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# Notes on the Diet and Growth of Murex *Pteropurpura macroptera* (Deshayes, 1838) (Gastropoda: Muricidae)

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**ABSTRACT** At a length of 27 mm and greater, each subsequent varices of *Pteropurpura macroptera* (Deshayes, 1838) represents one year of growth. Among snails still growing, a single varix is added most frequently during August or September. Reproduction occurs from April to early July. The growth rate *in situ* and in culture were similar. Egg capsules, embryos and the average number of each per cluster are provided. The diet in culture was exclusively bivalves.

**KEY WORD** *Pteropurpura macroptera*, reproduction, growth, diet

## INTRODUCTION

This paper presents previously unknown biological information regarding the diet, growth, reproduction, and estimated longevity of *Pteropurpura macroptera* (Deshayes, 1838) and is based on observations both on the reef, and 4 years in culture.

*Pteropurpura macroptera* occurs from Central California south to Baja California (BC), Mexico and again in the northern portion of the Golfo de California (Skoglund, 1983; Tuskes & Tuskes, 2016). Their habitat in southern California is rocky reef at depths typically below 18 m, but may occur as shallow as 10 m, in the cooler waters of central California. The deepest records for this species include 155 m off San Diego, California (La Grange, 1992) and a depth of 182 m, off Bahia de Los Angeles, BC, Mexico (Skoglund 1983). Figures 1 & 2 illustrate specimens from Point Loma, San Diego, California. Berschauer & Clark, 2018 illustrated the variation associated with this species.

Currently seven native species of Muricidae in the genus *Pteropurpura* are known from the eastern Pacific. Tuskes & Tuskes, 2016, reviewed the known biology at the time, discussed their distribution, variation, and illustrated the various species. They also noted issues with *P. leeana* (Dall, 1890), which has since been returned to the genus *Calcitrapessa.*

Among the eastern Pacific *Pteropurpura*, only the biology (reproduction, growth, diet) of two species has been published; *P. festivus* (Hinds, 1844) feeds on barnacles, limpets, bivalves, bubble snails, and is an occasional scavenger Tuskes & Tuskes, 2009, while *P. trialata* (Sowerby 1841) is a specialist, feeding on the worm snail *Thylacodes squamigerus* (Carpenter, 1857) Tuskes & Tuskes 2015.

## METHODS

Observations were made at Three Fingers Reef (off Point Loma, San Diego, California) at depths of 18 to 25 m. *Pteropurpura macroptera* of assorted sizes were maintained in an aquarium. The aquarium had a flow through system, and the water temperature was typically 12° C, during the winter, and approximately 17° C during the summer. These temperatures approximate winter and summer water temperatures at a depth of 20 m. Shell measurements of captive snails were taken

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during December after the period of late summer growth.

Excess live food was always present in the aquarium. Consumed prey were retrieved to determine if there was a specific pattern of attack. The growth/age increment of reared shells were statistically compared to collected material in collections via a two-tailed t-test. Collected shells in the growth phase were not scored. Live fauna associated *in situ* with *P. macroptera* were collected for the dietary study, which included, cnidarians, bryozoans, gastropods, bivalves and a brachiopod. The growth/age increment of reared shells were statistically compared to collected material in museums via a two-tailed t-test. Test results were calculated using the stat package by GraphPad Prism version10.4.0 (621) 2024.

Larvae per/capsule were determined by removing the tip of the capsule and expelling the contents onto a microscope slide, then photographing the content of the slide at 20 x and further enlarging the images with Photoshop, each larva on the image was marked and color coded differently for each group of one hundred larvae on the slide.

## RESULTS

When comparing the annual growth rate (length) of *P. macroptera* in culture vs. specimens in collections of the same age class (**Table 1),** there was no statistical difference in growth ($P < 0.05$). **Table 2** summarizes measurements of egg capsules, average number of capsules deposited per cluster and the average number of embryos per capsule.

## DISCUSSION

Both the color and shape of the varices of *P. macroptera*, are variable. The base color is typically brown to light brown. The color of form *tremperi* is brown with horizontal white banding, and an even rarer albanistic shell is known. At the study site, one color form *tremperi* was found; the rest were the typical brown shell (Figure 1). The variation in the shape of the varices was as follows: strongly scalloped margins 12%; moderately scalloped (Figure 1) 56%; scalloping nearly absent 32% (n=50). The texture of the varices ranges from smooth to heavily scaled.

**Diet:** Off Point Loma, San Diego, California, *Pteropurpura macroptera* were observed on rocky reef at 18 m and deeper but were never abundant. Murex snails are predators, as such, the obvious fauna associated with *P. macroptera in situ* were collected and offered for consumption. The cnidarians, bryozoans, other gastropods, and the brachiopod, all from the habitat of *P. macroptera* were not consumed.

In culture, the snails consumed every species of bivalve offered from Mission Bay, which included; *Laevicardium substriatum* (Conrad, 1837), *Chione undatella* (Sowerby I, 1835), *Chione californiensis* (Broderip, 1835), *Chionista fluctifraga* (Sowerby II, 1853), *Leukoma staminea* (Conrad, 1837), *Leptopecten latiauratus* (Conerad, 1837) and *Ruditapes philippinarum* (Adams & Reeve, 1850). The preference for bivalves was somewhat unexpected as *P. macroptera* is typically found on rock reefs. Few species of bivalves occur in that habitat, and we did not observe the snail feeding upon them. Yet they effectively drilled every species of bivalve presented to them in culture. The prominent bivalves *in situ* are the Rock Scallop

*Crassadoma gigantea* (Gray, 1825) and the False Jingle *Pododesmus macrochisma* (Deshayes, 1839) but *P. macroptera* were not observed associated with either species.

The characteristics of the holes in 63 *Chione* drilled by mature snails was as follows; 90% were circular, 10 % distinctly oval. The walls of the holes are parallel (not beveled) with an average diameter of 2.15 mm (STDV 0.4 mm). When the cavity of the shell is breached, drilling stops, leaving a thin shelf around the base of the central entry hole, (Figure 6). The inside diameter of the hole that enters the cavity of the shell averages 1.06 mm (STDV 0.15).

**Growth:** In culture, immature *P. macroptera* added one additional varix each year among shells that were approximately 27 mm and greater in length Table 2. Smaller live snails were not found, as such, the time required to develop from the protoconch to 27 mm is unknown and referred to as the base period. The plus symbol (+) in Table 1 is the number of subsequent annual growth events after the unknown duration of the base period. In culture mature shells did not grow after the first reproductive event but, based on the large size of some shells in collections, that is not true for all individuals.

Minute vertical ridges occurred on the 3$^{rd}$ or 4$^{th}$ whorl beyond the protoconch. Obvious varices began on the 4$^{th}$ -5$^{th}$ whorl at which time the shell length is 27 mm or greater. It may be that during the earliest stages, smaller snails develop whorls more rapidly than larger individuals.

In culture, initial observations that males may not continue to grow after sexual maturity as they do not need to be larger to successfully mate. Within two months after the first reproductive event five of the six males died as did one female. The cause of death is unknown. Females on the other hand grew notably larger. The increased size may be an advantage during reproduction as they develop over 40,000 eggs and have the ability to generate the base matrix and up to 74 egg capsules. The expenditure of that much energy, 2 months prior to the late summer growth period, may preclude the development of a varix some years. In 2023, the five surviving mature females and one male did not add varices during the normal growth period but were alive and feeding and in April of 2024 formed a cluster on the back wall. No mortality was observed among smaller, presumably immature snails, which did not participate in the reproductive activities and did develop varices during the fall of 2023.

Data indicates that cultured shells and specimens in collections of the same age class were so similar in length that there was no significant difference ($P < 0.05$) in length (Table 2.). At Three Fingers Reef, Point Loma, San Diego, California, the average length of mature *P. macroptera* was approximately 46 mm, a few specimens exceed 50 mm and only two exceeded 60 mm in length. In culture, all female *P. macroptera* collected are now 55-58 mm in length.

Why were larger shells not found? Perhaps the available resources on the reef are a limiting factor? Our cultured females would be considered large compared to the average length of mature shells on the reef. We observed that *P. macroptera* in both museums and private collections are often larger than the typical size of *P macroptera in situ*. The most likely reason is that collectors and those who purchase shells typically look for both the largest shells and in the best condition.

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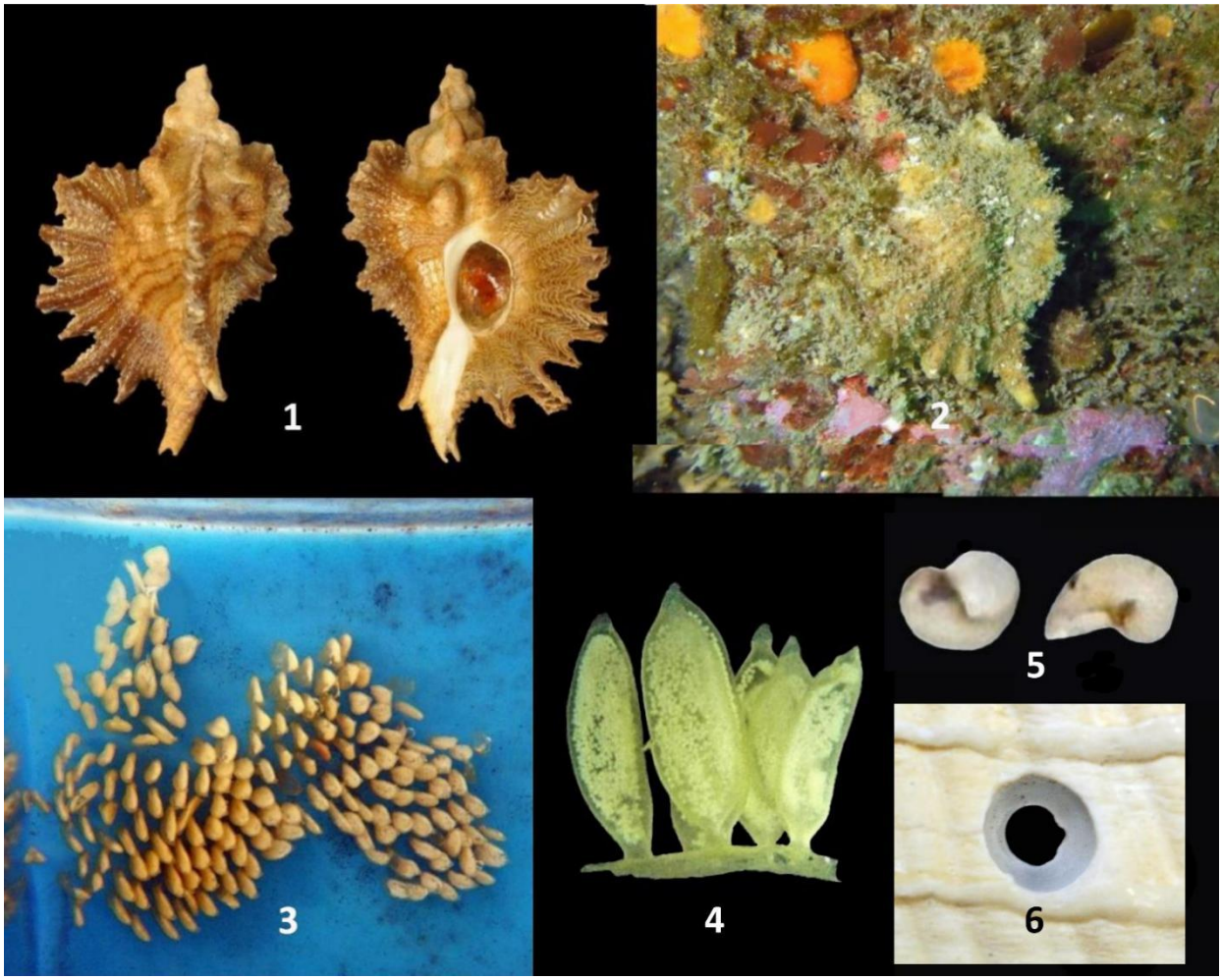
**Reproduction:** On the reef**, s**mall reproductive clusters have been observed in April-June. During the 3rd year in culture 6 snails measuring 42 to 57 mm gathered in the upper right side of the aquarium on 23 June. Females were at least 1 year older than the males. On 26 June, clusters of egg capsules were deposited on the glass extending up to the air/water interface (Figure 3). On 27 June, the snails dispersed, but two females remained with the egg capsules for six days. The snails that dispersed were joined by others, forming two new groups, between June 28th-30th. One group deposited two clusters of egg capsules on the back wall, the other group produced one cluster approximately 16 cm to the right on the same glass wall. The number of the larger females and the numbers of clusters was 1:1.




**Figures 1- 6. 1**. *Pteropurpura macroptera* from Three Fingers Reef, Point Loma San Diego, California, 61 mm. **2**. *P. macroptera* on the reef *in situ* Point Loma San Diego, California. **3.** Multiple clusters of egg capsules. **4**. Newly deposited egg capsules each containing hundreds of developing embryos and illustrating shape and attachment of egg capsules to the base matrix (7.4 x). **5**. Nautiloid shaped protoconch at time of emergence from egg capsule (60 x) image at left is looking into the aperture, right is profile. **6.** Typical drilled entry hole into clam, outside diameter 2.2 mm, inside diameter 1.1 mm, approximately 7x.

During the week of 10 July, four to eight new egg capsules were deposited on three occasions at the margins of the existing large clusters. The new capsules were easily distinguished by their clear cream color vs. the yellow brown of older egg capsules (Figures 3 and 4).

The female deposits a clear gelatin material on the glass and the base of the egg capsules were deposited in an up-right position, often arranged in a similar orientation (Figure 3). The gelatin base matrix becomes moderately firm with elastic qualities when probed. Egg capsules are pointed, broadly flattened, and taper basally to a short petiole (Figure 4 and Table 2).

The embryos within the capsule are spherical, white, measure 0.2 mm in diameter and are supported in a clear low viscosity liquid (Figure 4). As they mature the capsules darken from light cream to a yellow brown.

Ten capsules deposited in late June were removed at intervals from two clusters, presumably representing two different females. and examined to document development. When early developing larvae were removed from the capsules the first week of July, the average diameter was now 0.25 mm, and fine cilia caused the developing larvae to move in a tight circular pattern. The larvae died within one day after removal from the capsule, perhaps due to the lack of nutrients in the capsule liquid or from microbial agents.

Shell development was first noted on 11 July. Larvae exited from the apex of the egg capsules between 22-26 July. During that period the water temperature varied from 14-15$^{o}$ C. The protoconch is nautiloid in shape and measured 0.3 x 0.25 mm, representing one complete whorl with a broad aperture (Figure 5). The larvae that exited the egg capsules did not survive, as such, the duration in the planktonic larval stage remains unknown.

In 2024, egg capsules were again deposited on the right wall of the aquarium the last week of June, within 3 days of the reproductive event in 2023. There was no post reproductive mortality, and as in 2023, no mature snails added a varix.

**Summary**

The growth rate and age of snails less than 27 mm in length remains unknown. The largest specimens in collections were typically age class +7 years, plus the unknown duration of the base period. The largest snails in culture were age class +5. Reproduction is most frequent from April to early July. No feeding activity was observed *in situ*. In culture snails greater than 27 mm in length feed by drilling clams. When breeding snails form reproductive clusters egg capsules at attached to a base matrix that adheres to hard surfaces.

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| Age Class | Mean length | STDV | Degrees of Freedom | t-value | *P*- value | Statistical Probability |
|---|---|---|---|---|---|---|
| +1 Culture | 27.3 | 2.08 | 17 | 1.245 | 2.131 | p<0.05 |
| +1 Museum | 26.7 | 1.07 | | | | |
| | | | | | | |
| +2 Culture | 35.47 | 0.88 | 15 | 0.277 | 0.7851 | p<0.05 |
| +2 Museum | 35.32 | 1.23 | | | | |
| | | | | | | |
| +3 Culture | 42.38 | 1.40 | 27 | 0.1321 | 0.8961 | p<0.05 |
| +3 Museum | 42.31 | 1.668 | | | | |
| | | | | | | |
| +4 Culture | 48.23 | 1.94 | 24 | 1.298 | 0.2067 | p<0.05 |
| +4 Museum | 49.15 | 1.71 | | | | |
| | | | | | | |
| + 5 Culture | 56.07 | 1.69 | 21 | 0.089 | 0.9297 | p<0.05 |
| +5 Museum | 56.14 | 1.59 | | | | |
| | | | | | | |
| +6 Museum | 62.9 | 69.9 | n=7 | - | - | - |
| +7 Museum | 1.26- | 1.38 | n=4 | - | - | - |

**Table 1.** Comparison between size of cultured *P. macroptera* to same age classes as material in collections. There was no statistical difference in size at age classes +1 through +5 at a highly significant probability of 0.05. No cultured snails exceeded age class +5. The plus symbol (+) is the number of subsequent annual growth events after the base period. Live snails less than 27 mm in length were not found, as such, the time for the shell to grow from the protoconch to 27 mm is unknown and represents the base period.

| Character | Avg. | STDV |
|---|---|---|
| Capsules per cluster | 60.0 | 24.8 |
| Embryos per capsule | 547.8 | 122.7 |
| Capsule length | 8.4 mm | 1.1 |
| Capsule width | 2.9 mm | 0.1 |
| Capsule thickness | 1.1 mm | 0.1 |

**Table 2.** Summary of egg capsules measurements (n=10) and average number of embryos per capsule.