

# Thornyheads

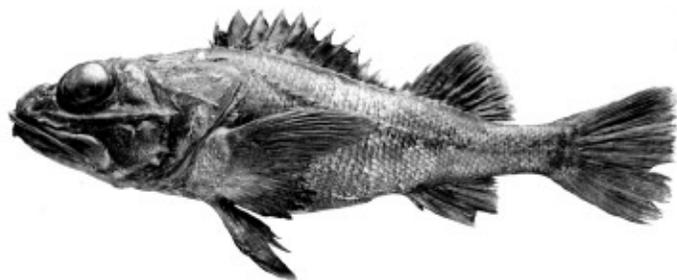
## History of the Fishery

Longspine (*Sebastes altivelis*) and shortspine (*S. malascanus*) thornyheads are both important to commercial fisheries in California, Oregon, Washington, Canada and Alaska, but are insignificant in recreational fisheries. In California, Oregon and Washington, thornyheads are taken in the deepwater commercial fishery for Dover sole, thornyheads, and sablefish, known as the DTS complex. In terms of landed weight and ex-vessel value, the DTS complex is the most important element in the California groundfish fishery.

Fishing for thornyheads is typically by bottom trawl and longline gear on sand or fine sediment, and in relatively deep water (1,800 to 3,000 feet, although some fishing grounds are as shallow as 600 feet). Fishermen report that there are areas where both thornyhead species are found together and other areas where one or the other is prevalent. Most of the thornyheads landed in California are taken in the Eureka, Fort Bragg, and Morro Bay areas. Few thornyheads are taken south of Point Conception.

Although there are physical differences between the two species and shortspine thornyheads grow to larger size, distinguishing between them can be difficult under field conditions. Landings and other data for each species may, therefore, be less reliable than data for thornyheads as a group. It is likely that thornyhead landings were mostly shortspine during the early years when the fishery operated in relatively shallow water. Longspine thornyheads were not landed in large quantities until later when the fishery expanded into deeper water. The long-term trend is toward a lower proportion of shortspine in landings. During the 1980s, thornyhead landings were about 75 percent shortspine, which decreased to only 25 percent shortspine thornyheads in the 1990s.

The west coast fishery for thornyheads first developed in northern California during the 1960s, when large thornyheads (primarily shortspine, minimum size 12-14 inches) were marketed as rockfish fillets in domestic markets.



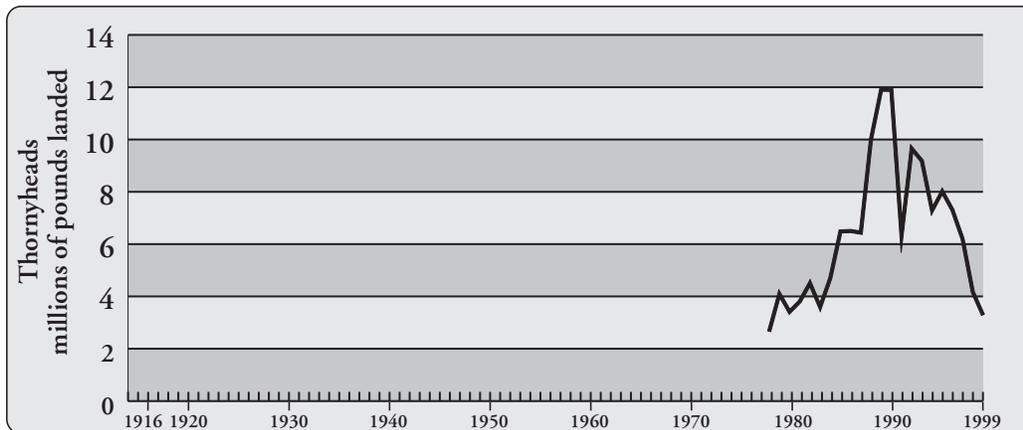
Longspine Thornyhead, *Sebastes altivelis*  
Credit: DFG

Increased landings during the 1980s were the result of higher prices and demand for thornyheads, primarily as a headed and gutted product exported to Japan. As markets for thornyhead matured, minimum marketable size decreased and smaller longspine thornyheads became valuable. During the 1980s, most processors began accepting fish as small as 10 inches, the fishery expanded into deeper waters, and landings of longspine thornyhead increased. By the 1990s, a two-tier price structure (higher prices for large fish) replaced the minimum size limits that had been previously imposed by the buyers.

Market factors and fishery regulations effect discard rates, particularly for small fish. Discard rates have changed over time but have often been substantial. During the late 1990s, trip limits imposed by fishery managers caused additional discarding of shortspine thornyhead because shortspine trip limits were reached before the limits for longspine. In 1999, managers assumed a 30 percent discard rate for shortspine thornyheads, and a five percent discard rate for longspine thornyheads.

California landings of thornyheads are consistently the largest on the West Coast. During most years, the California fishery accounted for over one-half of the combined California, Oregon and Washington landings. From 1953 to 1969, annual thornyhead landings in California were below 440 tons. Thornyheads became more common in landings when California trawlers began fishing intensively for Dover sole in the early 1970s. Landings averaged 1,540 tons annually from 1970 to 1979, increased throughout the 1980s, and reached a record high of 7,800 tons in 1992. Following the record high, landings during the remainder of the 1990s trended sharply downward due to harvest restrictions, to a low of 1,628 tons in 1999.

As export markets developed in the 1980s, nominal prices paid to fishermen increased by more than 60 percent, from \$0.23 in 1983 to \$0.38 per pound by the end of the decade. Gross revenues for thornyheads landed in California rose from \$728,000 in 1980 to \$5,971,000 in 1990 (dollar amounts not adjusted for inflation) as the result of increased prices and landings. The relative value of thornyheads in the groundfish fishery also increased during that time. Revenues from thornyheads were only 12 percent of total revenues for the deepwater fishery (DTS complex) during 1980, but increased to 39 percent by 1990. The value of California thornyhead landings trended upwards through the mid-1990s, and reached a high of \$8,292,000 in 1995, which coincided with record high ex-vessel prices (excluding live fish) of \$1.05 per pound. Annual thornyhead revenues declined after 1995 due the decreased tons landed and slightly lower prices (excluding live fish). Annual revenues from landings totaled about \$3,286,000 during both 1998 and 1999.



### Commercial Landings

#### 1916-1999, Thornyheads

Data for total thornyhead includes landings for longspined thornyhead, shortspined thornyhead, and unspecified thornyhead. Expansion data not available for years prior to 1978. Landings data for longspined thornyhead, shortspined thornyhead, and unspecified thornyhead are presented in the landings tables at the end of Groundfish Chapter. Data Source: CalCom, a cooperative survey with input from Pacific Fisheries Information Network (PacFin), National Marine Fishery Service (NMFS), and California Department

of Fish and Game (DFG). Data are derived from DFG commercial landing receipts with expansions based on port samples collected by PacFin samplers.

An important specialty market has developed for live thornyheads since 1993, which takes advantage of their lack of a swim bladder and ability to survive after capture at depth, and ex-vessel prices that are several times higher than for dead fish. Landings of live thornyhead increased from two tons in 1993 to an estimated 107 tons in 1999. Despite steady growth, the live fishery has remained a minor part of the total tons of thornyheads landed. However, due to the high ex-vessel prices, live fish accounted for a significant fraction (18.8 percent, or \$619,000) of the total value of thornyhead landings in 1999.

With the 4.5-inch mesh cod ends currently used in the commercial trawl fishery, thornyheads become vulnerable to bottom trawls at about five to seven inches in length and at an age of about eight to nine years. Thornyheads are seldom taken by gill nets or in the recreational fishery because of the depths at which they live.

Thornyheads are managed by the Pacific Fishery Management Council under the Groundfish Management Plan. Shortspine and longspine thornyheads were first regulated in 1990. Annual quotas and associated fishing regulations were established for thornyheads as a group during 1990-1994 because of difficulties in separating the two species in the landings. Beginning in 1995, individual quotas and trip limits were adopted and enforced for each species. The separate trip limits for each species resulted in a requirement that catches be sorted by species prior to weighing. Shortspine trip limits have been about 75 percent smaller than limits for longspine in recent years, which has likely caused some discards of shortspine because vessels could continue fishing for longspine after the shortspine limits were reached. During 2000, the total West Coast optimum yield for shortspine thornyheads was 1,250 tons of landed catch, and for longspine thornyhead it was 4,980 tons.

## Status of Biological Knowledge

Thornyheads (genus *Sebastolobus*) belong to the same family (Scorpaenidae) as the rockfishes (*Sebastes* spp.) but are distinguished from them in having more dorsal and head spines, in losing their swim bladder at the time they settle to the bottom, and in spawning gelatinous egg masses. Shortspine thornyheads grow to larger size and when small are found in shallower water than longspine thornyheads. Population dynamics of the two species differ. Shortspine thornyheads have longer life span, lower natural mortality, and smaller biomass than longspine thornyheads. Consequently, shortspine thornyheads are less productive than longspine thornyheads with respect to fishery yields.

Shortspine thornyheads tend to migrate toward deep water as they grow, and larger shortspine thornyheads may be found in deeper water with longspine thornyheads. Longspine thornyheads, in contrast, spend their entire lives in a more narrow range of depth. The adults of both species are major components of the assemblage of fishes on the continental slope. Both species have special enzymatic adaptations that allow metabolic activity despite the high pressure, low oxygen, and low temperature at the depths where they live. Peak spawning biomass for both species is in the deep "oxygen minimum zone" at 1,200 to 3,000 feet, where concentrations of dissolved oxygen may be less than 0.5 parts per thousand. Longspine thornyheads have been described as "oxygen minimum zone specialists."

Estimates of ages for both species are based on counts of growth rings in thin-sectioned otoliths. Shortspine thornyheads can grow to 30 inches and may be quite long-lived. Radiochemical analysis of otoliths from shortspine thorny-

heads suggest larger size-at-age than were obtained by annuli counts. It is particularly difficult to determine the age of older individuals, but recent estimates indicate that the maximum age of shortspine thornyheads off California may be in excess of 100 years. Longspine thornyheads grow to a maximum length of 15 inches. Their maximum age is probably at least 45 years.

Shortspine thornyhead are found at depths of about 100 to over 5,000 feet along the west coast of North America from northern Baja California to the Bering Sea and across the North Pacific to the coast of Japan. It is not known if separate stocks exist. Off California, shortspine thornyhead spawn during late winter and early spring. Males off Alaska may spawn at about 6.5 inches in length (estimated age five). About half of all females off California are sexually mature at 8.25 inches in length (estimated age 13) and almost all are sexually mature at 13.5 inches (estimated age 28). A female may release as many as 400,000 eggs annually in gelatinous egg masses that float to the surface. Larvae free themselves from the egg when about 0.25 inch in length and transform to juvenile fish at about 0.75 inch. Larvae and young juveniles are pelagic for 14 to 15 months and settle to the bottom when about one inch long during January to June of the year after they hatch. Juveniles settle in shallow water along the upper boundary of their habitat and move to deeper water as they grow. They spend the rest of their lives closely associated with the bottom. Shortspine thornyheads in Alaska are known to eat crustaceans, crabs, worms, clams, octopus, sea cucumbers, and fish. Longspine thornyheads feed primarily on polychaetes and small crustaceans.

Longspine thornyheads are found from Cape San Lucas, Baja California to the Aleutian Islands in water from about 1,000 to over 5,000 feet deep. It is not known if separate stocks exist. Like shortspine thornyheads, longspine thornyheads spawn in the late winter and early spring. Half of the females are sexually mature at about 7.5 inches (estimated age 14) and most are mature at 8.75 inches (estimated age 18). A female may produce as many as 100,000 eggs annually, which, like the eggs of the shortspine thornyhead, are released in gelatinous egg masses that float to the surface. Two to four batches of eggs may be spawned each year. Larval fish are pelagic after hatching and transform into juveniles during July to December. Young juveniles are pelagic for as long as 20 months and begin settling to the ocean bottom when about two inches long. Settlement starts during the summer of the year after they hatch. Juvenile longspine thornyheads settle in deeper water than do shortspine thornyheads, with newly settled juveniles occupying the same depth range as adults. There does not appear to be a tendency for individuals to move deeper as they grow.

## Status of the Population

Stock assessments are carried out for both longspine and shortspine thornyheads. Results are used by fishery managers to determine allowable fishing mortality each year. Shortspine thornyheads along the west coast of the U.S. were assessed in 1998 by two independent analyses. Both assessments used data from the fishery and data from scientific trawl surveys. Based on the combined results, the stock in 1999 had declined to 32 percent of unfished abundance. The best estimate of spawning biomass from central California to the U.S./Canada boundary in 1998 was 32,365 tons, compared to an estimated unfished stock size of 95,755 tons. Maximum surplus production and yield for thornyheads probably occurs at biomass levels greater than 40 percent of unfished stock size. Consequently, current abundance of shortspine thornyhead is less than desired, and recent fishing quotas have been set at levels to allow some growth in stock size.

The most recent assessment of longspine thornyheads was done in 1997, using fishery and survey data to estimate changes in abundance and associated uncertainty. The assessment covered the portion of the stock found from central California to the U.S./Canada international boundary. Results indicate that spawning biomass steadily declined in recent decades, from a high of 36,958 tons in 1964 to 20,203 tons in 1996. The degree to which longspine thornyheads have been fished down is generally thought to be appropriate for attaining maximum fishery yields from the stock, based on biological characteristics and population dynamics of the species.

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