

separated from each other by five centimeters. The snail was expanded with its head oriented away from the clam. When placed on the sand, the clam showed no activity during the next 30 minutes after which observations were discontinued. All but the lower (anterior) end of the body of the clam was covered by an envelope of slime secreted by the foot of the snail.

It seems clear that *P. duplicatus* captures *Ensis directus* by approaching it below the surface of the substratum and by irritating the lower portion so that it retreats upward. The snail then coats the razor clam with an envelope of slime which appears to have anesthetic properties. Successful capture probably depends on the ability of the snail to maintain contact with its prey until anesthesia takes place.

ON THE OCCURRENCE OF THE NUDIBRANCH *ALDERIA MODESTA* (LOVÉN, 1844) ON THE CENTRAL CALIFORNIAN COAST

By CADET HAND and JOAN STEINBERG

Department of Zoology, University of California, Berkeley

Alderia modesta (Lovén, 1844) has long been known from the coasts of northern Europe. It has been recorded from as far north as the Trondheim Fjord in Norway (Norman, 1893), south to Skibbereen in Ireland (Allman, 1845) and on the French coast (Gollien, 1929). Therefore, it has been of considerable interest to us to find well-established populations of an *Alderia* in two localities on the central Californian coast. Through the kindness of Monsieur G. Van Put of the Royal Institute of Natural Sciences of Belgium in Brussels and Dr. Erik Rasmussen of the Royal Veterinary and Agricultural College in Copenhagen, we have been able to compare specimens of *Alderia modesta* from both Belgium and Denmark with specimens collected by us from the California localities. The results of these comparisons have shown the *Alderia* from California to be identical with *A. modesta*.

ALDERIA Allman, 1845

Alderia Thompson, W. (nomen nudum), 1844, Rep. Brit. Assoc. Adv. Sci. for 1843, p. 250.

Alderia Alder, J., and A. Hancock (nomen nudum), 1845, Rep. Brit. Assoc. Adv. Sci. for 1844, p. 26.

Alderia Allman, G. J., 1845, Rep. Brit. Assoc. Adv. Sci. for 1844; Trans. of the Sections, p. 65.

Aldena (error pro *Alderia* Allman, 1845) Paetel, 1875, Fam. Gatt. Moll 6.

Type by subsequent designation: *Stiliger modestus* Lovén, 1844.

ALDERIA MODESTA (Lovén, 1844)

Stiliger modestus Lovén, 1844, Ofvers K. Vetensk.-Akad. Forhandl. Stockholm 1(3), p. 49.

Alderia amphibia Thompson, W., 1844 nomen nudum, Rep. Brit. Assoc. Adv. Sci. for 1843, p. 250; Alder, J., and A. Hancock, 1845, nomen nudum Rep. Brit. Assoc. Adv. Sci. for 1844, p. 26.

Alderia modesta Allman, 1846, Ann and Mag. Nat. Hist., ser. 1, 17, p. 5; Lovén, 1846, Ofvers K. Vetensk.-Akad. Forhandl. Stockholm, p. 8.

Alderia scaldiana Nyst, 1855, Bull. de l'Acad. de Belgique XXII, no. 2, pp. 435-37, figs. 1, 2.

DIAGNOSIS.—*Alderia*: Body elongate and elliptical. Head without rhinophores but produced into rounded lobes on either side of median line; mouth a vertical slit; eyes visible through integument behind lobes. Foot nearly straight anteriorly, bluntly tapered posteriorly; lateral margins wider than body. Groove laterally between body and foot. Cerata cylindrical, bluntly pointed apically; arranged longitudinally on either side of posterior three-quarters of body and roughly divisible into 3-5 rows set obliquely to longitudinal axis of body; number of cerata variable, maximum 15-16 on a side, often fewer. Anus on free tube located posteriorly in median line. Genital pores situated below first cerata on right side. General ground color translucent yellowish white; dorsum and cerata speckled with numerous black pigment spots; cephalic lobes and anterior dorsal region often heavily pigmented; anterior edges of cephalic lobes lacking pigment, unpigmented area sometimes extending back to region of eyes as a colorless line; cerata with a few opaque white dots, especially apically. The animals sometimes appear green because of the color of food present in the highly ramified digestive diverticula.

Jaws absent. Radula uniserial with 11-14 spoon-shaped teeth and sac containing discarded teeth at base; a single tooth measur-

ing $120\ \mu$ with a base of $40\ \mu$ (Fig. 1). Penis bearing single large spine $180\ \mu$ in length (Fig. 2).

The largest specimens collected measured 8 mm. in length. One of average size measured 5.5 mm. in length, 1.2 mm. in height and 2 mm. in breadth (Fig. 3).

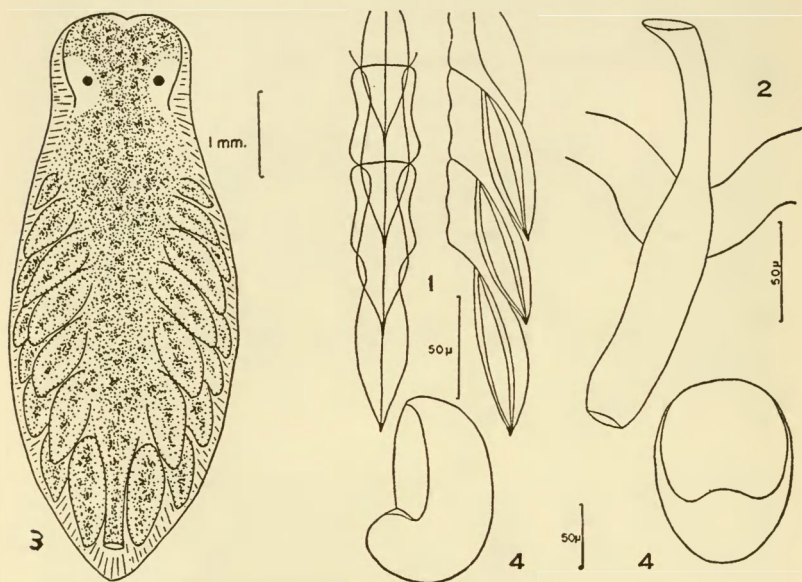


FIGURE 1. Top and side views of a portion of the radula of *Alderia modesta*. FIGURE 2. The penial spine of *Alderia modesta*. FIGURE 3. *Alderia modesta* (Lovén). FIGURE 4. Larval shell of *Alderia modesta*.

OCCURRENCE: Type locality: Bohuslan, Sweden (Loven, 1844). Other localities: northern and central Europe. New localities: (1) Bay Farm Island, Alameda Co., California, on *Vaucheria* sp. in a *Salicornia* marsh bordering San Francisco Bay in area wetted only by high tides, May, July, August, 1951 and March, 1954; with various ciliates, diatoms, nematodes, fly larvae, mites, small oligochaetes, harpacticoid copepods, amphipods. (2) Elkhorn Slough, Monterey Co., California, in *Salicornia* marsh on *Vaucheria* sp., August, 1951; July, 1952; with *Cerithidea* and *Phytia*.

DISCUSSION: The eggs of *Alderia modesta* are laid in round to elongate masses measuring about 5.5 mm. in length and 1.5 mm. in diameter. These masses are anchored at one end to the substrate and consist of an irregular coil of egg capsules embedded in a soft gelatinous matrix. The coil is about 200 μ wide. The capsules measure 150–180 μ in diameter and each contains a single egg measuring 70–80 μ in diameter. The capsules may be so closely packed together in the coil that many assume a polyhedral shape. The color of the eggs is yellowish when laid but changes to white as development proceeds. The veligers have been described by Rasmussen (1951), and ours appear to be quite similar. The larval shell is bowl shaped with only a suggestion of a whorl. A shell measured 124 μ in length and 88 μ in width (Fig. 4). There are no pigment spots on the veligers.

Insemination has been observed several times and is accomplished by hypodermic injection. During copulation peristaltic waves move along the extended penis and a flow of seminal material can be seen entering the recipient *Alderia*. Injection can apparently occur at any point on the body, and after copulation the body spaces, including those of the cerata, can be observed to be full of sperm.

Copulation was not observed to be reciprocal nor was there any indication of self-fertilization. Sperm were recovered from a recipient *Alderia* after copulation and were found to be very active. The sperm appear to have a spiral head (approx. 60 μ long) and a tail piece (approx. 45 μ long), but no middle piece could be distinguished.

On August 14, 1951 collections at Elkhorn Slough revealed many egg masses as well as four juvenile specimens, each about one millimeter long and having only a single pair of cerata with the anus located between. Others, about $\frac{1}{2}$ millimeter long, were found without cerata and with the shell still present. At this time an adult pair were observed copulating. One of the individuals injected the sperm into the fourth ceras on the right side of the other.

The animals, for the most part, are confined in their distribution to *Vaucheria* sp. which forms dark green mats on the mud. Other mats of algae, lighter green in color, generally support no

Alderia. These mats consist of a Cladophoracean (either *Rhizoclonium* or *Urospora*), *Oscillatoria* and *Enteromorpha*. The food of *Alderia* seems to consist entirely of *Vaucheria* on which it actively grazes.

An interesting characteristic of *Alderia* is a peculiar sickly sweet smell which is especially noticeable after a group of animals have been confined to a jar for some time. Another characteristic of the live animals is that the body surface, including the cerata, possesses many scattered ciliated cells. These cells appear to be effective in moving the film of water present on the algal substrate over the body of the animal, thus keeping the *Alderia* continuously wet in what approximates a terrestrial habitat. Still another characteristic of *Alderia* is that the cerata exhibit a rhythmic contraction which alternates from one side to the other. There are no anterior-posterior differences in the time of contraction.

Two other species ascribed to the genus *Alderia* have been reported from the Pacific Basin. One, *Alderia?* *albopapillosa* Dall, 1872, has been shown by Bergh (1880) to belong to the phanerobranchiate genus *Adalaria* Bergh. The other, *Alderia nigra* Baba, 1937, possesses distinct rhinophores, a character which excludes it from the genus *Alderia*. *Alderia harvardiensis* Gould and Binney, 1870, which was collected by A. Agassiz (1851) in the Charles River and the creeks around Cambridge, Massachusetts and by W. Stimpson (1853) in the region around the mouth of the Bay of Fundy, New Brunswick, is distinguishable from *A. modesta* only in the form of the anterior margin which appears in Agassiz's drawing (in Gould and Binney, 1870) to be concave rather than bilobed and in the darker coloration. There is, in the U. S. National Museum, a single specimen of *A. harvardiensis*. Through the kindness of Dr. Rehder this specimen has been examined by one of us (Steinberg), although no decision as to its real identity could be made. The specimen is in very poor condition and the anterior end has been damaged and the radula removed. From the form of the body which is still clear the specimen looked suspiciously like a small *A. modesta*. This species has not been recorded since the last century, but, if further material becomes available, it appears quite possible that *A. harvardiensis* may actually be *A. modesta*.

ACKNOWLEDGMENTS.—We gratefully acknowledge the kind help of Dr. Isabella Abbott for the identifications of the several genera of algae mentioned in the text, and Mrs. Lois Stone for the preparation of the figures.

LITERATURE CITED

- AGASSIZ, A., 1851, A note in the Proc. Boston. Soc. Nat. Hist. III, pg. 191.
- ALDER, J. AND A. HANCOCK, 1845, Report on the British Nudibranchiate Mollusca. Rep't 14th Meeting Brit. Assoc. Adv. Sci. for 1844, pg. 26.
- ALLMAN, G. J., 1845, On a new genus of Nudibranchiate Mollusca. Rep't 14th Meeting Brit. Assoc. Adv. Sci. for 1844, Trans. of Sections, pg. 65.
- , 1846, Note on a new genus of Nudibranchiate Mollusca. Ann. and Mag. Nat. Hist. XVII: 1-5.
- BABA, K., 1937, A new noteworthy species of the Saccoglossan genus *Alderia* from Amakusa, Japan. Dobutsugaku zasshi (English title: Zoological Magazine) Tokyo 49: 249-51, 3 figs.
- BERGH, R., 1880, On the nudibranchiate gasteropod Mollusca of the North Pacific Ocean, with special reference to those of Alaska. Proc. Acad. Nat. Sci. Phila. for 1880, pg. 83.
- DA COSTA, A., 1867, Saggio sui Molluschi eolididei del golfo di Napoli. Annuario del Mus. Zool. della R. Univ. di Napoli IV, pg. 32, Tav. II, fig. 3.
- DALL, W., 1872, Descriptions of sixty new forms of Mollusks from the West Coast of North America and the North Pacific Ocean. Amer. Journ. Conch., VII, pg. 137.
- ELIOT, SIR C., 1906, Notes on some British Nudibranches. J. Mar. Biol. Assoc. 7(3): 334-82.
- GALLIEN, L., 1929, Etude de deux mollusques opisthobranches d'eau saumatre. Bull. Soc. Linn. Normandie, Caen, Series 8, 1: 162-89.
- GOULD, A. A., 1870, Invertebrata of Massachusetts, edited by W. G. Binney, Boston.
- LOVÉN, S. L., 1844, Om nordiska Hafs-Mollusker. Öfvers. Kongl. Vetensk.-Akad. Forh. Stockholm, I, pg. 49.
- , 1846, Index Molluscorum litora Scandinaviae occid. habitantium. Ibid., III, pg. 8.
- NORMAN, A., 1893, A month on the Trondheim Fjord. Ann. and Mag. Nat. Hist., Series 6, XII, pg. 351.
- NYST, H., 1855, Description succincte d'un nouveau mollusque marin des rives de l'Escaut. Bull. de l'Acad. Roy. des Sci., des Lettres et des beaux Arts de Belgique, Brussels XXII: 435-37, figs. 1-2.

- PAETEL, T., 1875, Die bisher veröffentlichten Familien- und Gattungsnamen der Mollusken, Berlin, 229 pp.
- STIMPSON, W., 1853, Synopsis of the Marine Invertebrata of Grand Manan, pg. 25.
- THOMPSON, W., 1844, Report of the fauna of Ireland: Div. Invertebrata. Rep't Brit. Assoc. Adv. Sci. for 1843, pg. 250.
-

SOME ECOLOGICAL ASPECTS OF THE NAIAD FAUNA OF LAKE SPRINGFIELD, ILLINOIS

By PAUL W. PARMALEE

Lake Springfield, which is approximately 2 miles south and east of Springfield, Sangamon County, underwent construction in 1931 and was completed in May of 1935. The lake has a surface area of 6.8 square miles; there is approximately 57 miles of shoreline, 40 of which has been riprapped. By riprapping (placing broken stone or rock along the lake edge) much of the shoreline, silting resulting from eroded banks and bordering fields has been reduced to a minimum. The lake was formed by the damming of Sugar Creek, a small, relatively shallow, muddy creek that presently has little or no effect in feeding Lake Springfield with renewed water supplies. Lake Springfield is approximately 12 miles in length with a maximum width of two miles. Maximum depth is about 40 feet; average depth, 15 feet. Except for some emerging vegetation, there is little or no submerged or floating aquatic vegetation in most parts of the lake.

The year 1953 was one of below-average rainfall for Illinois and there was 12-14 inches less precipitation than during normal years. Because of this reduced precipitation and the continued use of the lake as a source of water by the city of Springfield, the water level dropped approximately seven feet during 1953. The gradual receding of the water left most of the shallow bays and inlets dry, and thereby exposing much of the mussel fauna of these areas to desiccation.

During October, 1953, an attempt was made to determine the species composition and relative abundance of the Lake Spring-