

Dover Sole

History of the Fishery

The stature of Dover sole (*Microstomus pacificus*) has evolved from that of an undesirable by-product of bottom trawling prior to the 1940s, to the most abundant groundfish in statewide landings. This phenomenal rise was the result of market demand during and following World War II and technological advances in fish handling and processing.

At the advent of trawling in the 1870s, Dover sole were inadvertently caught by lateen sailboats using paranzella nets. California's Dover sole fishery expanded from its beginning in San Francisco Bay to its present scope extending from Santa Barbara to the Oregon border. The developing trawl fishery experienced major changes in vessels and netting. Sailboats were replaced by steam, gasoline, then diesel-powered vessels. The original paranzella trawl net was supplanted by the more efficient otter trawl in the 1920s. By the 1980s, some trawl fishermen began to use roller or bobbin trawls to capture Dover sole and other deep-slope groundfish instead of more conventional trawls with rubber mudlines between the trawl doors and footrope to create a fish-herding mud cloud. A quick-freezing method, developed during World War II, hardened the soft flesh of the Dover sole to produce marketable fillets. This advance and the wartime demand for fish allowed trawlers to turn their attention to the large north coast population of Dover sole.

The directed Dover sole fishery began in 1943 when 28 tons were landed. Between 1944 and 1947, landings ranged from 62 tons to 1,400 tons. The fishery expanded to 3,600 tons in 1948, at which time Dover sole landing records were separated from nominal or unspecified sole landings, and rose further to 5,850 tons by 1952. Annual landings then remained stable at approximately 4,000 tons until 1969. From 1969 through 1989, landings averaged 10,200 tons and from 1990 through 1999, average landings dropped to 5,892 tons.

Commercial Dover sole landing limits were imposed coast-wide in 1989 and 1990 by the Pacific Fishery Management

Council (PFMC) as a trip limit on the aggregate poundage of Dover sole, thornyheads, and sablefish (the DTS complex). Prior to that time, market demand and gear regulations controlled statewide Dover sole landings. The intent of this regulation was to reduce the harvest of sablefish by restricting effort for the DTS complex. While reduced quotas and increasingly restrictive trip limits were placed on the DTS complex coast-wide during the 1990s, the major reason for the decline in California Dover sole landings was a reduction in market demand. The port of Eureka has historically supported the largest Dover sole fishery and was strongly impacted by the loss of a major Army contract. Fort Bragg, Crescent City, San Francisco, Monterey, and Morro Bay are other ports with significant Dover sole landings.

Sport utilization of Dover sole is practically nonexistent. The depth distribution of Dover sole normally places them beyond most sport fishing activity, and Dover sole, because of their feeding habits, are not vulnerable to hook-and-line fishing.

Status of Biological Knowledge

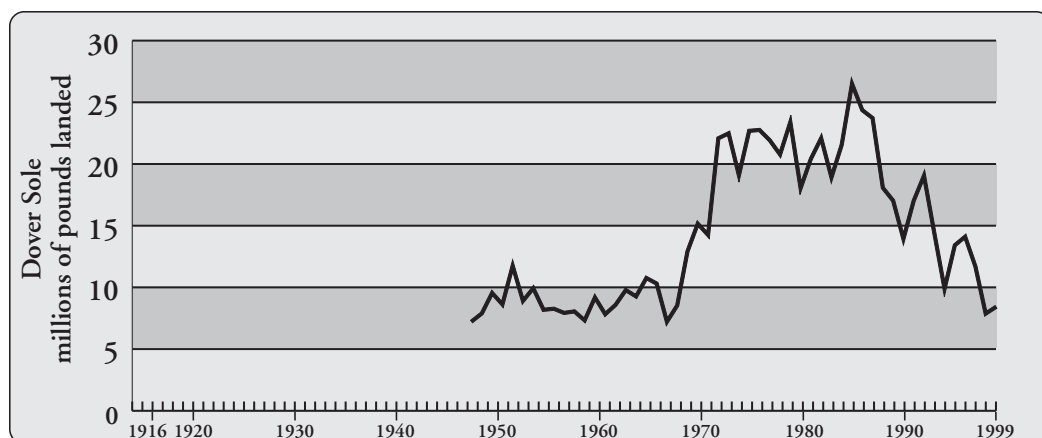
Dover sole occur from the Bering Sea to northern Baja California on mud bottoms at depths from 180 to 4,800 feet. Although early tagging experiments off Oregon and California suggested Dover sole move inshore in the summer, a more recent California Department of Fish and Game (DFG) tagging study discovered that not all Dover sole participate in the summer inshore movement. Most of the mature fish tagged and released in deep water were recovered in deep water regardless of season. The DFG tagging data indicate that two substocks may exist - one that migrates and one that does not. Juvenile Dover sole settle on the continental shelf and gradually move down the slope over their lifetime, reaching the oxygen-minimum zone as they become sexually mature.

Growth is rapid during the early years of life but decreases with age. Five-year-old Dover sole grow 0.7 inch per year, but by 10 years of age, growth slows to 0.4 inch annually. Dover sole may attain an age of over 50 years and reach 30 inches in length. Fifty percent of Dover sole females 12 inches long are mature. The youngest mature Dover sole in 1987-1988 studies was six years old, whereas earlier studies reported mature five-year-old females.

Dover sole may spawn nine batches to release all eggs in a spawning season. Egg production is correlated with size. Fish of 0.6 pound produce 33,000 eggs, while 2.4-pound fish produce 54,000 eggs on average. Incubation time for the buoyant eggs may vary from 10 days to one month depending on the ambient water temperature. Larvae are unusually large (one to two inches long) and have a



Dover Sole, *Microstomus pacificus*
Credit: DFG

**Commercial Landings****1916-1999,****Dover 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.

prolonged pelagic life of at least one year before settling to the bottom. Larvae have been found along the entire California coast, as far as 60 miles south of the U.S.-Mexico border and up to 280 miles offshore.

Dover sole feed commonly on polychaete worms, pelecypod and scaphopod mollusks, shrimp, and brittle stars. Only Pacific sleeper sharks and spiny dogfish are known to prey on Dover sole.

Status of the Population

In 1987 and 1988, the National Marine Fisheries Service (NMFS) conducted two surveys to assess the adult biomass of Dover sole in the area from Point Conception to Monterey Bay. The surveys found that 98 percent of the spawning biomass of Dover sole in central California waters live on the continental slope between 2,100 and 3,300 feet deep, an area characterized by low oxygen concentrations and very cold temperatures. A 1991 assessment using 1990 NMFS bottom trawl survey data provided estimates of biomass and yields for the area from Cape Mendocino, California to Cape Blanco, Oregon (Eureka area). Another assessment, conducted in 1992, included the Eureka area and the Columbia area and another completed in 1995 included the northern Monterey area as well as the US Vancouver area.

The last Dover assessment, conducted in 1997, treated the entire population in the Monterey area through the U.S. Vancouver area as a single stock based on research on the genetic structure of the population. The Point Conception area population has yet to be fully assessed. Using yield recommendations presented in the 1997 assessment, the PFMC set a coastwide landed catch limit of 8,955 tons. This stock is believed to be in equilibrium and near the target biomass level that would provide maximum sustainable yield.

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