayute River, Washington (Eschmeyer et al. 1983). They are most common south of Morro Bay, California (Fitch and Lavenberg 1971), with their distribution centered off northern Baja California (Moser and Watson 1990).

Bays and estuaries are thought to be nursery grounds for juvenile halibut less than eight inches, because they provide optimal habitat for growth and survival (Allen 1988; Allen and Herbinson 1990; Kramer 1990, 1991). The eventual migration of juvenile halibut greater than eight inches from bays to the open coast has been suggested to be the first significant movement of California halibut (Domeier and Chun 1995).

Halibut living in open coastal waters are associated with soft bottoms, sand dollar beds, kelp beds, and rocky relief extending offshore from the surf zone to 183 meters (Feder et al. 1974; Eschmeyer et al. 1983), although they are typically more abundant in waters less than 15 fathoms (Kramer and Sunada 1992; California Department Unpublished data).

Over the past four decades the Department has conducted extensive tag and release studies of California halibut. Tagging effort ranged geographically from Sebastian Vizcaino Bay, Baja California, north to Tomales Bay, California, with the primary effort centered between Oceanside and Point Conception (Young 1961; Domeier and Chun 1995). Results showed that halibut less than 20 inches remained relatively localized and traveled less than 2 miles, although halibut greater than 20 inches traveled greater distances. The average overall distance traveled was eight miles during the study period. Their results also indicated halibut movement was parallel to the coastline, and northward migrations were of significantly greater distances when compared to halibut traveling southward. However, tagged halibut recaptures south of the international boundary with Mexico may have gone unreported, limiting our knowledge of southward migrations.

Current Commercial Regulations:

Three principal gears are used to commercially catch California halibut: bottom trawl, set gill and trammel net, and hook-and-line. In general, commercial fishing regulations prohibit the sale of California halibut less than 22 inches total length, unless the weight is at least four pounds whole, 3.5 pounds dressed with the head on, or 3 pounds dressed with head off.

Bottom trawling is prohibited within the State's jurisdictional waters (0-3 nautical miles), except in the designated "California halibut trawl grounds," which encompass the area between Point Arguello and Point Mugu in waters greater than one nautical mile from shore. Trawls used in this area must have a minimum mesh size of 7.5 inches, and trawling is prohibited from March 15 to June 15, to protect spawning adults.

Set gill and trammel nets are prohibited within the States jurisdictional waters (0-3 nautical miles) in southern California from Point Arguello to the Mexican border, and in waters less than 70 fathoms or within one nautical mile, whichever is less, around the Channel Islands, including San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbra, Catalina Island, and San Clemente Island. North of Point Arguello, depth restrictions on set gill nets varies by district. In a recent action by the Department to protect sea otters and seabirds, gill and trammel nets were prohibited from Point Arguello (Santa Barbara County) to Point Reyes (Marine County) in 60 fathoms or less. The minimum mesh size to take halibut is 8.5 inches.

No commercial hook-and-line gear may be used to take halibut in Fish and Game District 16 (waters south of a line drawn from Pt. Pinos, Monterey Bay, 100 degrees magnetic to the eastern shore), and no more than 30 hooks may be used per troll line to take California halibut in Districts 6, 7, and 10 (ocean waters from the Oregon border to Pigeon Pt.).

Current Recreational Regulations:

Recreational regulations also require a minimum size limit of 22 inches total length, in addition to a daily bag limit of five California halibut south of a line due west magnetic from Point Sur, Monterey County, and only three halibut per day when fishing north of a line due west magnetic from Point Sur, Monterey County. Fillets must be a minimum of 16-3/4 inches in length and must bear the entire skin intact. Halibut can be taken using hook-and-line, spear, or hand.

How MPAs May Help:

Current management measures for California halibut appear to be maintaining a sustainable fishery according to market receipt information, CPFV logbook data, and Recreational Fishery Information Network (RecFIN) data. However, marine reserves that encompass bays, estuaries, and lagoons would protect juvenile halibut and the habitat they require for growth and survival. Also, relatively narrow reserves that are positioned adjacent to the coastline out to 30 fathoms would protect the adult spawning population in southern California from increased fishing pressure from private boat owners and commercial hook-and-line fishermen.

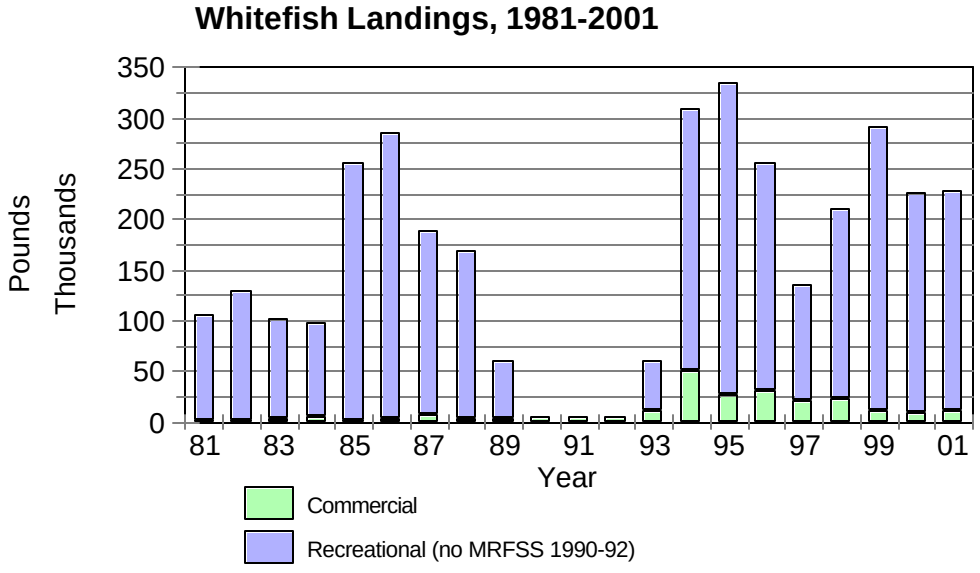
**Ocean Whitefish (*Caulolatilus princes*)**

Status of the Population:

The status of the population of ocean whitefish off California, and throughout the center of the population to the south of California, is generally unknown. Ocean whitefish are not believed to be resident to California waters, based on catch patterns and the distribution of their eggs and larvae. The southern California population of ocean whitefish is thought to be derived from central and southern Baja California, Mexico (Leet et al. 1992).

During the period 1980 through 2001, the California sport catch of ocean whitefish ranged between 43,000 fish (1989) and 335,000 fish (1995). Estimates of the pounds of ocean whitefish taken annually by anglers averaged about 149,000 during the 1980s and 213,000 during the 1990s, making this species an important component of the sport catch (see graph below). Following the peak in sport caught ocean whitefish in 1995, catches ranged between 91,000 to 212,000 fish for the balance of the 1990s. The average size of sport caught ocean whitefish ranged from 1.87 pounds per fish (1983) to 0.75 pounds per fish (1993).

Commercial landings of ocean whitefish remained at less than 10,000 pounds during the period from 1981 through 1992, but increased to nearly 51,000 pounds during 1994. Commercial catches have since ranged downward from 31,000 pounds in 1996 to 8,756 pounds in 2000, about 5-15 percent of the sport take during recent years. Given the generally sustained sport catches of ocean whitefish in recent years, the cause of recent declines in commercial landings is uncertain, but may be related to changes in market demand and/or restrictions on associated shelf and nearshore fisheries.



Home Range Migratory Patterns:

Ocean whitefish are reported to range from Vancouver, British Columbia, to Peru and possibly Chile, and in the vicinity of the Galapagos Islands. Off California, ocean whitefish seldom occur north of Point Conception, Santa Barbara County. Ocean whitefish inhabit shallow waters over rocky-bottom and kelp-bed habitats from near the surface to a depth of 450 feet. Loosely aggregated schools of adults often are found at depths of 10 to 65 feet. Adults swim a few feet above the bottom, dropping down occasionally to the substrate to feed. Ocean whitefish are more abundant around offshore islands and banks than along the mainland coast.

Ocean whitefish are not known to be a migratory species. However, ocean whitefish eggs, larvae, and juveniles stages may be carried significant distances along the California and Baja California coasts by nearshore current systems. These currents carry the pelagic stages of ocean whitefish northward into areas where they are not normally resident, and may eventually produce outlying "colonies" of adult ocean whitefish. These fish may thrive and grow in the cooler northern waters, but their reproductive success may be greatly inhibited by the existing oceanic conditions.

Current Regulations:

There are no specific regulations for the commercial take of ocean whitefish. Ocean whitefish may not be taken or possessed while recreational fishing in waters 20 fathoms or greater in depth in the southern rockfish and lingcod management area during a southern rockfish and lingcod closure from November to January, and in waters 20 fathoms or greater in depth in the Cowcod Conservation Areas (two large areas south of Pt. Conception).

Ocean whitefish are governed by the general 10-fish daily bag and possession limit. All fillets shall be a minimum of six and one-half inches in length. Each fillet shall bear a one-inch square patch of skin. There is no recreational size limit.

How MPAs May Help:

Current information indicates that ocean whitefish do not sustain reproducing populations off California (reproduction occurs to the south of California). Resident adult ocean whitefish that do occur off California generally result from the transport of larvae and juveniles northward into our waters. No-take reserves would prohibit commercial and recreational ocean whitefish fisheries without the long-term benefit of helping to sustain a locally reproducing population of ocean whitefish. To the extent that ocean whitefish are resident within a marine reserve, a prohibition on take would reduce fishing mortality on these fish. This, in turn, may result in enhanced growth of these fish in reserves, and allow for natural interactions with other locally reproducing species, but would not result in any expected enhancement of ocean whitefish production in local waters.

**Giant Kelp (*Macrocystis pyrifera*)**

Status of the Population:

The size and distribution of giant kelp beds has fluctuated greatly during the past 30 years. Kelp canopies have generally declined since1967, when the California Department conducted the first statewide survey documenting the size and distribution of kelp beds. Subsequent surveys in 1988 and 1999 found that kelp beds had declined statewide in each of those years compared to the 1967 level, with the greatest decline occurring along the mainland coast of southern California. This long term decline can be attributed to both natural disturbances such as warm water stress and intense storms associated with El Niños and human caused disturbances. These disturbances include increased turbidity and siltation associated with coastal development, pollution, and commercial and recreational fishing activities that remove animals such as California sheephead and California spiny lobster which may help sustain kelp forests through their trophic interactions.

Oceanographic conditions have been favorable for kelp growth during the past several years; relatively cool summer sea surface temperatures were followed by mild, dry winters with relatively few large swell events. These conditions have provided for strong recruitment and a general increase in canopy area for many beds, particularly those in southern California. The Department plans to conduct another statewide kelp survey in 2002.

Home Range/Migratory Patterns:

Giant kelp ranges from approximately Santa Cruz to southern Baja California, Mexico. The offshore edge of kelp beds in turbid waters usually occurs at depths of 50 to 60 feet, while in clear water around the Channel Islands of southern California, the offshore edge of the kelp bed may extend to more than 100 feet. Given favorable oceanographic and substrate conditions, giant kelp can occur and persist throughout the nearshore environment. Occurrences of giant kelp in California are frequently controlled by wave exposure and the availability of rocky substrate.

Current Regulations:

Commercial harvesters must posses a kelp harvesting license and pay a royalty on each wet ton of kelp harvested. Harvesters are not limited in the amount of kelp which may be harvested, however no kelp may be cut below 4 feet from the surface of the water (this protects the plant's reproductive structures which are located at the base of the plant). Department designated kelp beds may be exclusively leased for a period of up to 20 years, although harvesters may not lease more than 25 square miles or 50 percent of the total kelp resource (whichever is greater). Harvesters must report the weight of all kelp harvested by date and kelp bed number. Nine beds containing giant kelp are currently closed to commercial harvesting, and the Commission may designate,

through emergency regulation, any kelp bed or portion of a bed as a harvest control area where harvesting will be prohibited.

Recreational harvesters must possess a sport fishing license and may take no more than 10 pounds (wet weight) of giant kelp per day, except during the herring-roe-on-kelp season when 25 pounds may be harvested.

Under the current suite of regulations, the present level of harvesting is sustainable. In fact, from 1950 through 1980 the harvest appeared sustainable at levels nearly three times greater than those at present. Recent harvests are lower because the alginate industry has considerably reduced its demand for California kelp.

How MPAs May Help:

The long term decline in giant kelp has been linked to unfavorable oceanographic conditions, pollution, and habitat degradation (Foster and Schiel 1985). These factors are not likely to be affected by establishment of a reserve. Relatively large concentrations of sea urchins, perhaps a result of fewer predators, can also negatively impact kelp populations (North 1983, Tegner and Dayton 1991). Even so, reserves may benefit kelp by protecting species which feed on urchins such as California sheephead and spiny lobster that are the subject of intense directed fisheries. However, despite the protection offered to urchin predators in reserves urchins may still be more abundant in reserves than in adjacent areas subject to urchin harvest. Tegner and Dayton (1991) suggested that the commercial fishery for red sea urchins has helped to increase the long term stability of kelp off Point Loma. Other evidence suggests that the abundance may actually benefit kelp, by reducing the proportion of certain urchin species. In the Anacapa Island Ecological Reserve Natural Area the proportion of large red urchins to small purple urchins is higher than that in adjacent fished areas. Tegner and Dayton (1991) suggested that the commercial fishery for red sea urchins has helped to increase the long term stability of kelp off Point Loma.

Reserves may provide some benefit to portions of kelp beds which experience repetitive harvesting. Recently a small portion of a bed in Monterey County was closed due to a concern that certain plants were being negatively impacted by repetitive harvesting. Although much of the research involving the effects of harvesting on giant kelp have shown no negative long-term impacts, some studies have indicated that harvesting can reduce survivorship (Rosenthal et al. 1974) and that repetitive harvesting (defined as four or more harvests per year) can negatively impact yield (Brandt 1923).

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