California's Living Marine Resources:
A Status Report

The Resources Agency
The California Department of Fish and Game

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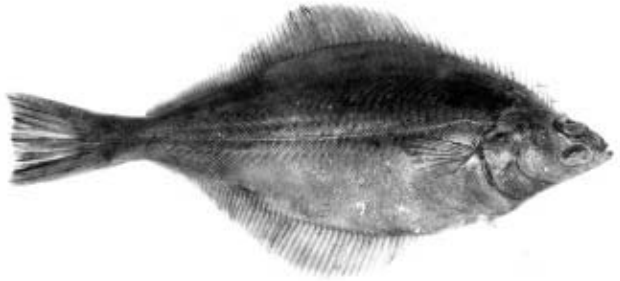
English Sole

History of the Fishery

English sole (*Pleuronectes vetulus*) has been commercially important since the introduction of the first trawl net, the paranzella, in San Francisco in 1876. The use of trawl nets made the catch of "sole" species one of the leading categories of fish landed in California, and English sole was the leading flatfish in that group until Dover sole took first place in 1949. Since then, English sole has been second in pounds landed except for 1970 through 1972, when petrale sole was second. The peak year for English sole was 1929, when 8.7 million pounds were caught off central California and at new fishing areas off Fort Bragg and Eureka. Annual landings in California averaged 2.8 million pounds during the 10 years from 1980 to 1989 and dropped to an average 1.3 million pounds between 1990 and 1999. The majority of recent California landings were made by trawlers fishing on the grounds off Eureka and San Francisco. Little is taken commercially south of Point Conception.

English sole are fished primarily by trawling in water 120 to 900 feet deep on sandy bottoms. Because of the shallow water in which this species is found, relatively small vessels can participate in the fishery. A very small portion of the catch is taken by commercial hook-and-line or by gill net, and it is not an important species for recreational fishing. Female fish greater that 11 inches comprise the majority of landings because females tend to be longer and heavier than males, and markets request fish of at least 11 inches in order to produce reasonable size fillets. While English sole fillets are desirable for the market and restaurant trade, demand is affected by the abundance of other flatfish and roundfish as well as the availability and price of imported fish products.



English Sole, *Pleuronectes vetulus*
Credit: DFG

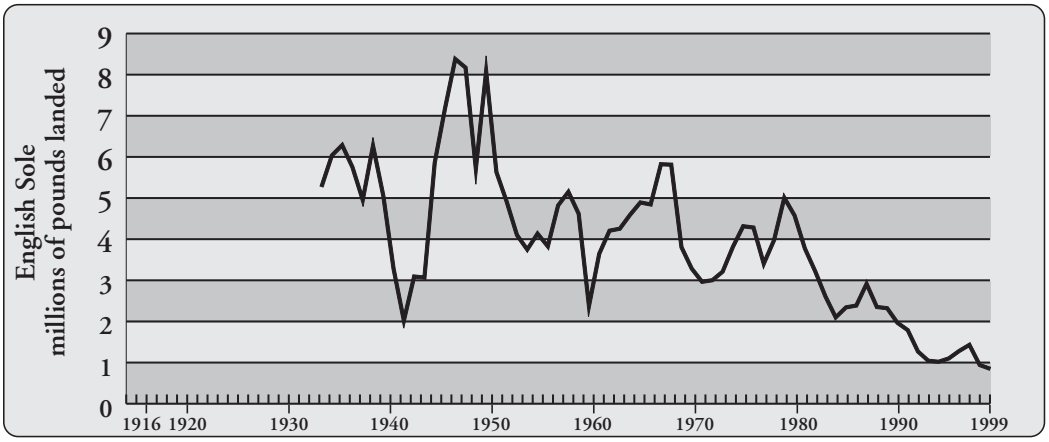
Status of Biological Knowledge

English sole range from San Cristobal Bay, Baja California to northwest Alaska in water as deep as 1,800 feet. Fish tend to move to deeper water in the winter and shallower water in the summer, and fishing effort follows these movements. Tagging studies in California, Oregon, Washington, and British Columbia show that, although there is little overall migration, small seasonal north-south movements probably occur, and some fish have been found to move in excess of 200 miles. Analysis of tag returns also suggest that four separate stocks are found in California: south of Point Conception, Point Conception to Bodega Bay, Monterey to Eureka, and Eureka to southern Oregon. The overlap in areas is a result of apparent north-south movement of the stocks. Some seasonal intermingling between stocks probably also occurs.

Three-year-old female English sole, on average, are only about eight inches, while 10-year-old females are about 14 inches. Fifty percent of female English sole are usually mature at five years and nine inches. Spawning generally occurs over sand and mud-sand bottoms at depths of 200 to 360 feet from September to April. In California, peak spawning occurs from December through February, with annual variations in timing apparently related to water temperature. Each fish probably spawns only once per year. Egg diameter is approximately 0.04 inch. Fertilized eggs are buoyant when first released, but shortly before hatching they begin to sink into the water column.

When the eggs hatch, in four to 12 days, the larvae are approximately 0.1 inch long. Typically the larvae are in the midwater column but sink deeper as they approach metamorphosis. During development, the larvae may be carried toward shore on lower-level water currents. Spawning and development during times of rapid plankton growth may result in good recruitment. During their pelagic phase of six to 10 weeks, the larvae grow to about 0.75 inch, then settle to the bottom and metamorphose to the adult benthic body form.

After metamorphosis, and for the first year of life, juvenile English sole are found in shallow bays and estuaries and feed all the way up to the intertidal zone. Juveniles are found in sand, mud, and eelgrass habitats. The population density of juvenile English sole in estuaries is several times higher than on the open coast; however, it is not known how important estuaries are to survival of juvenile English sole. In southern California, the shallow open coast may be more important as juvenile habitat than it is further north. As the fish grow they tend to move to deeper water. While in the estuary and nearshore shallow-water environment, juveniles feed on copepods, the palps of segmented worms, siphons of small clams, brittle stars, and other small invertebrates. At the end of their first



Commercial Landings 1916-1999, English Sole
Prior to 1931, all soles were combined as one group; individual species were tabulated separately when they became sufficiently important. Data Source: DFG Catch Bulletins and commercial landing receipts.

year of life (about five inches), most juveniles have moved to offshore waters.

Adult fish are seldom found in estuaries. They are opportunistic feeders eating shallowly burrowed or surface-active prey such as worms, small crustaceans, clams, and occasionally small fish, crabs, and shrimp. Adults can also dig into the sediment to reach deeper prey. The largest recorded English sole, from British Columbia, was 22.5 inches, and 21-inch fish have been taken in California. The oldest recorded age is 22 years. English sole are aged by counting the annual rings on the interopercular bone. The English sole is capable of interbreeding with the starry flounder producing an inter-generic hybrid called the hybrid or forkline sole or flounder.

Status of the Population

Little information is available to estimate the status of the English sole stock in California. Catch-per-unit-of-effort data exist but are complicated by the multiple species aspect of trawl fishing. In 1993, an assessment using data collected from 1977 through 1992, was conducted for the English sole stocks off Oregon and Washington. Results indicate that the biomass increased steadily during the assessment period, which was attributed to high recruitment. The author concluded that English sole stocks can sustain a high exploitation rate because a large portion of the spawning stock is comprised of small females that are not caught by the fishery due to the small size-at-maturity.

The California fishery is currently managed by the Pacific Fishery Management Council through gear regulations such as trawl net mesh size and a recommended Acceptable Biological Catch (1,100 metric tons at present). Landings are monitored and populations continually assessed for signs of biological stress.

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