

Reproductive Biology of *Assiminea californica* (Tryon, 1865)

(Mesogastropoda : Rissoacea)

BY

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(3 Text figures)

INTRODUCTION

Assiminea californica (Tryon, 1865) IS A SMALL mud snail inhabiting coastal saltmarshes from Vancouver Island, Canada to Cabo de San Lucas, Baja California, Mexico (KEEN, 1971). Although this snail occurs commonly in California saltmarshes, there is little information in the literature except for occasional appearances in species lists.

The reproductive biology of the genus *Assiminea* is known for only a few species. The anatomy of the reproductive systems of *Assiminea grayana* Fleming, 1828 is described and illustrated by KRULL (1935: 431, 449; figs. 15, 21). Portions of the reproductive anatomy of several Philippine *Assiminea* are described and diagramed by ABBOTT (1958: pls. 16, 19, 20, 21, 23, 24). The larval morphology, oviposition, and seasonality of *A. grayana* are discussed by SANDER (1950 and 1952), and SANDER & SIEBRECHT (1967). Some ecological aspects of hatching are discussed by SEELEMAN (1968). The genus *Assiminea* is dioecious.

ACKNOWLEDGMENTS

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MATERIALS AND METHODS

All snails used for this study were collected in the saltmarshes of San Francisco Bay at Palo Alto, California. Collections were carried out at least once each month to monitor possible seasonal changes in reproductive anatomy. Snails from Elkhorn Slough, Bodega Harbor and Humboldt Bay, California, were used for anatomical comparison.

Reproductive anatomy was determined by dissection of living animals in an isotonic sea-water solution. Snail innervation was determined by dissection and by observation through the integument of animals cleared in distilled water for a few hours.

Testis epithelium was examined histologically by staining the whole testis with aceto-orcein (1%) for 1 hour after a 45-60 minute soak in distilled water. The testis was then ruptured, spread on a slide, and allowed to dry. The preparation was covered with mounting medium and coverslip.

Young snails were reared on a thin layer of mud in covered petri dishes that were moistened periodically with distilled water. Adults were placed in the dishes for a few days until they had laid several eggs, then removed.

REPRODUCTIVE ANATOMY

The reproductive systems of snails from all localities are identical to the systems of snails from San Francisco Bay.

Male System:

The testis lies in the third whorl of the shell (Figure 1); the mantle between the shell and testis is heavily pigmented. The exterior epithelium of the testis is covered with small yellow granules which become more dense toward the ends of the lobes. The interior consists of a clear colorless fluid that usually does not contain sperm.

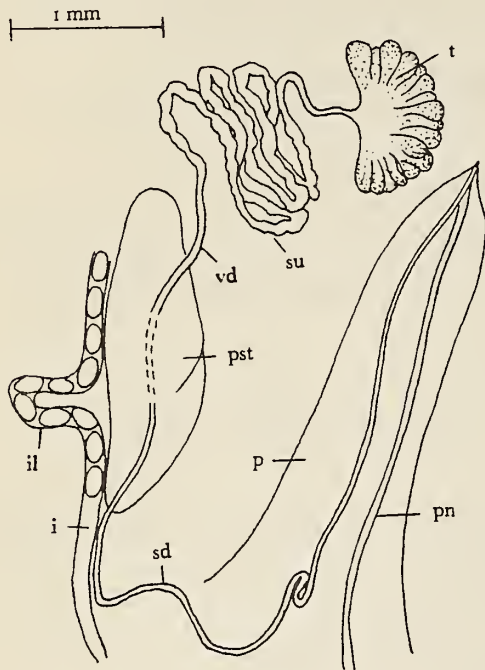


Figure 1

Male genital system of *Assiminea californica*

- | | | |
|--|----------------------|--|
| i - intestine | il - intestinal loop | p - penis |
| pn - penial nerve | pst - prostate | sd - spermduct portion of vas deferens |
| sv - seminal vesicle portion of vas deferens | vd - vas deferens | t - testis |

Sperm are produced in localized areas within the epithelium; cells in certain areas undergo meiosis forming spermatids in large numbers, while elsewhere little meiotic activity takes place. Periodically, the cells that hold the fully developed sperm cells rupture; the sperm aggregate in parallel, forming bundles of several cells attached at their heads. At these times the sperm bundles fill the testicular lobes and lumen while traveling to the vas deferens.

The vas deferens consists of several distinct sections. The long folded section near the testis acts as a seminal vesicle; the sperm within cause it to be a characteristic iridescent orange in life. A thin empty tube connects this folded section to the prostate. Emerging from the prostate it becomes a highly ciliated and rigid sperm duct. The duct parallels the intestine for a short distance before entering the head of the animal. At the base of the penis it makes a double loop before continuing to the penis tip.

The prostate, variable in size and shape, lies next to the intestine in the region of the intestinal loop. This organ is

innervated by two small nerves from the right visceral ganglion.

The large flat penis originates at the center of the animal's back within the mantle cavity. The epidermis around the tip is thickened, and the sperm duct protrudes through this thickening as an annulated projection (Figure 2a). The penis is innervated by a single large nerve from the right pedal ganglion.

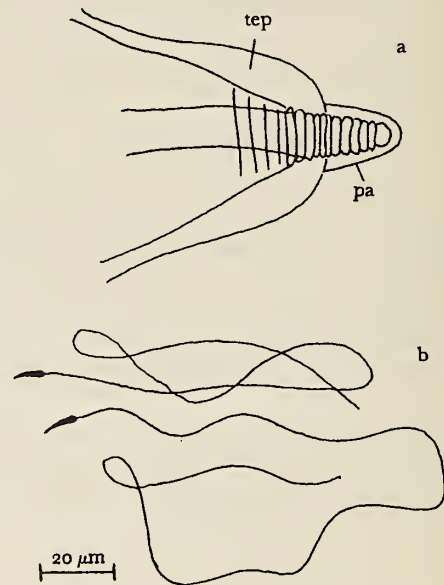


Figure 2

Assiminea californica

- | | | |
|---------------------------|-----------|-----------------------------|
| a - penis tip | b - sperm | pa - annulated tip of penis |
| tep - thickened epidermis | | |

The sperm dissociates from the bundles within the vas deferens, but remains more or less parallel to the other sperm. The sperm possesses an extremely long tail which undulates in corkscrew-shaped waves. The sperm head is small and vermiform (Figure 2b).

Female System:

The ovary extends from the third whorl to the apex of the shell, intermingled with the digestive gland (Figure 3). Unlike the testis, the mantle is not heavily pigmented between the ovary and shell. Contents of the ovary are of a grainy white nature with several eggs in various stages of maturation.

The oviduct follows the columella down to the seminal receptacle. Just before connection to the seminal receptacle the oviduct becomes a thick rigid loop. The contents of this loop, usually including sperm, are churned about rapidly by ciliary action. Shortly after the connection to the receptacle the oviduct enlarges into a chamber within the albumen gland. The bursa connects to the oviduct at this chamber. The oviduct continues through the capsule gland to the genital pore. The pore and the anus are in close proximity to the right ciliary trough which leads to the anterior foot.

The albumen and capsule glands join together into one continuous glandular mass. These glands are innervated by two small nerves from the right visceral ganglion, which arise from the same region of the ganglion as the prostatic nerves in the male.

The seminal receptacle contains sperm throughout the year. The sperm tails are in constant motion within the bulb but the heads are attached to or are in close proximity

to the bulb wall. The sperm within give the receptacle its characteristic iridescent orange appearance.

MORPHOLOGY OF EGG CAPSULES AND YOUNG

In habitat containers, egg capsules are found to be pushed into the mud and deposited singly. The capsules are nearly spherical, about 0.5 mm in diameter. A thin sticky mucus coating causes mud and detritus particles to adhere to the egg, rendering it almost undetectable visually in the substrate mud. The young snail emerges by splitting the wall, but there does not appear to be any pre-determined line of weakening on the egg capsule. The thin transparent capsule wall allows observation of the developing embryo during all stages of development.

The veliger stage passes completely within the capsule and the young at hatching crawls away from the empty case. The animal is not pigmented at hatching, appearing translucent blue-white in color; the protoconch is calcified and consists of 1.5 whorls. The animal becomes noticeably pigmented after several weeks within the habitat container.

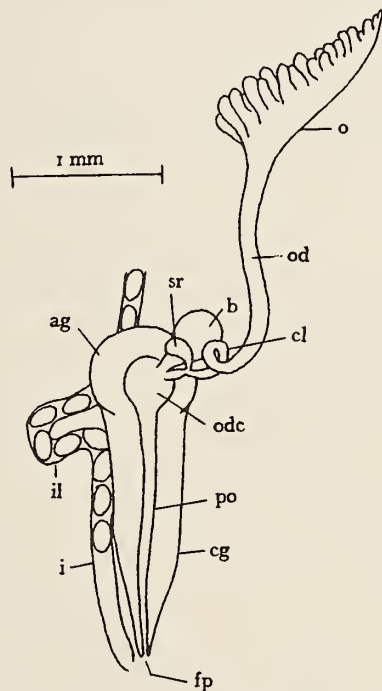


Figure 3

Female genital system of *Assiminea californica*

- | | | |
|-------------------------------|----------------------|--------------------|
| ag - albumen gland | b - bursa | cg - capsule gland |
| cl - ciliated loop of oviduct | fp - female pore | i - intestine |
| il - intestinal loop | o - ovary | od - oviduct |
| odc - oviduct chamber | po - pallial oviduct | |
| sr - seminal receptacle | | |

SEASONALITY

The reproductive anatomy of these snails shows no sign of atrophy during any part of the year. Snails, however, are more active during the wetter portions of the tidal cycle (during the spring tides), and during rainy weather. Copulating pairs are only found during these times of high humidity, but are never found submerged in water.

DISCUSSION

The male reproductive systems of the species in the genus *Assiminea* are very similar in structure consisting of the multi-lobed yellow testis, a long and usually folded vas deferens (ABBOTT, 1958: 223, 224). The prostate gland is large in *Assiminea grayana* (FRETTER & GRAHAM, 1962: 583) as is the prostate in *Assiminea californica*. The penis (or verge) of *Assiminea* varies in form from a long thin appendage that may have a swollen tip, to a shorter thicker form (ABBOTT, *op. cit.*: 224). Other features of the penis are a fleshy flap on one side of the penis in *Assiminea habei habei* Abbott, 1958 (ABBOTT, *op. cit.*: 253, pl. 16, figs. 7, 11) and swellings or bumps in *Assiminea grayana* (KRULL, 1935: 433, fig. 15).

The female system is known only from *Assiminea grayana* and consists of an ovary, short oviduct, which makes a loop similar to that in *A. californica* just before connection to the bursa, a seminal receptacle, and glandular mass. Unlike *A. californica*, the oviduct in *A. grayana* spirals slightly through the glandular mass before reaching the female pore. (KRULL, 1935: fig. 21)

Egg deposition and larval development are known only from *Assiminea grayana* which, while ovipositing eggs singly, deposits them in a mass of several small capsules (SANDER, 1952: 133-134; fig. 1). These masses are overlaid by a covering of fecal pellets (SANDER & SIEBRECHT, 1967: 142). The eggs hatch as free-swimming veligers (SANDER, 1950: 148; fig. 2), but the hatching of the veligers may be delayed; the eggs may sit ready to hatch for several days to months (SEELEMAN, 1968: table pp. 364-365; SANDER & SIEBRECHT, 1962: 144-145; table 1).

The reasons for such different reproductive strategies in *Assiminea grayana* and *A. californica* are unknown at this time. A consequence of the lecithotelic (large, yolky egg) and crawl-away young of *A. californica* is that the pockets of the populations of this snail, while geographically close, are somewhat isolated. Genetic mixing would only occur by the chance transport of individuals or eggs.

More study is needed to determine the extent of popu-

lation differences (if any) from throughout the range of *Assiminea californica*.

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