Solen sicarius

The sickle razor clam,
or blunt jackknife clam

Phylum: Mollusca

Class: Bivalvia, Heterodonta, Euheterodonta

Order: Imparidentia, Adapedonta

Family: Solenoidea, Solenidae

Description

Size: Individuals up to 125 mm in length (Haderlie and Abbott 1980; Kozloff 1993). The illustrated specimen (from Coos Bay) is 90 mm in length, which is the same size as reported type specimens (Oldroyd 1924; Ricketts and Calvin 1952).

Color: Shell very white in color, but covered with yellow green, and glossy periostracum (Ricketts and Calvin 1952). The foot can be darkly pigmented (Kozloff 1993).

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). Solenid and pharid bivalves are burrowers and some species are quite fast (e.g. *Siliqua patula*, see description in this guide). They have shells that are longer than wide and often razor-like at the opening edge (see Plate 397G, Coan and Valentich-Scott 2007).

Body: Long, dark and finger-like body. The posterior end swells to form an anchor (see Fig. 306 Kozloff 1993).

Color:

Interior: The mantle is fused along the entire ventral margin and restricts foot movement along anterior-posterior axis (Pohlo 1963), but serves as a barrier to outside foreign material. The ligament is long, entirely external, and not seated on nymph (Figs. 2, 4).

Exterior:

Byssus:

Gills:

Shell: Shell is slightly bent, elongate, and gapes at both ends. The dorsal margin is slightly concave and has beaks near the anterior end. The anterior margin is blunt while the posterior is rounded (Ricketts and Calvin 1952; Haderlie and Abbott 1980).

Interior: Adductor scars at opposite ends of shell and the anterior scar is elongate, while the posterior is oblong (Oldroyd 1924). The pallial sinus is shallow (Coan and Valentich-Scott 2007) and the pallial line extends beyond the anterior adductor scar. In the illustrated specimen, the line is a strong rib (Fig. 2), however there is no strong radial rib as in some Solenidae.

Exterior: Shell shape is cylindrical (solen = channel pipe, Quayle 1970). Length about four times the width and gapes at both ends (Coan and Valentich-Scott 2007). The shell is thin, the valves are moderately inflated, beaks are at near anterior end, and very weak (Figs. 1, 4). The dorsal margin is straight or slightly concave, but not arched (*Solen,* Keen and Coan 1974) (Fig. 1). The ventral margin is arched (Oldroyd 1924) and the anterior edge is truncate while the posterior is rounded.

Hinge: The hinge is close to anterior end (Kozloff 1993). Beaks are terminal and situated at anterior end (*Solen,* Keen 1971) (Figs. 1, 2, 4). One cardinal tooth is present in each valve and teeth are erect, recurved, and triangular (Oldroyd 1924).

Eyes:

Foot: The foot is with dark pigment (Kozloff 1993) (Fig. 4).

Siphons: Inhalant and exhalant siphons are joined (Fig. 4a). Siphons of both *Solen rostiformis* and *S. sicarius* can be readily autoto-

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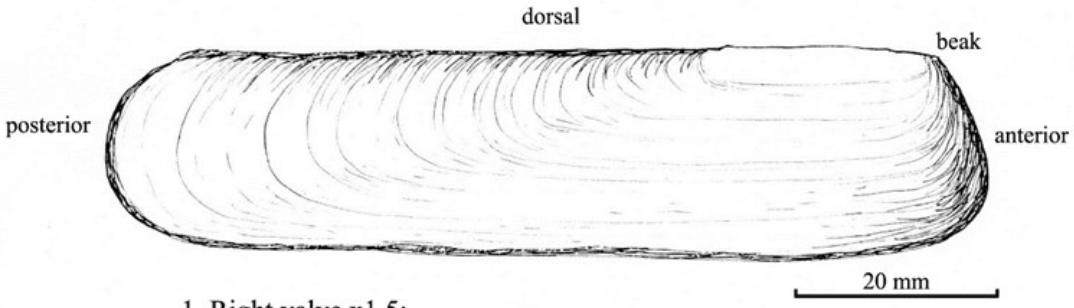
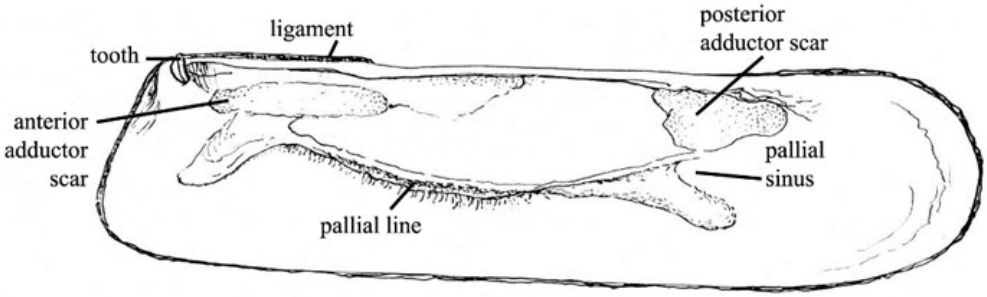
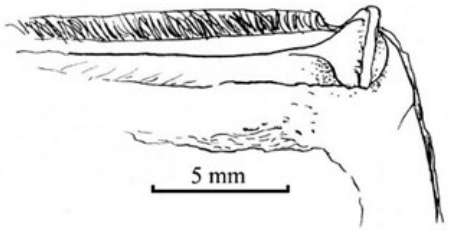


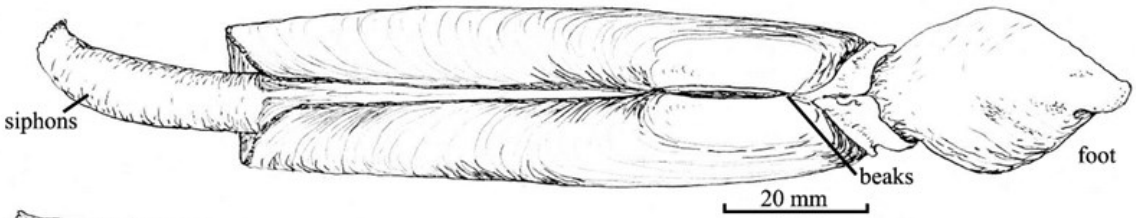
1. Right valve x1.5:
shell cylindrical; dorsal margin straight, anterior edge truncate; length 4x width; beaks terminal, very weak; shell white, periostracum yellow green, glossy.



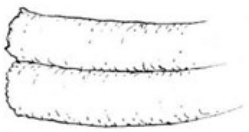
2. Right valve, internal:
adductor scars at opposite ends of shell; pallial line a strong edge; no radial rib.



3. Hinge area, left valve x4:
a large single tooth (each valve).



4. Dorsal view x1.5.



4a. Siphons (lateral view).

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mized at annular constrictions on the siphon (Ricketts and Calvin 1952; Pohlo 1963; Haderlie and Abbott 1980; Rudy and Rudy, personal observation). The siphon of the former species are even too large to be retracted completely into the shell (Ricketts and Calvin 1952).

Burrow: The burrow of *S. sicarius* is permanent, vertical, and reaches depths of 30–35 cm (Haderlie and Abbott 1980). Individuals dig rapidly and are very active, burying themselves completely within 30 seconds with four to five thrusts of the muscular **foot** (Ricketts and Calvin 1952; Haderlie and Abbott 1980).

Possible Misidentifications

Solenidae and Pharidae are two razor clam families represented locally and pharid genera were recently placed in the former family (see previous editions of this guide). They are both characterized by cylindrical shells that are about 2.5 times as long as high and gape at both ends. They have no dorsal margin ears (compare to Pectinidae, see Plate 394E, Coan and Valentich-Scott 2007), a hinge with ligament that is entirely external and dorsal, equally shaped adductor muscle scars (compare to *Mytilus trossulus*, this guide), and shells that do not have prominent radial sculpturing (Coan and Valentich-Scott 2007). The difference between the two families is that members of the Pharidae have one shell valve with two cardinal teeth and the other with four, while the Solenidae have a single cardinal tooth on each shell valve (Coan and Valentich-Scott 2007). Other local razor-shaped clams besides the Solenidae such as the Mytiiidae include some genera (e.g., *Adula*) which are also long and cylindrical. *Adula* (see *A. californiensis*, this guide) are usually a boring species, however, having hairy posterodorsal slopes, a very small anterior adductor scar, and no hinge teeth (Coan and Valentich-Scott 2007). Hiatellidae, including the geoduck, *Panopea generosa* have large, quadrate, gaping bivalves, without hinge teeth, and with nearly equal adductor muscle scars (Keen and Coan 1974).

Only two species, in the genus *Solen*, are reported locally in the Solenidae, they have an almost straight dorsal margin, a terminal beak, and one cardinal tooth in each valve (Keen 1971). *Solen rostiformis* (= *S. rosaceus,* but see Pohlo 1963; von Cosel 1992) has a thin shell that tapers and a periostracum that is lighter than *S. sicarius*; it is light olive green to brown in color. *Solen rostiformis* is a pink shelled clam and its siphons are annulated (and it can regenerate them when disturbed, Pohlo 1963). It lives in sandier situations than does *S. sicarius* (Coan and Carlton 1975). *Solen sicarius*, on the other hand, has a thick shell, a blunt posterior (‘the blunt razor shell’) and a dark brown periostracum. *Solen sicarius* is found occasionally in permanent burrows in mud or muddy sand (Kozloff 1974) and is the species most likely to be confused with *Siliqua patula*. It lacks an interior vertical rib and multiple hinge teeth, and is four times as long as wide, not 2.5 times, as in *S. patula* (Keen and Coan 1974). Furthermore, the profile in *S. patula* is much more oval, and not as cylindrical as in *Solen sicarius.*

Four species are reported locally in the Pharidae. *Siliqua patula* has an internal rib that slopes anteriorly, a wide and tapering posterior end. *Siliqua lucida* is smaller than *S. patula* (< 55 mm in length) and has an internal rib that is vertical and narrow and a posterior end that is truncate. It has been suggested that *S. lucida* are simply young *S. patula* individuals (Hertlein 1961), but this is not yet known. *Siliqua lucida* lives in protected bay sands and has concentric brown bands on its exterior. Although variations in *S. patula* have been synonymized, occasio-

nally readers will find references to *S. patula* var. *nuttallii*, which is more oval shape, with purple beaks and four hinge teeth in the left valve, not two (Oldroyd 1924). *Ensis myrae* and *Siliqua altra* are offshore species and *E. myrae* is has a shell that is long and thin.

Ecological Information

Range: Type locality is the Straits of Juan de Fuca. Known range extends from Vancouver Island, BC, Canada to San Quintin Bay, Baja California.

Local Distribution: Locally occurs in mudflats of both Coos Bay and Charleston.

Habitat: Individuals found in permanent vertical burrows of protected parts of bays, within mud or muddy sand (Coan and Valentich-Scott 2007). *Solen sicarius* is more common among eelgrass (e.g., *Zostera marina*) roots, in firm sediments than other mudflats.

Salinity: Collected at salinities of 30 in Coos Bay.

Temperature: Cold to warmer temperate waters.

Tidal Level: Low intertidal to shallow subtidal (Haderlie and Abbott 1980). In Coos Bay, individuals are primarily collected intertidally.

Associates: Known associates include the commensal pea crabs (e.g. *Pinnixa*, Quayle 1970).

Abundance: Not common, but becoming more abundant in Coos Bay (Rudy and Rudy, personal observation). In Inchon, Korea, a population of the congeneric species, *S. scrictus,* reached mean densities of 126 individuals/m^2 (Hong and Park 1994).

Life-History Information

Reproduction: Although little is known about the reproduction and development in *Solen sicarius*, reproductive aspects of biology have been studied for several congeners. *Solen marginatus,* a species that occurs on Spanish coasts, is reproductive from May to July (Spain, Remacha-Trivino and Anadon 2006) and in *Solen grandis*, spawning occurred from April to May. Several spawning events were observed for *S. dactylus,* in the northern Persian Gulf, from August to February (Saeedi et al. 2009). The sperm morphology of the congeners *S. cylindraceus* and *S. capensis* was studied by Hodgson et al. (1987). In both species, sperm were of "primitive type" (i.e., typical triangular shape that is not elongated in any way), with head pieces approximately 1.5µm in length, but acrosome morphology was species specific. In fact, sperm morphology appears to characterize many veneroid taxa (see Fig. 2, Healy 1995). Fertilized oocytes of *S. marginatus* were approximately 156 µm in diameter and surrounded by a chorion (da Costa and Martinez-Patino 2009) and mature oocytes of *S. gordonis* and *S. strictus* from Dadaepo, Pusan, Korea were 80–90 µm (Chung et al. 1986).

Larva: Bivalve development, including members of the Pholadidae, 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.) In *Solen grandis*, D-shaped larvae hatched after 20 hours and were 125 µm. After 5–6 days, larvae were early umbo stage and approximately 250 µm (Guo-qiang et al. 2009). Settlement occurred after nine days in *Solen marginatus* when larvae were approximately 300 µm (da Costa and Martinex-Patino 2009).

Juvenile:

Longevity:

Growth Rate: In the congener, *Solen marginatus,* seed were 19 mm at four months and one year old juveniles were 38.5 mm. After three years, individuals were 80 mm (da Costa and Martinez-Patino 2009).

Food: A suspension and filter feeder.

Predators: Known predators include birds (e.g., white-winged scoter, Grosz and Yocom 1972) and sea stars (e.g., *Pisaster brevispinus*, Sloan and Robinson 1983).

Behavior: A very good digger, it can bury itself in 30 seconds. However, *S. sicarius* is not as fast a burrower as *S. patula*: an individual 7 cm in length requires 45 seconds to 11 min to bury itself (compare to 7–27 seconds for *S. patula*, see description in this guide) (Pohlo 1963). Interestingly, *Solen sicarius* can also both swim and jump (MacGinities 1935). They do so by either expelling water from their siphons rapidly or through the opening surrounding the siphon. With these techniques they are able to move up to two feet through the water or use the blast of water to soften sediments for rapid burrowing (Ricketts and Calvin 1952; Haderlie and Abbott 1980).

Bibliography

1. BRINK, L. A. 2001. Mollusca: Bivalvia, p. 129-149. *In:* Identification guide to larval marine invertebrates of the Pacific Northwest. A. Shanks (ed.). Oregon State University Press, Corvallis, OR.
2. CHUNG, E. Y., H. B. KIM, and T. Y. LEE. 1986. Annual reproductive cycle of the jackknife clams, *Solen strictus* and *Solen gordonis*. Bulletin of the Korean Fisheries Society. 19:563-574.
3. COAN, E. V., and P. VALENTICH-SCOTT. 2007. Bivalvia, p. 807-859. *In:* The Light and Smith manual: intertidal invertebrates from central California to Oregon. J. T. Carlton (ed.). University of California Press, Berkeley, CA.
4. DA COSTA, F., and D. MARTINEZ-PATINO. 2009. Culture potential of the razor clam *Solen marginatus* (Pennant, 1777). Aquaculture. 288:57-64.
5. GROSZ, T., and C. F. YOCOM. 1972. Food habits of white winged scoter in northwestern California. Journal of Wildlife Management. 36:1279-1282.
6. HADERLIE, E. C., and D. P. ABBOTT. 1980. Bivalvia: the clams and allies, p. 355-410. *In:* Intertidal invertebrates of California. R. H. Morris, D. P. Abbott, and E. C. Haderlie (eds.). Stanford University Press, California.
7. HEALY, J. M. 1995. Comparative spermatozoal ultrastructure and its taxonomic and phylogenetic significance in the bivalve order Veneroida. Memoires du Museum National d'Histoire Naturelle. 166:155-166.
8. HODGSON, A. N., C. J. DEVILLIERS, and R. T. F. BERNARD. 1987. Comparative spermatology of two morphologically similar species of *Solen* (Mollusca, Bivalvia). South African Journal of Zoology. 22:264-268.
9. HONG, J., and H. PARK. 1994. Growth and production of macrobenthic fauna on a macrotidal flat, Inchon, Korea I. Growth of the razor clam, *Solen strictus* (Bivalvia, Solenidae) from Chokchon tidal flat. Bulletin of the Korean Fisheries Society. 27:549-559.
10. KABAT, A. R., and D. O'FOIGHIL. 1987. Phylum Mollusca, Class Bivalvia, p. 309-353. *In:* Reproduction and development of

marine invertebrates of the northern Pacific Coast. M. F. Strathmann (ed.). University of Washington Press, Seattle, WA.
11. KEEN, A. M. 1971. Sea shells of tropical west America: marine mollusks from Baja California to Peru. Stanford University Press, Stanford, CA.
12. KEEN, A. M., and E. COAN. 1974. Marine molluscan genera of western North America: an illustrated key. Stanford University Press, Stanford, CA.
13. MACGINITIE, G. E. 1935. Ecological aspects of a California marine esturary. American Midland Naturalist. 16:629-765.
14. OLDROYD, I. S. 1924. Marine shells of Puget Sound and vicinity. University of Washington Press, Seattle.
15. POHLO, R. H. 1963. Morphology and mode of burrowing in *Siliqua patula* and *Solen rosaceus* (Mollusca: Bivalvia). Veliger. 6:98-104.
16. QUAYLE, D. B. 1970. The intertidal bivalves of British Columbia. British Columbia Provincial Museum, Victoria, BC, Canada.
17. REMACHA-TRIVINO, A., and N. ANADON. 2006. Reproductive cycle of the razor clam *Solen marginatus* (Pulteney 1799) in Spain: A comparative study in three different locations. Journal of Shellfish Research. 25:869-876.
18. RICKETTS, E. F., and J. CALVIN. 1952. Between Pacific tides : an account of the habits and habitats of some five hundred of the common, conspicuous seashore invertebrates of the Pacific Coast between Sitka, Alaska, and Northern Mexico. Stanford : Stanford University Press, Stanford.
19. SAEEDI, H., S. P. RAAD, A. A. ARDALAN, E. KAMRANI, and B. H. KIABI. 2009. Growth and reproduction of *Solen dactylu*s (Bivalvia: Solenidae) on northern coast of the Persian Gulf (Iran). Journal of the Marine Biological Association of the United Kingdom. 89:1635-1642.
20. SLOAN, N. A., and S. M. C. ROBINSON. 1983. Winter feeding by asteroids on a subtidal sandbed in British Columbia. Ophelia. 22:125-141.
21. VON COSEL, R. 1992. *Solen rosaceus*: three species. Veliger. 35:366-3

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