The Development of a Northeast Pacific Opisthobranch: *Dirona Albolineata*

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INTRODUCTION

Although the aesthetics and behaviors are well described in many field guides, little information is available in the literature concerning the early development of nudibranch molluscs from the northeast Pacific. Hurst (1967) compared morphological traits of the egg masses and veliger larvae of nudibranchs from the San Juan archipelago. However, she described characters for identification in the field, and gave no indication of embryonic duration. M. F. Strathmann (1987) provided a summary of the available data on several nudibranchs of this region, but did not include a developmental time table for *D. albolineata*. Goddard (1992) characterized the mode of development and variability in mode of development in nudibranch molluscs from the coastal waters of the northeast Pacific Ocean. His work included *D. albolineata* and will be of use for making comparisons with my data presented here.

During the Comparative Embryology course at OIMB, Spring term 2008, I reared cultures of the arminid nudibranch *Dirona albolineata.* I also observed the early development of this opistibranch species which is characterized by spiral cleavage, gastrulation by invagination and epiboly, and offspring that hatch as planktotrophic veligers after having passed through a trochophore stage.

After metamorphosis, *D. albolineata* juveniles are capable of using their jaws and narrow radula to crack shells of small snails. This carnivorous species has also been observed to feed on ascidians, such as *Bugula*, and bryozoans. The body of mature *D. albolineata* is translucent to purplish with a wide, undulating frontal veil and compressed, sharp-tipped cerata. The anterior edge of the veil, the tail and the lateral edge of each cerata are all lined with an opaque white line. The distribution of this species ranges from Puget Sound, Washington to San Diego, California, as well as the former U.S.S.R.

MATERIALS AND METHODS

The cultured egg mass of *Dirina albolineata* was collected from the inside of a mesh container in the Invertebrate Zoology lab at OIMB. After collection the egg mass no longer remained in tact and was divided into four cultures. Two 250 mL Pyrex beakers and two 177 mL finger bowels containing the nudibranchs and filtered seawater were held in a flow table at 10-12°C. Each of the containers were exposed to indirect natural and artificial lighting in the Embryology lab. Except during the weekends, the seawater was changed each day by reverse filtration using a 30 μm cupped filter. The containers were also changed at these times. Once hatched, the free-swimming veliger larvae were supplemented with two strains of alga, *Isochrysis* and *Dunaliella tertiolecta*, throughout rearing.

RESULTS

Dirona albolineata was observed to have an embryonic period of 8-10 days (Table 1). The coiled egg mass was a gelatinous cord containing numerous egg capsules (see Figure 1A). The egg mass contained an average of 2-3 gastrulas per capsule at the time it was collected (see Figure 1B). At 4-6 days post-fertilization (see Figure 1C) the ectodermis of the embryos had become ciliated and they showed the first signs of motility. One day later, the velar lobe and prominent prototroch of the embryos resembled early molluscan trochophore larvae (see Figure 1D). The apical tuft, however, was still not distinguishable. During this stage larvae were slowly swimming together in a clockwise direction within the capsule. Simultaneously, individual larva were also randomly moving their velums up and down, and side to side. Growth of a protoconch and visceral organs occurred during the following four days, including development of a larval kidney, statocyst and foot. Torsion was not observed. Twelve hours prior to hatching, bilobed veliger larvae were swimming and spinning about at a great rate within the capsules. The activity of veligers inside of the capsules appeared to contribute to the rupturing of

the capsule wall during hatching. A few larvae were observed to swim with part of their bodies still within the capsule. After hatching no veliger swam uniformly, other than velum first. Within two days of hatching, the free-swimming veliger larvae had begun feeding on the algal supplements. Hatched *D. albolineata* spend at least 16 days as veliger larvae becoming competent to settle and metamorphose. At this point, the velum is withdrawn into the protoconch aperature and absorbed (see Figure 2D). With their locomotory cilia no longer functional the larvae can not remain afloat in the water column and they sink to the bottom of the dish.

DISCUSSION

My results for the embryonic period of *Dirona albolineata* were comparable to Goddard's (1992) data. The larvae in this study, however, developed and hatched quicker than those in his study.

Torsion may or may not be detectable in *D. albolineata.* Thompson (1958) was unable to observe torsion for very yolky opisthobranch embryos, and Tardy (1970) observed torsion after formation of the shell. The development of this species needs to be better examined closer to the time of torsion.

Although I did not calculate the average size of egg capsules, I was able to estimate their size knowing the diameter of the lens objective that was used. My estimate of 0.17 mm does correlate with Goddard's 0.12-0.22 mm egg capsule length.

Hatching occurred within 12 hours after the seawater was changed for each culture dish. Hurst noted that "egg masses hatch earlier if placed in a strong water current and may be caused to hatch by addition of fresh sea water. This may be due to the effect of a good oxygen supply, change in osmotic conditions, or to a mechanical cause" (1967). However, I was unable to determine these as factors causing my cultures to hatch.

In the future, it would be of interest to closely examine the development of this species. With the information presented here the embryogenesis of *Dirona albolineata* could be more closely followed and described to elicit more meaningful details.

Table 1 Embryonic time table for *Dirona albolineata*.

Development	Days After Fertilization
Gastrula	0-3
Ciliated cells	3-5
Trochophore	4-6
Veliger	6-8
Hatching	8-10
Settlement	16-18

LITERATURE CITED

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