Cryptomya californica

False Mya

Phylum: Mollusca

Class: Bivalvia, Heterodonta, Euheterodonta

Order: Imparidentia, Myida

Family: Myoidea, Myidae

Taxonomy: *Sphenia californica* is the original name given to *Cryptomya californica* (Keen 1966; Coan 1999; Coan and Valentich-Scott 2012). Although *C. californica* is almost exclusively used currently, the taxonomy of this species includes many synonyms (e.g., *Cryptomya kamtschatica, C. magna, C. oregonensis, C. quadrata, C. washingtoniana, Macoma kerica, Mya inopia, M. mindorensis, M. tenuis*). *Sphenia* species tend to live attached to shells or stone, while *Cryptomya* species are found within the burrows of other invertebrates (Zhang et al. 2012, see also Coan 1999 for Sphenia characteristics). The name of the genus reflects individual's ability to be buried deep within the sediment despite short siphons (*kryptos* = hidden, *myax* = shellfish) as they utilize the burrows of other burrowers (Coan and Valentich-Scott 2012).

Description

Size: Individuals average 20 mm in length, but are found up to 30 mm (Haderlie and Abbott 1980; Lawry 1987). The illustrated specimen (from Coos Bay) is 21 mm in length (Fig. 1).

Color: Exterior chalky and white and yellowish, with dull reddish brown periostracum (Lawry 1987). Interior glossy white with spoon-shaped tooth on the right valve orange in color.

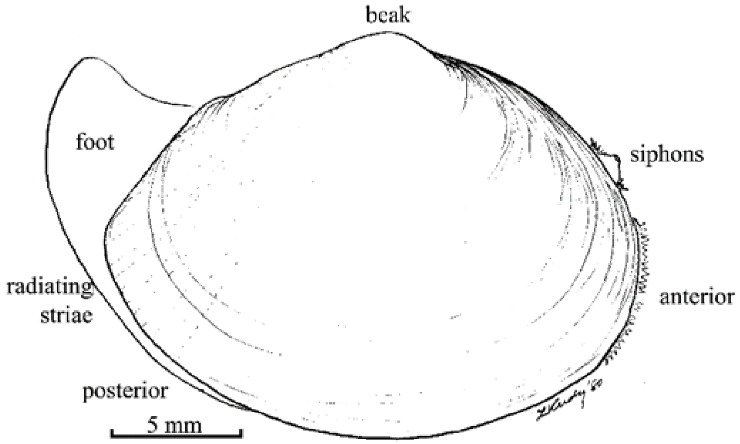
General Morphology: Bivalve mollusks are bilaterally symmetrical with two lateral valves or **shells** that are hinged dorsally and surround a mantle, head, **foot** and viscera (see Plate 393B, Coan and Valentich-Scott 2007). Myoid bivalves are burrowers and borers, with long siphons and hinges with few teeth (Coan and Valentich-Scott 2007), although *C. californica* has relatively short siphons (Fig. 6). A distinctive feature of the Myidae is the presence of a strongly projecting chondrophore that is spoon or peg-shaped and is present on the left valve only (see Plate 395H, Coan and Valentich-Scott 2007).

Body: (see Fig. 319, Kozloff 1993).

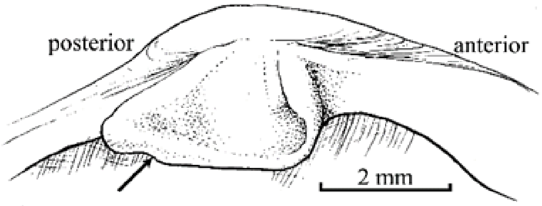
Color:

Interior: Ligament is internal and seated in a shallow resilifer (a pit or groove). In right valve, the ligament is orange, leathery, and corresponds with the chondrophore on the left valve (Figs. 3, 4). Esophagus and stomach are surrounded by extensive intestinal diverticula, which extend from the right side of the stomach to the posterior portion of the foot, passing through the heart dorsally. The rectum is positioned dorsally and posterior to the adductor muscle. The anus is situated inside the excurrent siphon (Lawry 1987; Yonge 1951). A crystalline style (consisting of a gelatinous cortex and liquid core, Lawry 1987) resides in a sac lined with cilia, which allow it to rotate and press agains the gastric shield of the stomach to aid in digestion (Lawry 1987). The crystalline style contains starch-hydrolyzing enzyme amylase and rotation rates range from 7 to 30 rpm (at 10–21˚C). Within the crystalline style are mutualistic bacteria of the genus *Cristispira*. These spirochetes benefit from food particles concentrated by *C. californica* and the clam presumably benefits from an aid in digestion (Lawry et al. 1981; Lawry 1987). (For further information on digestion in *C. californica*, see Lawry 1987).

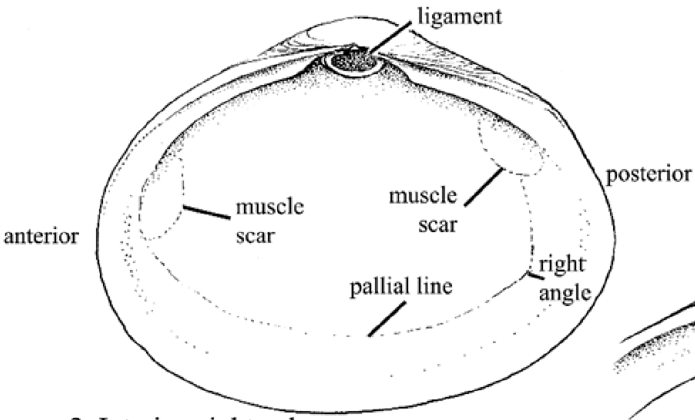
Cryptomya californica



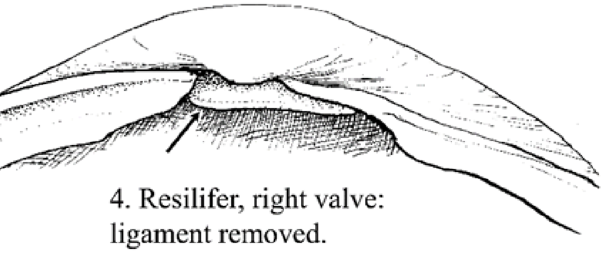
1. *Cryptomya californica*, exterior, right valve (L:2.1mm) x4.25: beaks central; anterior rounded, posterior truncate, gaping, concentric sculpture, same radial striae; shell thin, fragile, chalky white; siphons very short.



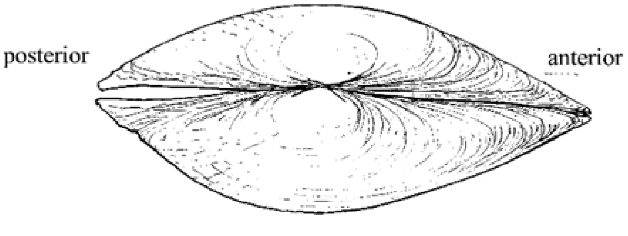
2. Chondrophore, left valve x11: spoon-shaped, broad, horizontal.



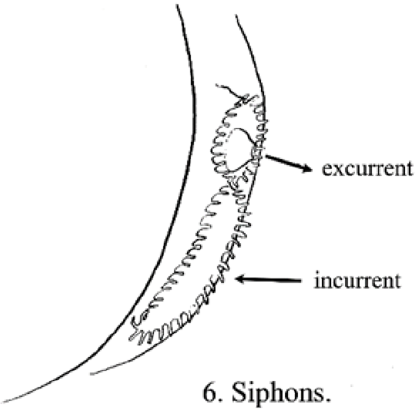
3. Interior, right valve: glossy white; anterior and posterior muscle scars equal; no cardinal or lateral hinge teeth; no pallial sinus, pallial line entire, forms a right angle posteriorly.



4. Resilifer, right valve: ligament removed.



5. (Dorsal view): posterior gapes slightly; no external ligament.



6. Siphons.

Hiebert, T.C. 2015. *Cryptomya californica. In:* Oregon Estuarine Invertebrates: Rudys' Illustrated Guide to Common Species, 3rd ed. T.C. Hiebert, B.A. Butler and A.L. Shanks (eds.). University of Oregon Libraries and Oregon Institute of Marine Biology, Charleston, OR.

Exterior:

Byssus:

Gills: Gills pump water through the mantle cavity. They are large and covered in cilia that concentrate and transport food particles. Undigestable material is sorted by the labial palps and egested as pseudofeces, which are expelled through the incurrent siphon (Lawry 1987; Yonge 1951).

Shell: Shell is thin, fragile with external thin and brown periostracum and light concentric sculpture (Quayle 1970). The overall shape is oblong and gapes posteriorly (Haderlie and Abbott 1980).

Interior: Adductor muscle scars equal (family Myidae). Pallial line is entire and forms a right angle posteriorly (Fig. 3). The pallial sinus is absent (or inconspicuous) in members of the genus *Cryptomya* (Fig. 3). The chondrophore is broad, horizontal, and projecting (left valve only). The right valve is with resilifer to receive the chondrophore.

Exterior: The right valve is more convex than the left (McLean 1969). The shell sculpturing is similar to *M. arenaria*, but smaller (Haderlie and Abbott 1980). The beak is central and fairly prominent (Fig. 1).

Hinge: No true teeth or hinge plate, except for chondrophore and resilifer (Myidae, McLean 1969).

Eyes:

Foot: Foot extends through pedal gape and facilitates digging (Fig. 1). Individuals dig with muscular contractions of the foot coupled (making the foot appear alternatively knife and spade-shaped) with its epidermal ciliary action. Individuals are anchored by the foot and pull themselves onto the anteroventral portion of the shell. They then rock back and forth in a dorsoventral plane, working themselves into the substrate to completely bury themselves (except the siphons) in 5 minutes (Lawry 1987).

Siphons: Siphons are short (less than 1 mm in length), oval, and white (Coan and Valentich-Scott 2007). The excurrent siphon opening is controlled by a membrane, and both siphons possess an outer tentacular ring (Lawry 1987). The incurrent siphon is surrounded by additional tentacles and the excurrent siphon is short and vase-like (Fig. 6).

Burrow: Individuals found in burrows up to 50 cm deep (Haderlie and Abbott 1980; Lawry 1987). For digging behavior see **Foot**. Inhabits the burrows of other invertebrates (e.g., *Callianassa californiensis*, *Upogebia pugettensis*, *Urechis caupo)* and extends short siphons into burrow. *Cryptomya californiensis* receives oxygen, food, and can remove waste by utilizing these burrows (Lawry 1987).

Possible Misidentifications

There are five bivalve subclasses based on morphology and fossil evidence and one of those is the diverse Heterodonta. Recent molecular evidence (18S and 28S rRNA) suggests that the heterodont order Myoida is non monophyletic (Taylor et al. 2007). The family Myidae includes 25–40 species worldwide, which can be divided into groups such as those that are burrowing (*Mya*), those that are attached to shells or stone (*Sphenia*) or those utilizing the burrows of other species (*Cryptomya*, *Paramya*) (Zhang et al. 2012). Characters of the Myidae include a shell that is not cemented to the substratum, valves that are (relatively) morphologically similar, a dorsal margin without ears, a hinge with an internal ligament in a distinct resilifer or chondrophore that is spoon shaped and present on the left valve (Coan and Valentich-Scott 2007). *Cryptomya* species are characterized by hinge without tooth-like process anteriorly on the right valve. *Mya,* on the other hand, have thick shells, gaping anteriorly and posteriorly and commarginal growth lines (Zhang et al. 2012).

There are only three local myid species including *Platyodon cancellatus*, *Mya arenaria* (see description in this guide) and *Cryptomya californica*. *Platyodon cancellatus* can be distinguished from the latter two species because its shells are heavy and with wavy commarginal sculpture and a round anterior. It has a truncate, gaping posterior end covered with periostracum. It also bores into rock and hard clay while *M. arenaria* and *C. californica* burrow into sand or mud. The shells of the two latter species are relatively thin. In *M. arenaria*, the pallial sinus is deep and individuals reach sizes of 120 mm, while in *C. californica* the pallial sinus is shallow, inconspicuous and individuals tend to be smaller (30 mm) (Coan and Valentich-Scott 2007). *Mya arenaria* is found as deep as 30 cm and is not necessarily near *Callianassa* burrows, where one might find *C. californica*. The siphons are *M. arenaria* are also longer than those of *C. californica* (Figs. 1, 6). Additionally, *Sphenia luticola* is a myid species that may occur in our area, but is found offshore in rocks and within kelp holdfasts (Coan and Valentich-Scott 2007). Juvenile *Mya* are not easily distinguished from *Sphenia* species, but *Mya* can be recognized by a large continuous pallial sinus (Coan 1999).

Cryptomya californica can be distinguished from other small white clams (*Macoma* spp., for instance) by its lack of any external ligament, the fragility of its shell, and internally, by its lack of hinge teeth, and presence of the chondrophore in the left valve. The Mactridae, including the gaper clam, have a chondrophore in both valves. However, mactrid adults are large, gape widely, and have small hinge teeth (which Myidae lack). Their posterior edges are also truncate, not rounded, and their siphons are leather-like at the tips.

Ecological Information

Range: Type locality is Santa Barbara, California (Keen 1966). Gulf of Alaska to northern Peru (Chicagot Island) (Keen 1971; Haderlie and Abbott 1980).

Local Distribution: In bays and estuarine mudflats and sand flats where *Callianassa* or *Upogebia* beds are found. In Coos Bay, sites include the airport extension site, Pigeon Point, and South Slough, among others. Other Oregon estuaries where *C. californica* occurs include Tillamook, Netarts, Nestucca (Hancock et al. 1979), Yaquina, and also offshore (Lawry 1987).

Habitat: Sand and sandy mud, nearly always with siphons extending into the burrow of *Callianassa californiensis*, the ghost shrimp (which, in turn, often inhabits oyster beds). Individuals also occurs in muddy gravel and rocks on the open coast (Haderlie and Abbott 1980; Coan and Valentich-Scott 2007).

Salinity: Collected at salinities of 30.

Temperature: Occurs over a wide range of water temperatures geographically (see **Range**).

Tidal Level: Individuals can be found to 6 meters below the surface (Quayle 1970) as well as the upper to mid-intertidal zones. Individuals also found in the low intertidal and subtidal on the open coast (Haderlie and Abbott 1980) and are common in lower estuarine mudflats, up to +0.3 meters (Lawry 1987).

Associates: The burrows of *Callianassa californiensis* can include a community of marine invertebrates including the polynoid polychaete *Hesperonoe complanata*, three different pinnotherid (pea) crabs (e.g., *Fabia concharum,* Haderlie and Abbott 1980), and the goby, *Clevelandia ios*. This *Callianassa-Cryptomya* complex of organisms often cooccurs with *Sanguinolaria nuttallii* (Peterson 1984). *Cristispira* populations are constantly replenished by ingestion of bacteria from the environment (populations decrease when individuals are maintained in the laboratory with filtered seawater, Lawry 1987). *Cryptomya californica* individuals also have a commensal association with the mud shrimp, *Upogebia pugettensis,* and the spoon worm, *Urechis caupo* (McLean 1969; Lawry 1987; Coan and Valentich-Scott 2007). An average of eight *C. californica* were observed per *U. pugettensis* burrow (Griffin et al. 2004). Finally, amebocytes, spirochetes (*Cristispira*), and gram negative bacteria (*Vibro* spp.) are often observed near or concentrated within the crystalline style and stomach (Lawry 1987).

Abundance: Individuals can be very common and, in some parts of Coos Bay, it is the most abundant bivalve (e.g., airport mudflat, North Bend) (Gonor et al. 1979). This common estuarine species is, thus, often used in toxicity and biomarker tests (e.g., DDT, Ferraro and Cole 1997).

Life-History Information

Reproduction: Sperm acrosome is 5 µm in length and is tapered and slightly curved; the total sperm length (including flagellum) is 45 µm. Oocytes are oblong and 65 µm x 53 µm, with nucleus that is 30 µm, and nucleolus that is 13 µm (see Fig. 4c, d, Lawry 1987). The development of *C. californica* has not been described (Brink 2001).

Larva: Bivalve development generally proceeds from external fertilization via broadcast spawning through a ciliated trochophore stage to a veliger larva. Bivalve veligers are characterized by a ciliated velum that is used for swimming, feeding and respiration. The veliger larva is also found in many gastropod larvae, but the larvae in the two groups can be recognized by shell morphology (i.e. snail-like versus clam-like). In bivalves, the initial shelled-larva is called a D-stage or straight-hinge veliger due to the "D" shaped shell. This initial shell is called a prodissoconch I and is followed by a prodissoconch II, or shell that is subsequently added to the initial shell zone. Finally, shell secreted following metamorphosis is simply referred to as the dissoconch (see Fig. 2, Brink 2001). Once the larva develops a foot, usually just before metamorphosis and loss of the velum, it is called a pediveliger (see Fig. 1, Kabat and O'Foighil 1987; Brink 2001). (For generalized life cycle see Fig. 1, Brink 2001.)

Juvenile:

Longevity:

Growth Rate:

Food: Filters material from water pumped into the burrows of commensal species. *Upogebia pugettensis* and *Urechis caupo* are more effective detritus filterers than *Callianassa californiensis*, and *Cryptomya californica* ingests more in the burrow of the latter species (MacGinitie and MacGinitie 1949). Individual compete for suspended particles with extra large gills providing a larger surface area for filtering (Haderlie and Abbott 1980; Kozloff 1993). Ingested items include detritus, diatoms, bacteria, dinoflagellates, crustaceans and annelids. The *Upogebia-Cryptomya* complex is capable of filtering 100% of carbon from overlying water in one day (4.66×10^5 to 1.86×10^6 g Cd^{-1}, Griffen et al. 2004). The portion of suspended material removed by *C. californica* increases with increasing phytoplankton concentrations (Griffen et al. 2004).

Predators: Individuals remain relatively protected within their burrow. The invasive green crab, *Carcinus maenas*, has been known to eat *C. californica* (Palacios and Ferraro 2003)

Behavior: Interestingly, individuals remain just below the surface as a short-siphoned clam of its size normally would, however, they can live deep within the substrate, by utilizing the burrows of other species (see **Foot**, **Associates**, and **Burrow**).

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T.C. Hiebert and M. Hunt