

Pismo Clam

History of the Fishery

Humans and other predators have utilized the Pismo clam (*Tivela stultorum*) resource for thousands of years. The Pismo clam has been found in 25,000-year-old Pleistocene (ice age) deposits and in American Indian kitchen middens 200 to 2,000 years old. Indians used the clam for food and the shells for digging, scraping and ornaments. The name Pismo is derived from the Indian word *pismu* meaning tar. Natural deposits of tar are found in the Pismo Beach area.

Records of the commercial harvest of Pismo clams began in 1916, and were kept through 1947 when the commercial fishery in California was prohibited. During that period, approximately 3,137 tons were commercially harvested. The majority was harvested from the Pismo Beach and Morro Bay areas, with a small percentage from Monterey Bay. Annual landings ranged from a high of 332.8 tons in 1918 to a low of 13 tons in 1945. The average annual harvest was approximately 98,600 clams (average two pounds each) with a high of 334,700. The clams were purchased by restaurants, were sold whole and canned in markets, and were used as bait and animal food.

The importation of Pismo clams from Baja California occurred as early as 1919 and most likely continues to this day. After 1962, clam imports from Mexico into the United States have not been identified by species. From 1919 through 1962, 232 tons of Pismo clam, mostly canned, were imported into the United States. In Baja California Norte, from 1990 through 1999 Pismo clam landings ranged from a low of 411 tons in 1994 to high of 1,025 tons in 1992, with a 10-year average of 434 tons. In Baja California Sur, from 1978 through 1995 landings ranged from a low of 1,213 tons in 1984 to high of 6,505 tons in 1981, with a 18-year average of 3,234 tons.

The usual method of collection by recreational clammers is by using a four- to six-tined garden fork. During a low tide the clammer selects a section of beach with exposed wet sand or water of wading depth and probes in the sand until encountering a clam. Another method is to shuffle one's bare feet along the bottom until a siphon or shell is felt. Pismo clams can also be found by looking for the half-inch-long tufts of the commensal hydroid (*Clytia bakeri*) which attaches to the shell and is exposed above the sandy surface. Divers search for the clams by probing with a knife or looking for exposed shells, siphons, or tufts of hydroids.

Pismo clams have a distinctive and excellent flavor; they are prepared as chowder, seafood cocktail, fried or eaten raw. Pismo clams have been implicated in several human fatalities involving Paralytic Shellfish Poisoning (PSP). It is advised that only the white meat be consumed and that all dark meat and digestive organs be discarded.

Recreational clamming is regulated by bag limit (10), a minimum size (5.0 inches north of and 4.5 inches south of the San Luis Obispo/Monterey county line), the immediate measuring and reburial of sub-legal clams, and closed seasons and areas. The objectives of these regulations are to prevent the depletion of the clam population and to maintain a population of sexually mature clams that have a chance to spawn several times before being harvested.

Status of the Biological Knowledge

The Pismo clam shell is thick, heavy, and strong, and the outside is smooth with fine concentric growth lines. The inside of the shell is white and the outside has a varnish-like periostracum, usually yellowish, tan or greenish. Shells of individual clams vary considerably in both color and pattern, ranging from pale beige to brown, occasionally with brown radiating marks running from the umbo to the margin on a light background.

The historic range of the Pismo clam is Half Moon Bay, California to Socorro Island, Baja California Sur, Mexico, including two of the Channel Islands (Santa Cruz and Santa Rosa Islands). However, it has not been found at Half Moon Bay for decades and its present range extends northward only to Monterey Bay. It is found in the intertidal zone and offshore to 80 feet on relatively flat, sandy beaches of the open coast. Occasionally, it is also found in entrance channels to bays, sloughs and estuaries. Because of its short siphons, the Pismo clam generally lives close to the surface of the sand and seldom burrows deeper than six inches, but it has been found eight to 12 inches deep in southern California. The clam characteristically orients vertically with the hinge and excurrent siphon toward the ocean, the mantle edge and incurrent



Pismo Clam, *Tivela stultorum*
Credit: DFG

siphon toward the beach, and the ligament at the center of the hinge oriented up. Burrowing is accomplished by moving the foot rapidly to loosen the surrounding sand. Then jets of water eject the loosened sand up along the shell sides, and the weight of the clam and pull of the foot together drag the clam down through the sand.

The age of Pismo clams has been determined by observation of marked individuals and by growth rings on the shell. In California, a growth ring is generally formed during the winter months when water temperatures are cool and food abundance is relatively low. In Baja California, most clams form a growth ring during the August-October period, although some may form a ring at any time of the year.

The Pismo clam is about 0.009 inch at metamorphosis and may grow to more than 7.3 inches in length. Growth is continuous throughout the clam's life, with the average length increasing by approximately 0.84 inch per year for the first three years. Increases in shell length are greatest in spring, summer and early fall. Growth of older clams is slower. At age 10, the increase in shell length is usually not more than 0.2 inch per year. A 4.5-inch clam may be from five to nine years old. At Pismo Beach, clams reach 4.5 inches between ages seven and eight.

In California, the largest Pismo clam reported was 7.32 inches long and estimated to be 23 years old. The oldest Pismo clam was estimated to be 53 years old. In Baja California, the largest Pismo clam reported was 7.36 inches long and estimated to be 26 years old. Several Pismo clams from Baja have been aged to be 43 years old. The smallest Pismo clam reported from the wild was 0.24 inch long.

In the majority of Pismo clams, the sexes are separate with equal numbers of males and females. Fertilization occurs externally when the male releases sperm and the female releases eggs into the surrounding water. Pismo clams are mature at one year in southern California and two years in central and northern California. The smallest known mature clam in southern California was 0.7 inch and in northern California was 0.5 inch.

Spawning can occur anytime, but the majority spawn from June to September. The number of eggs per female increases with increased shell size and ranges from 10 to 20 million eggs per female, with an average of 15 million per five-inch female. In laboratory-held clams, egg numbers were roughly proportional to clam size. The number of eggs ranged from as many as 4.7 million in a 2.9-inch female to 0.4 million in a 1.2-inch female. Eggs range in diameter from 0.00296 to 0.00324 inch.

The larvae metamorphose, settle to the sandy bottom, and attach themselves to the sand grains by means of byssal threads. After several months, when the clam is more able to maintain a position on the sandy bottom, the

byssal threads degenerate. In laboratory culturing experiments, fertilized eggs hatched into larvae in approximately 48 hours. Larvae 60 to 72 hours old displayed the behavior of settling to the bottom and remaining benthic or near-benthic throughout larval development. If larval Pismo clams in nature also exhibit a benthic phase, larval transport by nearshore currents may be limited. Larvae larger than 0.009 inch and 22 to 50 days old have completed metamorphosis, developed a foot, and buried themselves in the sand. At day 120, post-larval clams (0.048 inch) have the triangular appearance of an adult. No byssal threads were observed on laboratory-cultured post-larval Pismo clams.

Little is known of post-larval conditions in nature; however, in laboratory cultures post-larval growth was relatively slow, and survival generally poor. Although spawning probably occurs every year, it is not always measurably successful. In some years, virtually no young-of-the-year clams settle on beaches. Recruitment success appears to be influenced by oceanographic conditions (water temperature, currents), which in turn influence phytoplankton availability. Unfortunately, the necessary conditions for optimum spawning success are not known.

The Pismo clam is a filter feeder. Water taken in through the incurrent siphon passes over the gills, where food particles are removed. Food includes organic and inorganic particles such as phytoplankton, bacteria, zooplankton, eggs, sperm, and detritus from the disintegration of plants and animals. The inhalant siphon has a very fine net of delicately branched papillae across the opening, forming a screen that excludes the entrance of large particles but permits the intake of water and food particles. Despite this elaborate system, half of the stomach contents is sand. An actively feeding three-inch clam filters as much as 15 gallons of water per day.

Pismo clams have many predators, including moon snails, rock crabs, sharks, rays, some surf fishes such as the California corbina in southern California, gulls, sea otters, and humans. Otters were estimated to have eaten 520,000 to 700,000 Pismo clams in one year at Monterey Bay. A single sea otter was observed to eat 24 clams in 2.5 hours. The extension of the sea otter's range to Monterey Bay in 1972, Morro Bay in 1973 and Pismo Beach in 1979 has precluded the recreational fishery for Pismo clams in those areas.

Parasites of the Pismo clam include a polychaete worm that bores into the clamshell, and larval cestodes, which have been found inside the clam as 0.15-inch diameter yellowish-white cysts. The cestodes can impair the clam's sexual development but are not harmful to man if eaten. Trematodes have been reported in some clam populations. A commensal hydroid is often found attached to the external shell of the clam, and commensal pea crabs are

occasionally found in the mantle cavity and feed on food particles collected by the clam's gills.

Status of the Population

Pismo clam populations have been highly variable over the years and from beach to beach. Settlement and recruitment have also been highly variable from year to year. The Department of Fish and Game first examined Pismo clam recruitment in 1919, and annual surveys have been conducted from 1923 to 2000 to obtain information on age, recruitment, year class strength, and exploitation trends. Through 1948, only Pismo Beach was surveyed. Since 1948, beaches in Morro Bay, Cayucos, Monterey County, and from Santa Barbara County to San Diego County were subsequently included.

During the storms of 1982-1983, Pismo clam populations along southern California beaches were severely depleted, resulting in limited recreational fisheries after 1983. The Pismo Beach clam populations had three successive strong year classes (1986, 1987, and 1988), resulting in the largest number of sublegal clams ever recorded from surveys on Pismo Beach. Because of the exceptional recruitment in the Pismo Beach area and low abundance in southern California, 10,000 clams were transplanted from the Pismo Beach area to Huntington State Beach in 1989. The first follow-up survey found only 142 clams, the second only 14 clams and three partial shells. Biologists are uncertain as to the fate of the clams. At the same time, approximately 1,000 clams were transplanted within the Channel Island National Park.

In 1990, abundance of young Pismo clams appeared to be a widespread phenomenon along southern and central California from San Diego to Pismo Beach. Densities were documented at Ventura County and Pismo Beach of five clams per square foot (one- to three-year olds) and 26 clams per square foot (one- to six-year olds), respectively.

From 1990 to the present, recreational fishing for Pismo clams continues on a few southern California beaches. From 1990 to 1993 a recreational fishery occurred in the Pismo Beach area for the first time since 1982. During this period, sea otters were foraging off shore and in other areas. In 1992, sea otters were again observed foraging in the Pismo Beach area and in 1993 the last take of a legal size Pismo clam was reported there. Pismo clam surveys in the Pismo Beach and Morro Bay areas from 1992 through 2000 indicated low levels of recruitment.

No population estimates have been made for the total Pismo clam resource in California. Whether successful recruitment will result in ongoing recreational fisheries in light of continuing human growth and the expansion of the sea otter's ranges is unclear.

Management Considerations

See the Management Considerations Appendix A for further information.

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