COMMERCIAL CLAMS OF THE NORTH AMERICAN PACIFIC COAST

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

Circular 237

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By

MURRAY H. AMOS

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Commercial Clams of the North American Pacific Coast

By

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INTRODUCTION

About 500 different species of bivalve mollusks are native to the Pacific coast of North America. Only nine of these species appear in commercial markets, although about 35 species are commonly considered edible. The other species are either too small, too few in number, or both, to support a commercial clam fishery.

The commercial harvest of clams along the Pacific coast of the United States and Canada for 1963 (the latest year for which complete data are available) was about 5,672,000 pounds worth $463,000 to the fishermen. This harvest yielded about 1,596,000 pounds of clam meats, an estimate based on a yield of 42 percent meat from razor clams and 25 percent meat from all other species. Of these totals, Canada produced about 812,000 pounds of meats and the United States 784,000 pounds.

HABITAT

The common commercial clams are found from the intertidal zones of beaches and mud flats out to depths of over 30 fathoms. Some, such as the razor, pismo, and bean clams, prefer the sandy beaches of the open coast exposed to the pounding of the surf. Others live in the quieter waters of protected bays, inlets, and sounds. Clams usually are buried in the bottom, from just under the surface to depths of over 4 feet, depending on the species; occasionally the littleneck clam, the cockle, and the jackknife clam are on the surface or partially exposed.

ANATOMIC FEATURES

All clams have two shells composed of three layers. The outer layer, or "periostracum" is often varnishlike and sometimes partially worn away. The middle layer is generally chalky and composes the bulk of the thickness of the shell. The inner layer is usually hard and, in some species, iridescent or lustrous. The two shells are joined at the back by a hinge ligament generally visible from the outside. Concentric rings are laid down on the shells of almost all species as the clam grows. A few species also have ridges on the shell radiating from the hinge to the edge.

The growth rings vary from indistinct to prominent, depending on the species. The rings may be used to age some species, since formation of rings is influenced by changing environmental conditions during the year. The colder temperature and reduced food abundance of winter slow the growth of the clams. The concentric growth rings are laid down closer together forming a more prominent band often of a different shade from the rest of the shell. While these growth checks may be used to age the clam, they are not always infallible. Often, for reasons unknown, an extra check may appear between two true winter checks.

Two of the most prominent features of the soft tissues of the clam are the foot and the siphon or "neck." In digging, the foot is projected into the substrate and blood is pumped into a blood sinus, causing the tip of the foot to expand. A set of muscles then contract, pulling the clam toward the anchored tip. Some species, such as the razor clam, can repeat these actions rapidly and often descend faster than a man can dig in soft sand. Others, such as the horse clam and geoduck, remain virtually immobile once established in the bottom.

The siphon consists of two fleshy contractile tubes used to conduct water in and out of the clam. In some species the tubes are joined together to form a single structure; in others they are separated. The incoming water brings food and oxygen to the clam. The excurrent water carries away waste products and, during spawning season, eggs or sperm.

Note.--Revision of Fishery Leaflet 223, dated April 1947.

Clams usually lie buried in the bottom, hinge vertical, with the siphons protruding above the surface. Their depth in the substrate is generally related to the length of the siphon. The cockle, which has a very short siphon, is usually at or near the surface, whereas the long-necked horse clam may be buried several feet into the bottom. During low water when the intertidal beds are exposed, the siphons are usually retracted just below the surface and covered with a thin layer of sand, mud, or fine gravel.

The food of the edible clams consists of detritus from the bottom and drifting microscopic plant and animal life ("plankton") in the sea water. Particles are removed from the incoming water by motile hairlike structures (cilia) on the gills, passed to the sensitive palps near the mouth for sorting, and then ingested. From the mouth the food moves through a short esophagus to the stomach. In some species a pouch off the stomach contains a flexible transparent rod, the "crystalline style," which is composed of a starch-reducing enzyme. Erosion of the style by rotation within the stomach frees the enzyme to assist in digestion. The digested material is then passed to the intestine for absorption, and the remaining waste products empty into the outflowing water of the excurrent siphon tube.

REPRODUCTION

The edible clams begin spawning in the spring as the waters warm. Spawning may be repeated several times during the spring and into the summer as portions of eggs and sperm ripen and are discharged through the excurrent siphon tube. Fertilization takes place in the open water, and the eggs hatch into larvae within a few hours to a few days, depending on species and water temperature. The larvae are free-swimming animals totally unlike the sedentary adults. They gradually develop through free-swimming and bottom-crawling stages before assuming the adult form and "setting" on the bottom, which becomes their permanent habitat.

The majority of the clams have the sexes separate, that is, separate male and female individuals. Some, such as the cockles and the pismo clam, are hermaphroditic, producing both eggs and sperm, sometimes simultaneously. In a few species of clams, an individual may be a male at one life stage and a female at another.

In some years the water along the Pacific coast, particularly northward from California, does not become warm enough to induce spawning in a number of the species of commercial clams. Even presumably well-adapted native species may spawn only lightly, or not at all during cool summers. Certain British Columbia butter clam beds have had only one major spawning and setting in 20 years, and low temperatures are probably a major factor in this failure to adequately reproduce.

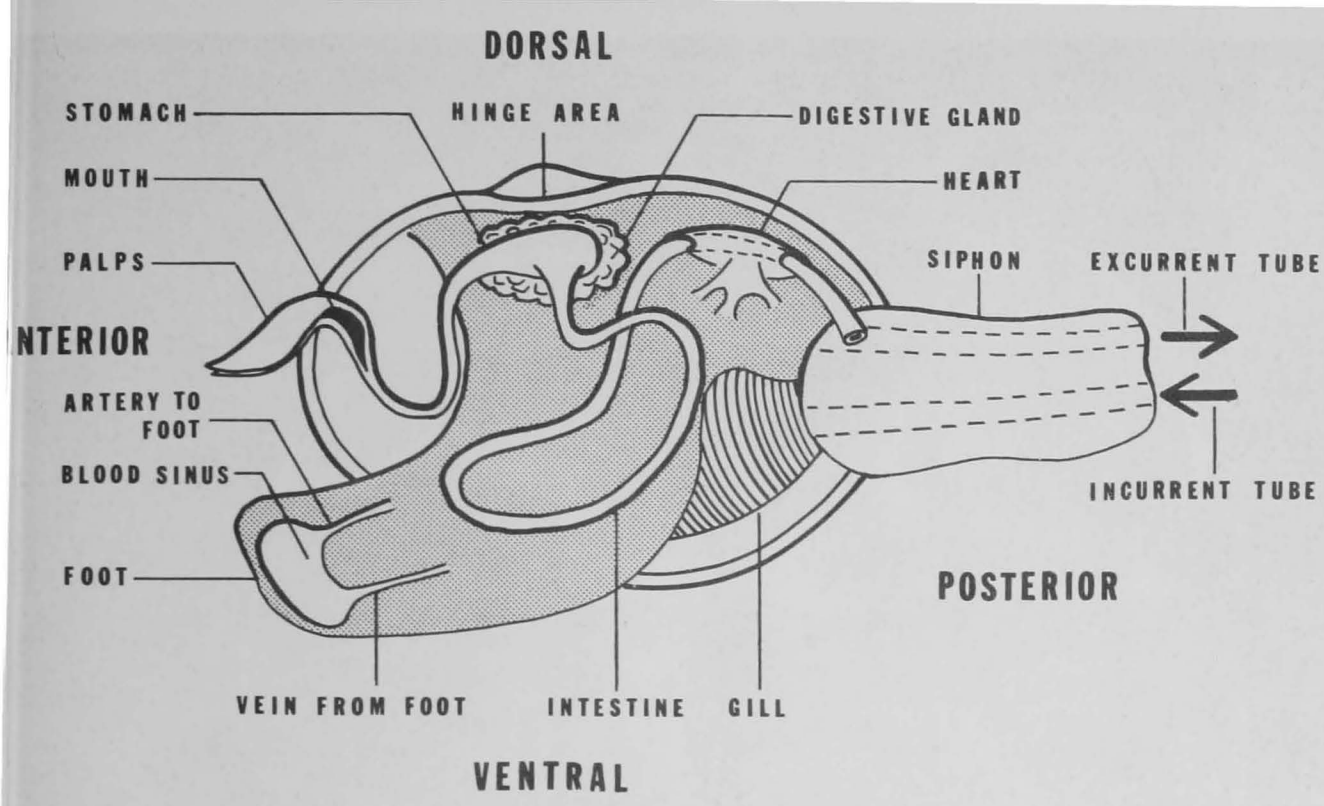
PROPAGATION

Clams are not now propagated commercially on the Pacific coast. Recent advances in techniques at the Bureau of Commercial Fisheries Laboratory at Milford, Conn., indicate that propagation soon may become feasible and commercially profitable. The Washington State Shellfish Laboratory at Brinnon, Wash., has studied the cultivation of clams for several years with some success. Also, under the aegis of Victor L. Loosanoff in California, efforts are being made to establish true clam farms based on the work of the Milford and Brinnon laboratories.

In artificial propagation techniques developed to date, mature clams are taken into a hatchery, where they are induced to spawn in trays of sea water. The fertilized eggs are collected, washed, and placed in containers of sea water maintained at a constant temperature--usually about 24° C. (75° F.). Under favorable conditions the eggs develop into free-swimming larvae in 12 to 16 hours. The hatched larvae are then held in constant-temperature sea water, 20° C. (68° F.) to 30° C. (86° F.), until metamorphosis is completed (usually within 30 days) and the larvae take the sedentary form of juvenile clams. During this period the larvae must be fed certain species of algae and "naked flagellate" protozoans that have been found acceptable as food. These food organisms must also be cultured in quantity at the hatchery.

As with all animals, particularly when in dense concentrations, clam larvae are subject to diseases, predation, and competition with other forms of marine life. The sea water used in a shellfish hatchery is sterilized by exposure to germicidal ultraviolet light. This treatment not only controls bacteria and fungi that are injurious to clam larvae, but also protects the cultures from invasion by undesirable predators and competitors such as small crustaceans, protozoans, rotifers, and the larvae of various worms. A number of antibiotics and other chemicals also are useful in the treatment of larval cultures for diseases or infestations. To prevent harmful bacteria being fed to the larvae, food organisms must also be treated with antibiotics or sterile cultured in bacteria-free media. In addition, other forms of sea life that can utilize the food cultures must be prevented from growing and multiplying in the food culture containers.

Successful propagation of clams depends on fastidious application of the techniques. Persons interested in attempting clam propagation



Schematic diagram of median section of clam (Mouth and palps displaced anteriorly and one pair of gills removed.)

should consult the paper, "Rearing of Bivalve Mollusks," by Loosanoff and Davis (1963). The full reference is given in the last section of this leaflet.

HARVESTING

Most of the annual catch of edible clams is taken by hand with shovels, rakes, or forks (usually potato forks). Rakes or forks are preferred for the species found near the surface because they loosen the ground and do not leave mounds or water-filled holes in which young clams may be buried too deeply and smothered. For razor clams a special narrow-bladed shovel, known locally as a "clam gun," is used. Clam dredges are not used as extensively on the Pacific coast as on the Atlantic coast for the commercial taking of clams.

PRINCIPAL SPECIES

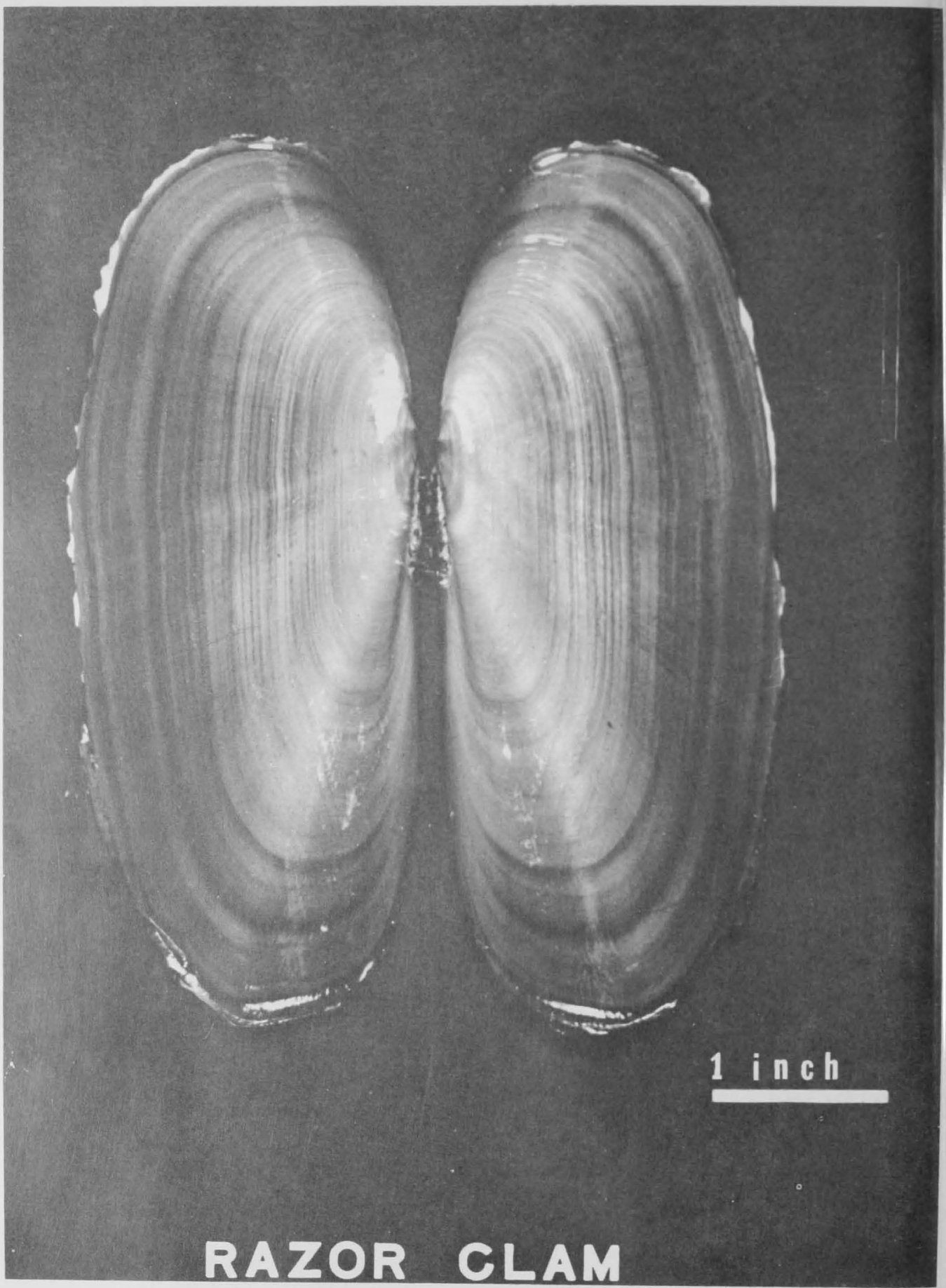
In the following sections a scientific name is given for each species. Unfortunately, the scientific names of the commercial bivalves are not as well established as might be expected. Several of the species have been variously classified into a number of different species and genera. In general, I have followed the taxonomic classification given in "American Seashells" by Abbott (1954).

Razor Clam

The range of the razor clam, Siliqua patula, is from Pismo Beach, Calif., to the Bering Sea; however, it occurs in commercial quantities only from the Oregon beaches to the western end of the Alaska Peninsula. The most productive beds are from Tillamook Head to Moclips along the coasts of Oregon and Washington; the Queen Charlotte Islands beaches in British Columbia; and the shores of Cook Inlet, Orca Inlet, the Copper River delta near Cordova, and the mainland side of Shelikof Strait in Alaska. In 1963, the U.S. commercial fishery for razor clams yielded 377,000 pounds of meats worth $167,000 to the fishermen. Razor clams represented about 48 percent of the total clam meats taken on the U.S. Pacific coast. In the same year the British Columbia razor clam fishery yielded 62,000 pounds of meats (value unspecified), composing about 7.5 percent of the British Columbia clam meat production.

Razor clams live in the intertidal zone and seaward some distance beyond the breaker line, on the sandy ocean beaches of the open coast. Small beds may be found inside the mouths of coastal harbors, but growth is usually inferior in these locations. They are not found in the large inland sounds such as Puget Sound and the Straits of Georgia.

Spawning of razor clams apparently begins when the water temperature rises to 13° C.



RAZOR CLAM

55° F.)--usually during the second half of May and early June in Oregon and Washington, and 2 to 3 weeks later in Alaska. Spawning continues for several weeks; adult females may each produce 6 million to 10 million eggs. In years of heavy setting, as many as ,000 to 1,500 young clams are found per square foot of beach surface. High mortalities are common at the setting stage, however, because young clams are very delicate.

Razor clams grow at different rates in different localities. In the southern beds in Oregon and Washington, initial growth rate is much higher than in Alaska, but after several years the growth rate declines rapidly. Clams have a smaller final size and a shorter life span in the southern beds than in the northern beds. By the end of the first winter, young clams reach a length of about four-fifths of an inch in the south, but only one-fifth of an inch in the Cordova district of Alaska. To reach an average size of 4 1/2 inches, clams require 3 1/2 years in the southern beds, but 6 1/2 years in the Cordova district.

The maximum age for the southern razor clams is about 13 years, but clams from Alaska may reach 19 years. Age of razor clams is determined from the rings on the shell, although this method may not always provide the correct age. In younger specimens length is a fair indication of age. The lengths of 2-year-old and 4-year-old razor clams from the same bed differ greatly, but the lengths of 8-year-old and 12-year-old clams are almost equal.

Razor clams are harvested at low tide by commercial diggers and, in many places, by a large number of tourists and local residents. If the surface siphon holes of the clams are not easily visible, the diggers strike the surface of the beach with the handles of their shovels. The vibration causes the clam to retract the siphon and start downward, leaving a characteristic hole. At this time the clam is rapidly spaded out before it can descend beyond reach.

Razor clams can dig down in the sand to a depth of several feet as fast as 9 inches per minute. The ability to move so rapidly is facilitated by the shape of the shell, which is slender and tapered, and the presence of a powerful foot or "digger." There is little evidence that razor clams move horizontally or migrate between areas.

Most of the commercial catch of razor clams is canned. A few clams are marketed fresh, as shucked meats, and some are frozen and packaged as steaks. Protective measures for maintaining sustained yield from the stocks are promulgated by British Columbia and the several States in which razor clams occur. These regulations may include closed seasons, closed areas, bag limits, and size limits. Persons wishing to engage in clamming, either commercially or for recreation, should consult local authorities for regulations.

In recent years the take by sports diggers has far exceeded the commercial catch on the principal razor clam beaches of Washington. In 1964, sports diggers took an estimated 2,290,000 pounds of razor clams, or nearly 11,500,000 individual clams. The commercial catch quota for 1964 was 125,000 pounds. Commercial diggers actually took only 30,000 pounds, owing to a beach closure following a shipwreck and oil spill.

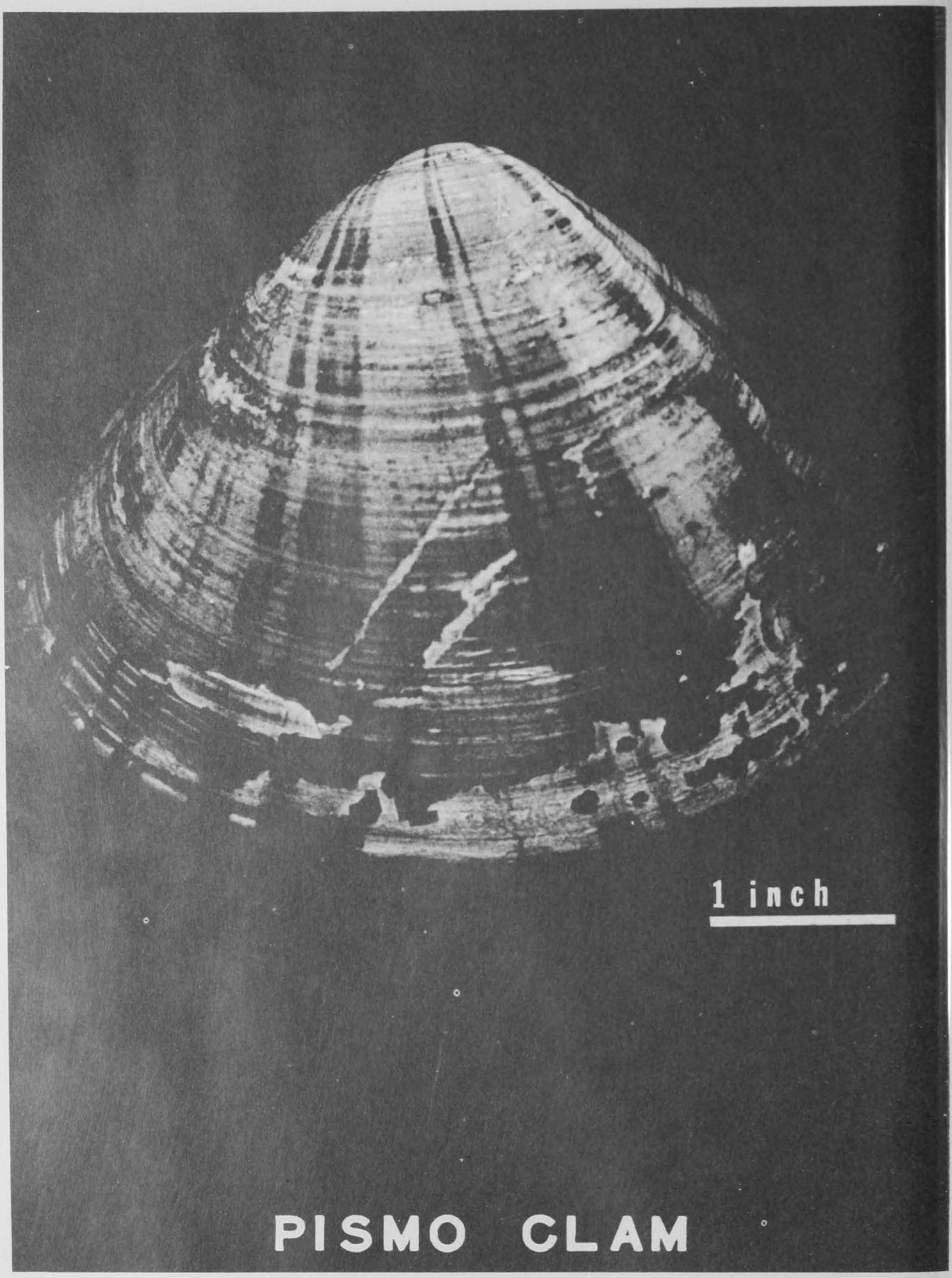
Pismo Clam

Pismo clams, Tivela stultorum, inhabit the open coastal beaches from Half Moon Bay, Calif., to Magdalena Bay, Baja California, Mexico. This clam, also known as "giant tivela" is found from the intertidal zone out to a depth of 80 feet, and in some areas is rare in less than 20 feet of water. The pismo clam is a relatively sluggish digger and seldom burrows deeper than 6 or 7 inches. It usually lives with its hinge vertical and toward the ocean.

Several decades ago, pismo clams were so plentiful they were turned out of the sand at low tide by horse-drawn plows and fed to hogs. Because of this intensive fishery, the clam population was severely reduced; no commercial fishing for the species is permitted now by the State of California. Recreational diggers continue to harvest quantities of these clams under strict regulations governing seasons and bag limits. Chief source of pismo clams for the market are the beds on the beaches of Baja California, Mexico.

Pismo clams spawn in late summer. Various estimates of the egg production of a single large female range from 15 million to 75 million. Each egg measures about 1/360 inch in diameter. The growth of the pismo clam shows a definite seasonal rhythm--rapid in the summer and very slow in the winter. In general, the species grows very slowly, and requires 4 to 7 years to reach a length of 5 inches. Some pismo clams attain an age estimated as between 20 and 35 years. The larger clams reach a length of about 7 inches.

The shells of the pismo clam are symmetrical triangular fan shaped. Color is variable, particularly in the juveniles, and ranges from pale buckskin to dark chocolate. The shells are thick and covered with the varnishlike periostracum also found on razor clams. Some shells may be marked with chocolate-brown lines radiating from the hinge to the edge of the shell. The thick shells may assist pismo clams on exposed beaches in retaining their positions while in heavy surf.



PISMO CLAM

Butter Clam

Two species of clams on the North American Pacific coast are now commonly called butter clams. The southern species, Saxidomus nuttalli, is also known as the "Washington clam," "big clam," and "money shell" (because the California Indians used the shells for money), and is found from San Diego to Humboldt Bay in California. The northern species, Saxidomus giganteus, has the common names "Washington clam," "quahog," "Coney Island," "beef-steak," and "great Oregon" clam. This species ranges from Humboldt Bay northward to Alaska.

In 1963, the U.S. commercial fishery for butter clams yielded about 51,000 pounds of meats worth over $11,700. About 99 percent were taken from the bays and inland sounds of Washington State.

British Columbia is by far the largest source of butter clams. The 1963 catch was 584,200 pounds of meats, or about 84 percent of the total clam meats taken commercially in British Columbia. Butter clams are marketed fresh or canned, whole or minced, and as chowder or juice.

Butter clams are distributed from the lower levels of exposed tide flats out to depths of over 30 fathoms in some areas. They appear to prefer mixed gravel-mud substrate, though they are also found in sand. They live in the upper 12 inches of the substrate, most commonly 6 to 10 inches beneath the surface. The shell length of butter clams occasionally reaches 7 inches in the southern species and about 6 inches in the northern species. In commercial catches the usual size landed is 3 to 5 inches.

Butter clams can be recognized by the large external ligament at the hinge; the relatively thick egg-shaped shell; the fine, concentric growth lines that parallel the curvature of the shell; and the relatively short, black-tipped siphon. The shell color varies from chalk-white to bluish-gray, depending on the substrate in which they are located. Generally the shells are white and clean looking if the clams are dug from clean gravel or sand; in mud or silt the shells often appear brownish or bluish-gray. This color difference is related to the substrate and is also noticeable in a number of other species of commercial clams.

Littleneck Clam

The native littleneck clam, Protothaca staminea, is found from Alaska to Mexico, but is of commercial importance only in British Columbia and Washington. The U.S. catch in 1963 totaled 214,400 pounds of meats worth $107,194. In the same year the British Columbia catch was 32,700 pounds of meats. Littlenecks are also taken by noncommercial diggers in Oregon, Washington, and British Columbia. In addition to the name "native littleneck," this clam is also known as "rock clam," "rock cockle," "bay cockle," "hard shell clam," "Tomales Bay cockle," "ribbed carpet shell," and "butter clam." Use of the common name "butter clam" for this species should be avoided to prevent confusion with the Saxidomus species.

Littlenecks are usually found in the intertidal zone, between -3 and +4 feet of the "mean lower low water datum plane (0-foot tide level)." They prefer the same type of mixed mud-gravel ground as the butter clams and often are found intermingled with these species. They may burrow to a depth of 8 inches but are usually within 6 inches of the surface, and occasionally are on the surface. Littlenecks are the smallest of the common commercial species. Average market size is about 2 inches, though the largest individuals may be nearly 3 inches long.

Littleneck shells are usually cream to gray, often indistinctly mottled with brown. The oval shell has ribs radiating from the hinge to the edge of the shell, and concentric growth lines at right angles to the ribs, resulting in a crosshatched appearance. The edge of the shell is not scalloped, however, as in the cockle.

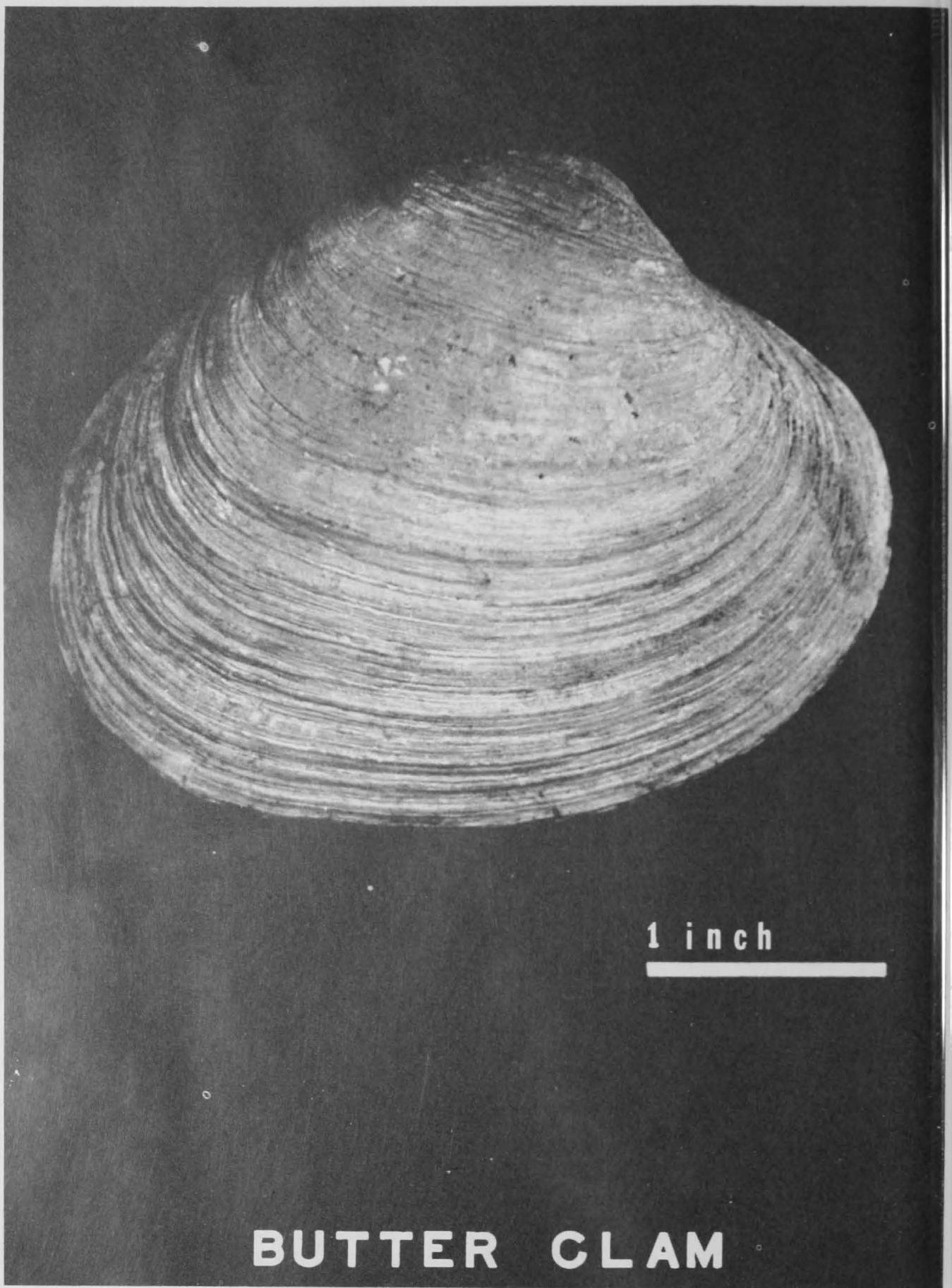
Manila Clam

The Manila clam, Tapes philippinarum, is not a native of the Pacific coast of North America. It may have been introduced accidentally in shipments of Pacific oysters from Japan or perhaps planted intentionally by Japanese immigrants. It is now found from British Columbia to northern California. The Manila clam is also called the "Japanese littleneck" and "Japanese cockle."

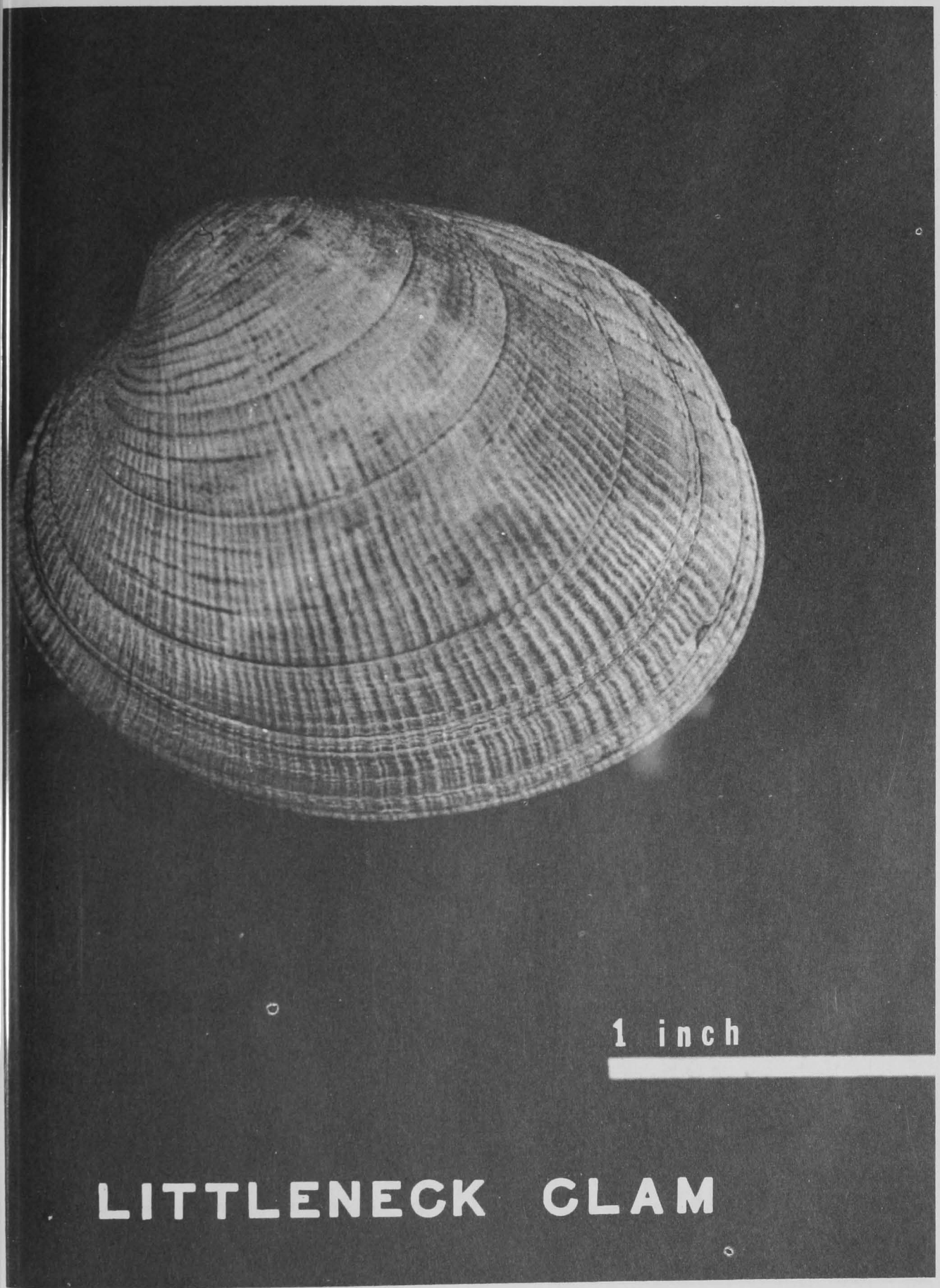
Commercial harvest of this species in 1963 totaled 32,600 pounds of meats in British Columbia and 119,600 pounds in the State of Washington. The latter catch was worth $62,756 to the diggers.

Manila clams usually inhabit the middle intertidal area, prefer coarse sandy mud substrate, and occur over a somewhat wider tidal range than the littlenecks or butter clams. Commonly they lie buried 1 to 2 inches beneath the surface and can be dug with a rake or fork. They may attain a length of 3 inches, but the average market size is nearer 2 inches.

The shells resemble those of the littleneck clam, but are a more elongated oval. The ribs radiating from the hinge are more numerous and are not as prominent as in the littleneck clam. Shell color is highly variable, but usually is yellowish to buff, with black or brown patterns in lines or mottling. The shells are generally purple on a portion of the inside. The shell bears prominent concentric growth lines.



BUTTER CLAM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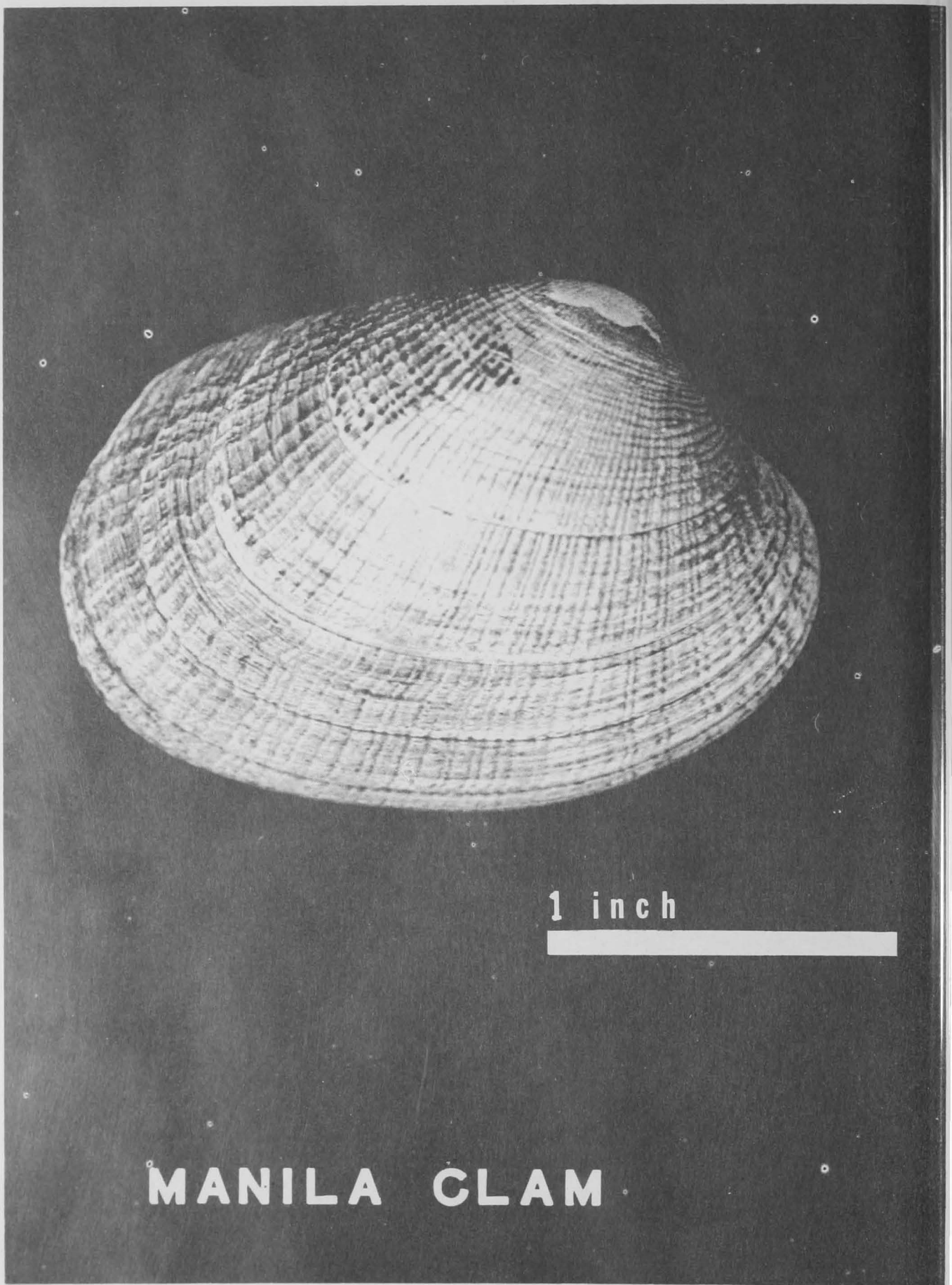
LITTLENECK CLAM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MANILA CLAM

Soft-Shell Clam

The soft-shell clam, Mya arenaria, also known as the "eastern clam," "mud clam," "long-necked clam," "steamer," "nannynose," and "long clam," is an Atlantic coast species that was accidentally introduced on the Pacific coast in about 1870 in shipments of eastern oysters to California and Washington. Later it was planted in a number of places and soon spread along the coast from California to Alaska. For a time this clam supported a commercial fishery, but in recent years has been of commercial consequence only in Oregon, where the 1963 take of 20,800 pounds of meats worth $9,735 was reported as mixed clams, "principally eastern soft clams."

Soft-shell clams are commonly found in the firmer mud flats though they also inhabit mixed gravel, sand, or mud. The soft-shell clam has a long siphon, which permits it to live 8 to 14 inches beneath the surface. Consequently, a shovel, rather than a fork or rake, is usually used to harvest it on the Pacific coast. Soft-shell clams often occur high in the intertidal zone and farther up-bay than other species of bay clams. This distribution reflects a tolerance of low salinities.

The shells of the soft-shell clam are chalky-white to bluish-gray, and often appear chalky, as in the butter clam. They may reach a length of 6 inches, though the average market size is probably 3 to 4 inches. The shell is oblong, thin, and brittle--hence the term "soft shell." This clam is readily identified because one shell (called the "left valve") has a large spoon-shaped "hinge tooth" that projects internally at right angles to the plane of the shell.

Cockle

The cockle, Clinocardium nuttalli, also known as the "heart cockle," "basket cockle," and "cockerel," is found from the Bering Sea to Mexico. It is most common in British Columbia waters and Puget Sound. The cockle is not often in dense enough concentrations to harvest commercially, though each year a few hundred to a few thousand pounds of meats are obtained. In recent years Alaska has been the chief commercial source.

Cockles are found in the lower tidal zone, usually 1 to 3 inches beneath the surface and often only partially buried. Cockles have a large muscular foot and are active diggers, but their very short siphons do not allow burrowing to great depth. The usual substrate is sand or mud, or a mixture of the two. When disturbed, the cockle can retract all body parts within the shells and close tightly. The average size of marketed cockles is usually 3 to 4 inches. One specimen was reported as 4-3/4 inches from hinge to edge; it weighed 26 ounces and was estimated to be 10 years old. The cockle is hermaphroditic, i.e., each individual produces both male and female germ cells. The eggs often are discharged first and the sperm cells later in the season, although they may be shed simultaneously. Spawning begins in the spring and may continue for some time. As does the razor clam, the cockle grows more rapidly in the south than in the north.

The shells of the cockle vary from light brown to gray and often have a variegated red-brown mottling. The shells are essentially round, and prominent ribs radiate from the hinge area. The edge of the shell is strongly scalloped.

Horse Clam

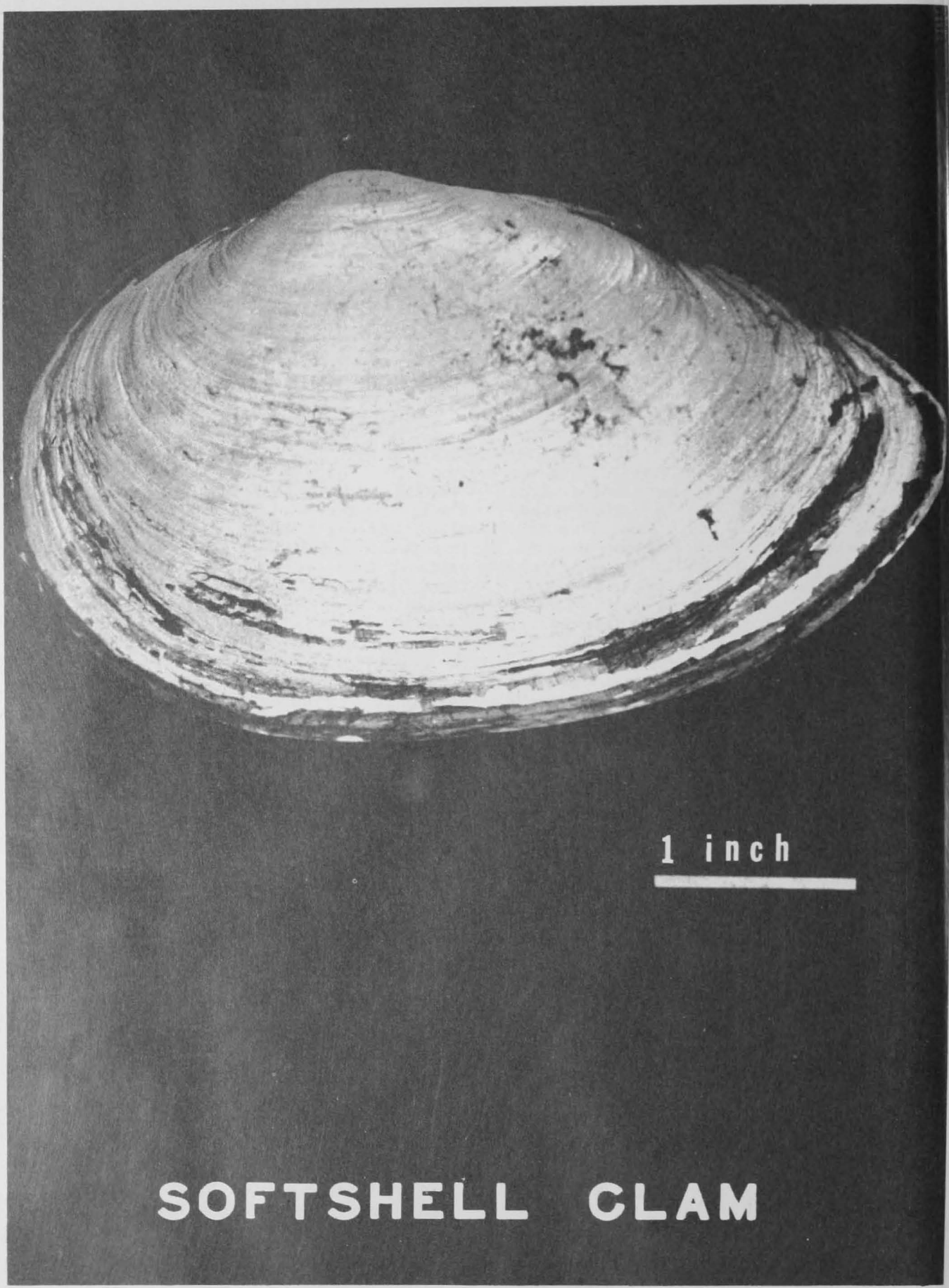
The horse clam, Schizothaerus nuttalli, is a large clam found from Alaska to San Diego, Calif. It has many common names, such as "gaper," "empire," "blueneck," "blue," "horseneck," "rubberneck," "bigneck," "otter-shell," "summer," and "great Washington" clam. Horse clams are of minor commercial importance but appear fairly often in sport catches. Commercial production, principally from Oregon and California, probably did not exceed a few hundred pounds of meats in 1963.

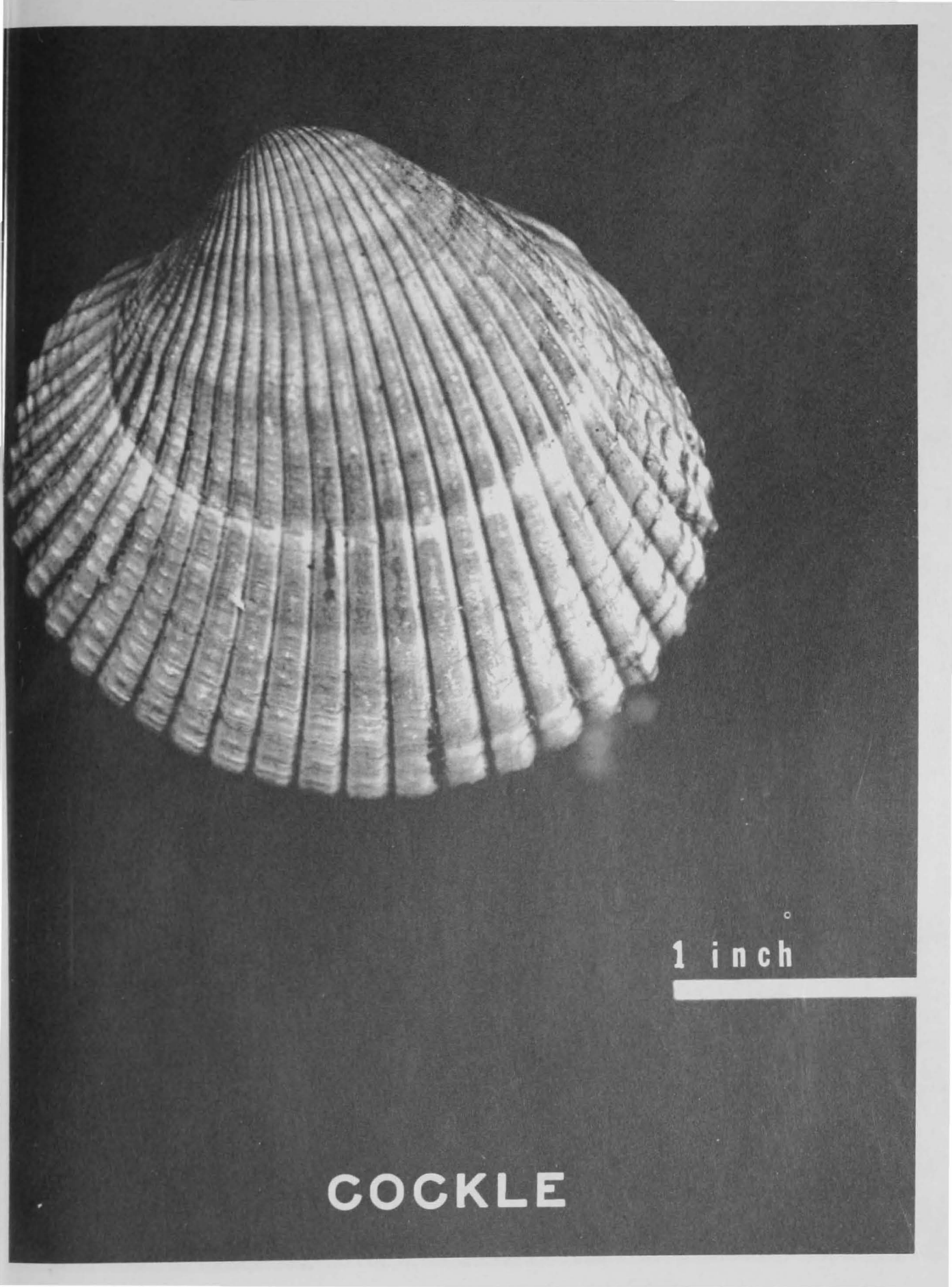
Horse clams live from the minus tide zone (i.e., below the 0-foot level) out into deeper waters, generally 1 to 3 feet beneath the surface of a mud or mud-sand bottom. The horse clam is the most sedentary of the commercial clams. The subsurface depth is established early in the adult life, after which digging ceases. Even if disturbed, the horse clam does not attempt to escape by digging, despite the presence of a large foot or "digger."

Horse clams may reach a length of 8 inches and weigh 4 pounds. The shells are thin and cannot completely enclose the body and bulky siphon. The large siphon, which is capable of great extension, is protected by a tough brown skin and by two horny flaps at the tip. The siphon provides most of the meat from the horse clam, and is skinned and pounded or ground, usually for chowder. The Indians formerly dried the siphons for winter use.

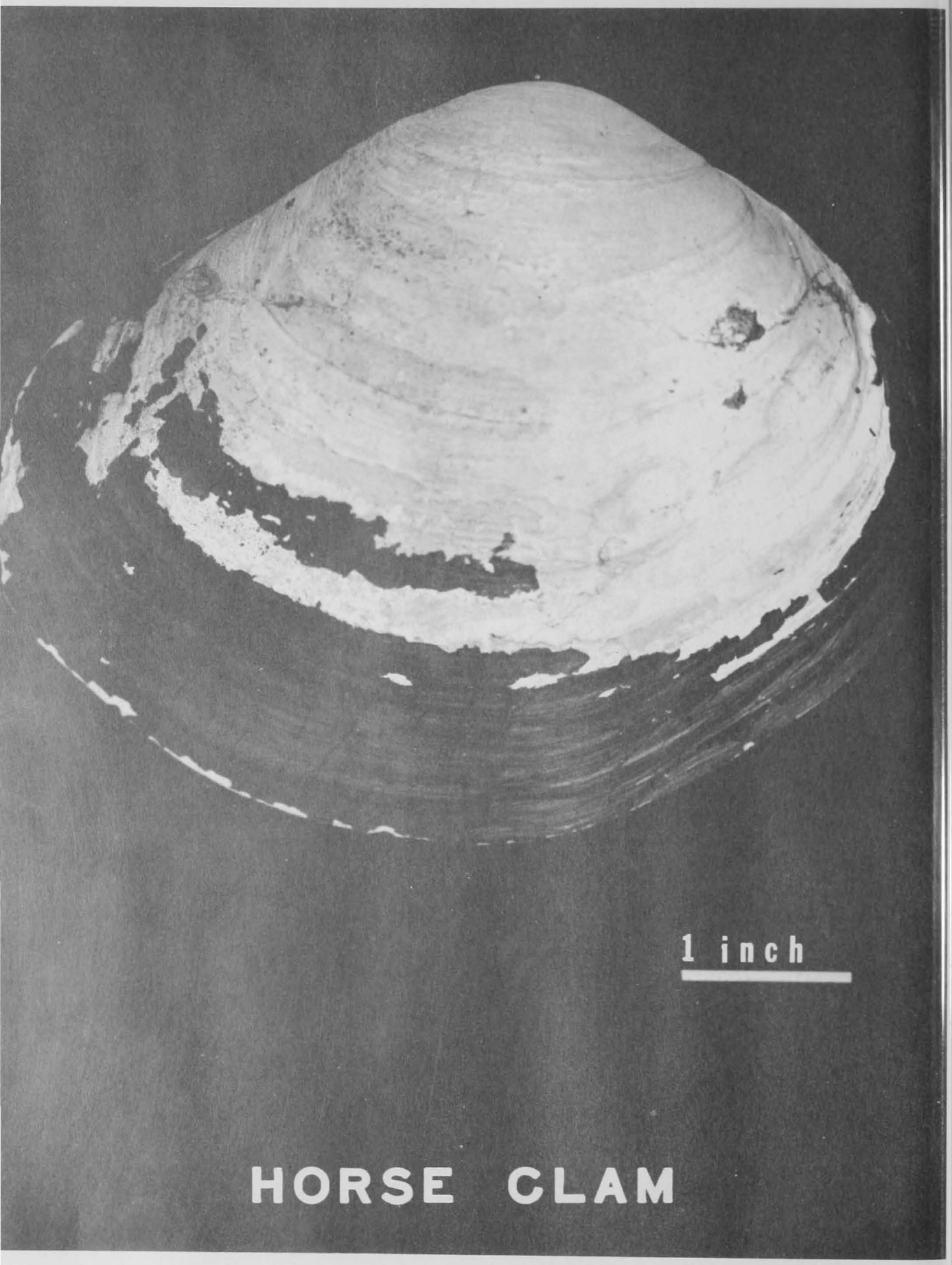
The shells are chalky-white, as in the butter and soft-shell clams, and often have dark brown patches. The new growth at the outer edge of the shell may be covered by a brown skinlike periostracum. At the posterior end the edges of the shell are arched away from the normal plane of shell growth to accommodate the siphon. There is also a large pit in the hinge region of the shell, where the hinge ligament is attached.

Many horse clam catches include a closely related clam, the gray-neck, Schizothaerus


1 inch
SOFTSHELL CLAM



COCKLE



HORSE CLAM

capax. The external appearance of the two species is closely similar, and they appear to occupy the same habitat; they are not usually separated in catch statistics. The gray-neck does not become as large as the horse clam.

Jackknife Clam

The jackknife clam, Tagelus californianus, is a south coast species found from Humboldt Bay, Calif., to Panama. In the United States it is fished commercially only in the San Diego area, where it is used chiefly for fish bait and brings extremely high prices. The 1963 commercial catch was 18,200 pounds of meats worth $36,073, or about $1.98 per pound.

Jackknife clams are inhabitants of mud or mud-sand bottoms and intertidal areas of inner bays, sloughs, and estuaries. Unlike the other species of clams discussed in this circular they establish a permanent vertical burrow, usually 15 to 20 inches long. The top of the burrow is about 4 inches beneath the surface. The clams fit snugly in their burrows but can move up and down rapidly. Jackknife clams are further distinguished by having two siphons, each with a single tube.

The shells of the jackknife clam may reach a length of 4 1/2 inches. They are thin, flat, and much elongated. A clam 4 1/2 inches long is only about 1 1/4 inches wide. The shells are grayish-white and usually are covered with a dull brown periostracum.

Other Species

Of the remaining 25 or more species of edible clams, few ever appear in commercial markets. The most prominent of these non-commercial species is the geoduck (pronounced "goyduk," or, more commonly, "goo-ee-duck"), Panope generosa, found from Alaska to Mexico. The name geoduck is apparently derived from the transliteration "gweduk," the Nisqually Indian term for this clam. This is the largest clam of the North American Pacific coast and may reach a weight of 8 pounds, though 3 pounds is more common. One geoduck, dredged from 30 fathoms, was reported by the Washington State Department of Fisheries to have weighed 20 pounds. Shells of large geoducks are generally no larger than those of large horse clams, though the weight of the whole animal may be nearly twice that of the horse clam.

Geoducks are found in sandy mud bottoms from the lower low tide level out to 30 fathoms or more. Because they are usually buried 3 to 4 feet or more in the substrate, considerable digging is required for their capture. Contrary to popular belief, the geoduck is an extremely poor digger. There is only a small opening through the mantle for the foot, which is almost vestigal.

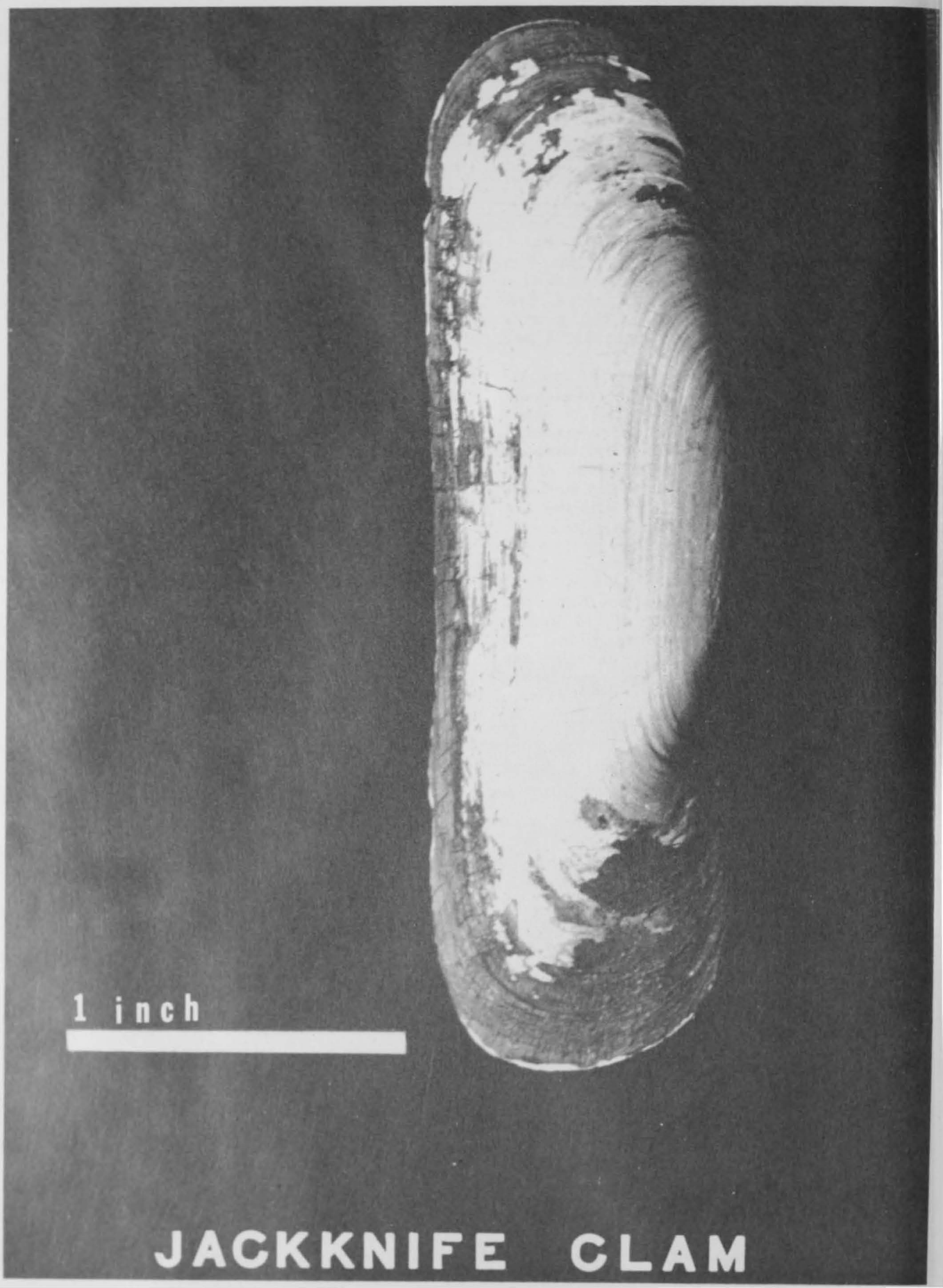
The geoduck is often confused with the horse clam, despite recognizable differences. The shell of the geoduck is more rectangular and gapes on all sides except at the hinge, whereas the horse clam gapes chiefly at the siphonal end; the siphon of the geoduck is relatively much larger than that of the horse clam and does not have horny flaps at the tip. The shells of the geoduck are whitish, and often covered with a dull yellow-brown periostracum. Geoducks are comparatively scarce and protected by personal-use bag limits and closed areas.

The Bodega tellen, Tellina bodegensis, is taken commercially in years when it occurs in sufficient abundance. It ranges from the Queen Charlotte Islands, British Columbia, to Cape San Lucas, Baja California, but is harvested only from certain bays of Oregon. The Bodega tellen occupies sandy beaches along the open coast but is usually most abundant in coarse shifting sand near the entrance to bays. It attains a length of 2 1/2 to 3 inches. The shell is relatively heavy, white, and oblong, with numerous distinct concentric lines. The siphonal end of the shell is bent slightly to the right; the opposite (anterior) end is round. These clams are excellent diggers and burrow rapidly when disturbed.

Another clam, which occasionally appears in harvestable quantities, is the bean clam, Donax gouldi. It is found from Pismo Beach, Calif., to Cape San Lucas, Baja California, in the sandy beaches of the open coast. Bean clams are small, usually not much over 1 inch long. Population density varies widely; in some years they are extremely abundant. In years of great abundance they are collected and steamed for broth. The shells are heavy and strongly concave, with faint ridges radiating from the hinge to the edge. Shell color is highly variable, usually white, yellow, orange, or bluish-purple.

The wedge clam, Donax californicus, also appears in widely varying population densities. It is found in bays and inlets from Goleta, Calif., to Magdalena Bay, Baja California. Adult wedge clams are usually about 1 inch long. The shells are thin and wedge-shaped; indistinct ridges radiate from the hinge area. The wedge clam shells are generally yellowish because of the heavy periostracum. Where the periostracum is worn away, the shells are buff. In years of great abundance, wedge clams are collected for use in broth.

The remaining edible clams are generally taken only incidentally in digging for other clams. An excellent source of information on these species is "Common marine bivalves of California" by John E. Fitch (1953).



JACKKNIFE CLAM

SANITARY CONTROL

Clams, like all other shellfish, are subject to rigid sanitary regulations and inspection by State and Federal health authorities. Employees of shucking houses must undergo frequent medical examinations; persons carrying contagious diseases are not permitted to handle fresh clams. The shucking houses and their equipment are also inspected periodically by Municipal and State sanitary authorities. Clams opened in the shucking houses are examined, and samples are tested at intervals for disease organisms.

Certain laws prohibit the removal of clams from waters in which they are exposed to excessive amounts of bacteria or toxic substances. State health or fishery authorities sometimes find it necessary to close shellfish beds to fishing. These closures should be closely observed. Persons wishing to dig for clams should consult with the appropriate authorities and also watch for emergency closures, which can occur at any time.

CLAM FISHERY REGULATIONS

The clam fisheries, as with all other fisheries within territorial waters, are regulated by the bordering States. In most States a special fishery agency has been established and directed to promulgate and enforce laws for the protection of the resource. In some States enforcement may be by the State police or by cooperative effort of State police and State wardens. The State fishery agencies may require licenses for commercial clammers and sometimes for recreational diggers. They also may establish closed seasons, bag limits, and size limits for each species. Persons interested in digging for clams should ask their State fishery agency about existing laws relating to the species they intend to take.

ACKNOWLEDGMENTS

An earlier leaflet on Pacific coast commercial clams was prepared in 1947 by Victor L. Loosanoff under the title, "Commercial clams of the Pacific coast of the United States." Much of it is incorporated in the present leaflet. Additional information included in this paper came from the following publications: "Washington State shellfish," by the Washington State Department of Fisheries; "Bay clams of Oregon," by Lowell D. Marriage of the Fish Commission of Oregon; and "Common marine bivalves of California," by John E. Fitch of the California Department of Fish and Game. Kenneth K. Chew of the University of Washington College of Fisheries and Cedric E. Lindsay of the Washington State Department of Fisheries suggested improvements.

SELECTED REFERENCES

ABBOTT, R. TUCKER.
1954. American seashells. D. Van Nostrand Co., Inc., New York, 541 p.

BANNOT, PAUL.
1940. The edible bivalves of California. Calif. Fish Game 26(3):212-239.

CALIFORNIA DEPARTMENT OF FISH AND GAME.
1963. The California marine fish catch for 1961. Its Fish Bull. 121, 56 p.

DEPARTMENT OF FISHERIES OF CANADA.
1962. British Columbia catch statistics - 1961. Dep. Fish. Can., 164 p.

FITCH, JOHN E.
1953. Common marine bivalves of California. Calif. Dep. Fish Game, Fish Bull. 90, 102 p.

FRASER, C. McLEAN.
1929. The spawning and free-swimming larval periods of Saxidomus and Paphia. Trans. Roy. Soc. Can. (Sec. 4) 23:195-198.
1931. Notes on the ecology of the cockle. Trans. Roy. Soc. Can. (Sec. 5) 25:59-72.

FRASER, C. McLEAN, and P. SMITH.
1928. Notes on the ecology of the butter clam. Trans. Roy. Soc. Can. 22:271-286.

JOHNSON, MYRTLE E., and HARRY J. SNOOK.
1927. Seashore animals of the Pacific coast. MacMillan Co., New York, 659 p.

LOOSANOFF, VICTOR L., and HARRY C. DAVIS.
1963. Rearing of bivalve mollusks. In F. S. Russell (editor), Advances in marine biology 1:1-136. Academic Press, London and New York.

LYLES, CHARLES H.
1965. Fishery statistics of the United States - 1963. Bureau of Commercial Fisheries, Statistical Digest 57, 522 p.

MARRIAGE, LOWELL D.
1954. The bay clams of Oregon. Fish Comm. Oreg., Contr. 20, 47 p.

QUAYLE, D. B.
1941. The edible molluscs of British Columbia. Rept. B.C. Fish. Dep. - 1940, J85-J87.

RICKETTS, EDWARD F., and JACK CALVIN.
1952. Between Pacific tides. 3d ed. Stanford University Press, 502 p.

TAGELBERG, HERB C.
1964. Growth and ring formation of Washington razor clams. Wash. Dep. Fish., Fish. Res. Pap. 2(3):69-103.

WASHINGTON STATE DEPARTMENT OF FISHERIES.
1964. Washington State shellfish. Wash. State Dep. Fish., 16 p. Olympia, Wash.

WEYMOUTH, FRANK W.
1920. The edible clams, mussels and scallops of California. Calif. Fish Game Comm., Fish Bull. 4, 72 p.
1923. Life history and growth of the Pismo clam. Calif. Fish Game Comm., Fish Bull. 7, 120 p.

WEYMOUTH, FRANK W., H. C. McMILLIN, and H. B. HOLMES.
1925. Growth and age at maturity of the Pacific razor clam, Siliqua patula (Dixon). Bur. of Fish. Bull. 41:201-236.

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