10. KELP GREENLING

Review of the Fishery

Anglers have enjoyed fishing for kelp greenling, *Hexagrammos decagrammus*, for sport and sustenance for over a hundred years. The first greenling fishery was established by prehistoric Native Americans. Coastal Native Americans from the rocky shores of central California harvested kelp greenling, as well as rockfishes, providing a major source of food for people living in these coastal communities. Excavation of central coast Native American midden sites indicates a fishery existed between 6200 B.C. and 1830 A.D. Over one half of all fossil fish remains from these sites contained kelp greenling; lingcod, *Ophiodon elongatus*; cabezon, *Scorpaenichthys marmoratus*; and rockfish.

Today, kelp greenling is highly sought after by anglers and spear fishermen. Shore-based anglers take them from central to northern California, but they are more frequently targeted in the northern-most sections of the state. Between 1980 and 2006, shore angling accounted for 62 percent of all sport caught kelp greenling in California. The average angler catch for those years was 68,100 fish per year. Recreational landings of kelp greenling were much higher in the 1980s relative to the 1990s through 2003 (Figure 10.1a). The average angler catch per year from 1981-1989 and from 1993-2003 was 108,900 fish and 36,250 fish, respectively. Current data from 2004 through 2006 show a continuation of low catch levels (Figure 10.1b). Significant restrictions in regulations have occurred since the late 1990s which likely account for much of the observed decline (see Management Considerations, below). It is not known if any of the decline in annual recreational catch since the 1980s is a result of decreased abundance.

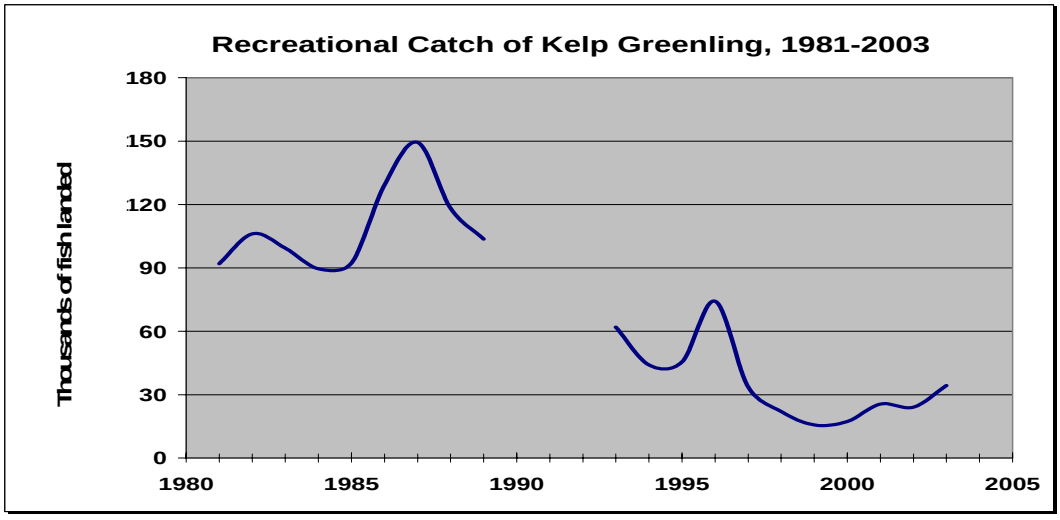

Figure 10.1a. Recreational catch (in numbers of fish) of kelp greenling from 1981 to 2003.Data source: MRFSS data for all gear types. No data available for 1990-1992.

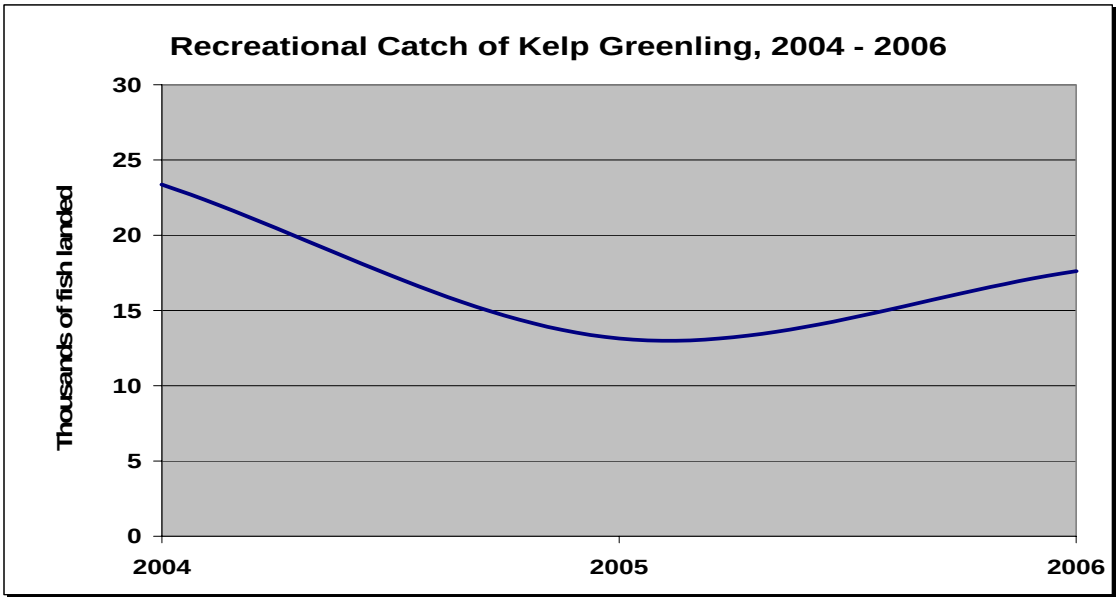

Figure 10.1b. Recreational catch (in numbers of fish) of kelp greenling from 2004 to 2006. Data source: CRFS data for all gear types.

Prior to 1999, there were no size limits and anglers could take 15 fish per day. In 1999, the bag limit for greenling was reduced to 10 fish per day followed by an establishment of a 12-inch (30.5-centimeter) size limit in 2000. A further reduction of the daily bag limit was instituted in 2003 when the limit was set at two fish and has remained so to the present.

Kelp greenling are commonly targeted commercially by hook-and-line and trap. Up until the 1990s, the commercial fishery for kelp greenling was largely based on incidental catch when fishing for lingcod and nearshore rockfishes. However, this pattern quickly changed in 1997 with the emergence of the nearshore "live-fish" fishery. Commercial landings of greenlings prior to 1997 peaked at 5,700 pounds (2.6 metric tons) per year. This number dramatically increased the following year to about 17,500 pounds (7.9 metric tons) and peaked at over 52,000 pounds (23.6 metric tons) in 2000 (Figure 10.2 and Table 10-1).

In the early years of the fishery, commercial landings played a minor role in overall landings of kelp greenling. From 1981 until 1998, sport fish landings accounted for the vast majority of kelp greenling landings. The large difference between commercial and recreational landings during this time period can largely be attributed to greenling being taken as incidental catch when fishing commercially for other nearshore fish species. However, in 1999 and 2000, commercial landings exceeded recreational for the first time. This short-lived increase in landings resulted from commercial fishermen specifically targeting kelp greenling for the "live-fish" fishery. This trend was reversed starting in 2001 after implementation of new

regulatory actions. Recreational landings continue to remain higher than commercial landings to date (Figure 10.2)

In 2001, the Department of Fish and Game set total allowable catch (TAC) limits and allocations to the recreational and commercial fisheries in order to better manage the fishery. This was the first time that kelp greenling was actively managed with ongoing monitoring. Initially in 2001, the commercial allocation was set at 19,400 pounds (8.8 metric tons) per year but was reduced to 13,400 pounds (6.1 metric tons) the following year. During this time, season, depth, and size limits were also imposed. This was followed by the implementation of a restricted access program in 2003 which limited the number of permits in the fishery. In order to comply with management decisions set forth in the Nearshore Fishery Management Plan (NFMP), (see Management Considerations, below) allocations were set at conservative low levels as a result of an unknown stock abundance. Currently, the annual kelp greenling commercial landings allocation is set at 3,400 pounds (1.5 metric tons).

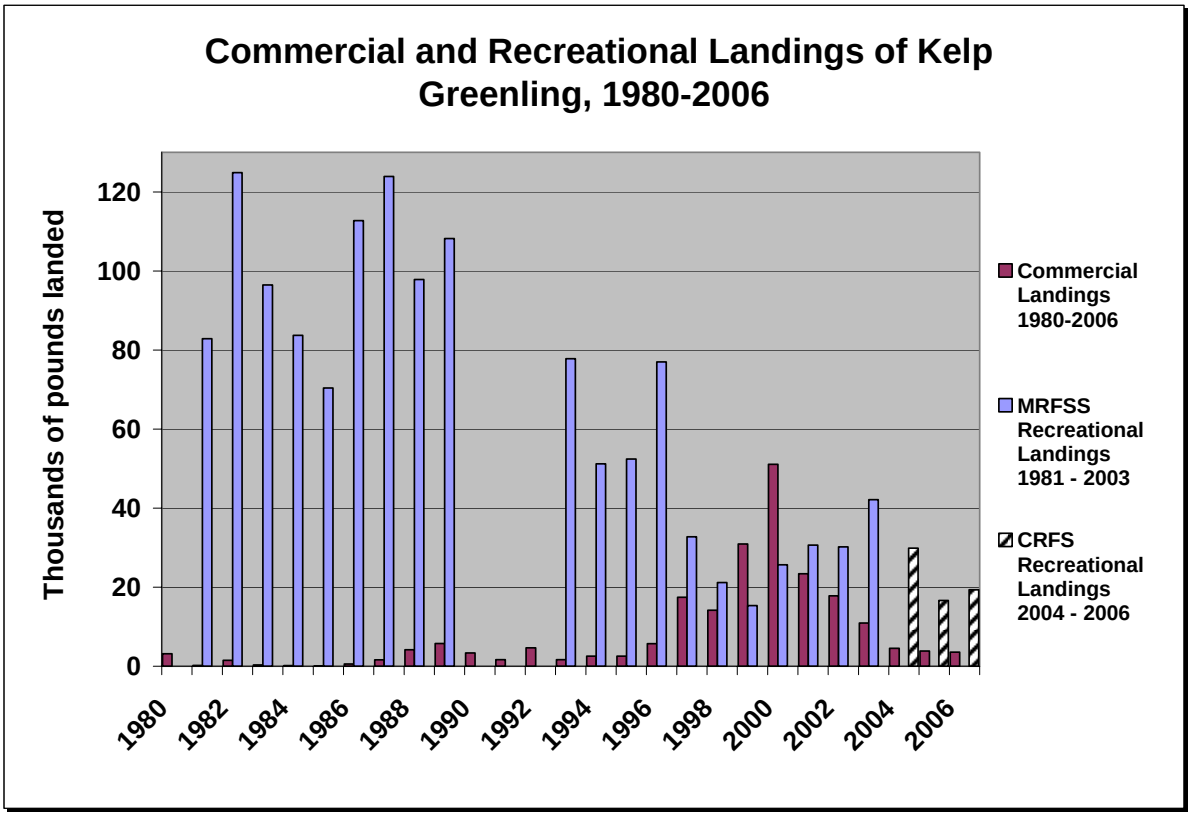

Figure 10-2. Annual kelp greenling landings (in pounds) for commercial landings from 1980 to 2006, MRFSS recreational landings 1981 to 2003, and CRFS recreational landing 2004 to 2006. No MRFSS data available for 1981and 1990 to 1992.

Fishing revenue from the 2006 commercial harvest of kelp greenling was about $24,000 (ex-vessel 2006 dollars). The contribution to total business output, for the State, from this 2006 commercial harvest is estimated to be $45,000. Likewise, total employment and wages from kelp greenling is estimated to be the equivalent of 1 job and $21,000, respectively.

Status of Biological Knowledge

The kelp greenling is a member of the family Hexagrammidae, which includes rock greenling, *Hexagrammos lagocephalus*, and lingcod. They are abundant from the Aleutian Islands, Alaska, to central California but are occasionally seen as far south as La Jolla, in southern California. Kelp greenling inhabit kelp beds and rocky reefs but are also known to frequent sandy bottom areas; they are found subtidally to a depth of 150 feet (46 meters). Generally, they range in size up to 18-inches (45.7-centimeters) but have been reported to reach 24-inches (61-centimeters). Currently, studies are being conducted to determine the movement patterns of kelp greenling. It is unclear if they move between rocky reefs or prefer to stay on one reef. It has been documented that males show a high degree of site fidelity during breeding season, but it is not known whether this is a seasonal or long-term behavior.

Although males and females are similarly colored, it is easy to distinguish the sexes. Both sexes range in color from light grey to brown in body color, but males have blue irregular spots on their head and forebody, whereas females are speckled with red-brown to gold spots. For over 70 years, it was thought that the two sexes were different species until it was discovered that kelp greenling were sexually dimorphic.

The reproductive behavior of kelp greenling is similar to other hexagrammids and cabezon, *Scorpaenichthys marmoratus*. Females participate in multiple spawning events per season, and males exhibit egg-guarding behavior (nesting). Although it is not precisely known when the spawning season takes place for kelp greenling, it is believed to occur between September and December in California. During this time, males become increasingly territorial and often establish nesting sites among rocky outcroppings where increased water circulation occurs. By doing this, males increase the survivorship of young by providing protection from egg predation and by fanning to increase oxygen flow over their egg clutches. Spawning females, which mature by their fourth year, lay sticky egg masses that adhere onto kelp, rocky outcrops, and other substrate that males claim as nesting sites. Egg masses range from golf-ball to tennis-ball size and have an average of 4,000 eggs per cluster. Batch spawning females contribute a minimum of three egg clutches per spawning season, and multiple females may contribute egg clutches to a single nest.

Larvae incubate under male parental care for 4 to 5 weeks and emerge about 1/3-inch (8.5-millimeters) long. These larvae can spend up to a year in the plankton feeding on copepods before finally settling from the pelagic environment to the nearshore benthic community. There is no difference in growth rates for males and females for the first 3 years. At 3 years of age, both sexes are around 7-inches (17.8-centimeters); thereafter, males grow at a much slower rate than females. Males and females reach a maximum size of around 12-inches (30.5-centimeters) and 14-inches (35.6 cm), respectively, at around 12 years. Adult kelp greenlings consume a wide variety of food including crabs, amphipods, polychaetes, ascidians, and juvenile fishes. The primary predators of kelp greenling are fishermen, lingcod, and harbor seals, *Phoca vitulina*.

Status of the Population

There are currently no estimates of abundance for kelp greenling in California. Although a stock assessment was attempted in 2005, it was not accepted for management use because the biological data needed to establish trends in population growth were limited (see Management Considerations, below). It is likely that much of the observed decline in catch from recreational anglers is a response to a decrease in fishing pressure, stronger regulations limiting daily take and sizes, or depth and season restrictions. It is not known if any of the decline can be attributed to decreases in abundance or to other factors. The amount of annual recruitment of kelp greenling is unknown. This makes determining population replenishment very difficult and contributes to the overall lack of knowledge pertaining to kelp greenling population size and structure.

Management Considerations

The kelp greenling became a federally designated groundfish in 1982 when the Pacific Fisheries Management Council (PFMC) adopted the Pacific Coast Groundfish Fishery Management Plan. Since then, it has been managed under the joint jurisdiction of the state and the federal government. Prior to 1982, this species was managed by California Department of Fish and Game (CDFG) through regulations adopted by the state legislature and the California Fish and Game Commission (FGC).

Since the late 1990s, considerable federal pressure developed to rebuild "overfished"[1] species. Subsequent management actions designed to avoid these species shifted fishing effort into nearshore areas, putting additional pressure on shallow species such as kelp greenling. At the same time, state and federal

[1] "Overfished" is a formal federal or state designation used when the status of an assessed stock is determined to be at a critically low level; several important California groundfish species share this designation including bocaccio, canary, cowcod, widow and yelloweye rockfishes and previously, lingcod.

management took a more precautionary approach for unassessed, “data poor” species by lowering harvest limits. In addition, the popularity of the commercial live-fish fishery increased dramatically in the 1990s, resulting in even greater pressure on nearshore stocks.

California’s Marine Life Management Act (MLMA) of 1998 was adopted in response to the need to take a more precautionary approach to management that prioritized resource sustainability, and to address the rapid development of the live-fish fishery. This important piece of legislation made the possession of a commercial nearshore permit mandatory and delegated finfish management authority to the FGC. Minimum commercial size limits for nearshore species including kelp greenling were enacted. The MLMA also required that the FGC adopt a Fisheries Management Plan (NFMP) for nearshore finfish.

In 2000, under these new guidelines, the FGC adopted a precautionary approach for nearshore stocks including kelp greenling. In the absence of a kelp greenling assessment, harvest limits were set at 50 percent of historic landings.

Nineteen nearshore species including the kelp greenling are managed under provisions outlined in the NFMP, which was adopted by the FGC in 2002. The NFMP also mandated a precautionary management approach for stocks without quantifiable assessments so harvest limits continued to be set at 50 percent of historic landings until better information was available. In conjunction with the NFMP adoption, the FGC adopted a restricted access program which reduced the number of nearshore permittees regionally, limited approved gears to trap and hook-and-line, and provided for minimal bycatch in other fisheries.

Recreational and commercial catches are routinely monitored throughout the year to keep catches within annual TACs as much as possible. The commercial fishery has closed early for the past six years and commercial allocations were exceeded during five of those years. However, harvest allocations are being maintained at a very conservative level until better stock assessment data are available.

The significant gaps in sound scientific data represent one of the challenges in managing the kelp greenling fishery. As a result, kelp greenling will continue to be conservatively managed. Currently, the statewide total allowable catch for greenlings is 37,600 pounds (17 metric tons), of which the commercial fishery is allocated 3,400 pounds (1.5 metric tons) and the recreational fishery is allocated 34,200 pounds (15.5 metric tons).

A 2005 greenling stock assessment was not accepted for use in management due to limited scientific data. Specifically, there was uncertainty regarding greenling age, growth, and mortality rates. A basic knowledge of fish growth coupled with the relative numbers of juveniles and mature fish in the population are essential to help answer questions about how fishing affects the population’s long-term sustainability. It is helpful to know at what size and age a fish reaches sexual maturity and what percentage of the fish population is of reproductive size or age. Development of a fishery independent index of abundance, coupled with collecting more complete data

on age and growth (including sex-specific length at age data), maturity, and movement patterns within California waters, will aid management. Current studies by CDFG are addressing movement patterns and growth, and will be used in future stock assessments and management.

Sean Hoobler
Marine Biologist, Monterey, (Shoobler@dfg.ca.gov)

Further Readings

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Table 10-1. Commercial landings (pounds) of kelp greenling, 1980-2006					
Year	**Pounds**	**Year**	**Pounds**	**Year**	**Pounds**
1980	3,147	**1990**	3,334	**2000**	51,070
1981	216	**1991**	1,645	**2001**	23,432
1982	1,477	**1992**	4,626	**2002**	17,817
1983	316	**1993**	1,651	**2003**	10,930
1984	158	**1994**	2,550	**2004**	4,533
1985	79	**1995**	2,577	**2005**	3,840
1986	609	**1996**	5,710	**2006**	3,581
1987	1,578	**1997**	17,445		
1988	4,180	**1998**	14,177		
1989	5,783	**1999**	30,925		