LARVAL DEVELOPMENT AND PHOTOTAXIS OF *STRIATOBALANUS TENUIS*, A DEEP SEA BARNACLE

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Introduction

Larval development of many shallow water barnacle species (Crustacea: Cirripedia) has been well studied (Lang, 1979). In the deep sea, the larval development of some goose barnacles (Order Pedunculata) was briefly described but remained unknown for acorn barnacles (Order Sessilia). In addition, the presence of phototactic behaviors, which are common in larvae of shallow water species, remained controversial in the deep sea where light is limited (Bingham and Young, 1993). In this study, we would like to study the larval development and phototaxis of the deep sea barnacle, *Striatobalanus tenuis* (Hoek, 1883).

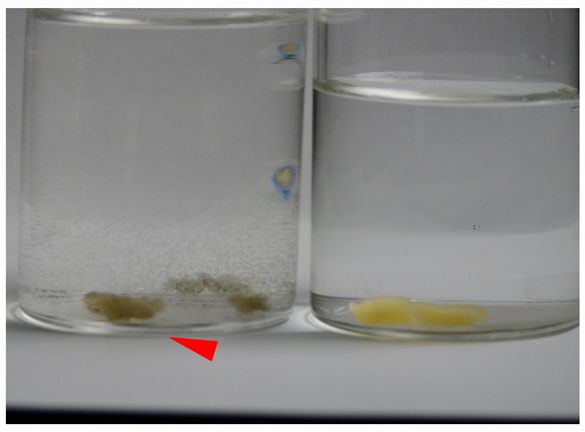
Materials and methods

Striatobalanus tenuis is a deep sea (300~400m) barnacle found in East and South China Sea. It inhabits on rocks, gastropod shells and crab surface. In this study, we collected adult S. tenuis individuals from Kezailiao fishing port and cultivated their fertilized egg masses at 20°C. The hatched larvae were fed with microalgae and water was changed once a week. The larvae of each stage were preserved with 5% formaldehyde for morphological study.

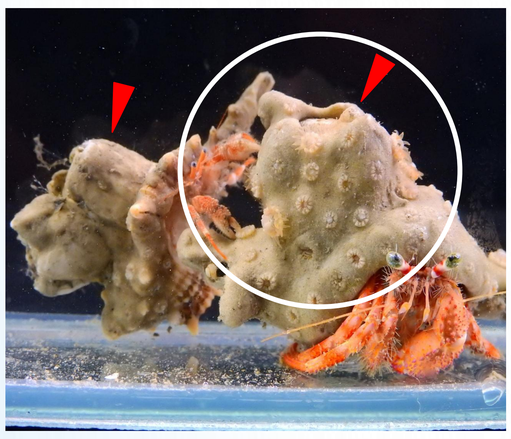
In morphological study, some of the samples were observed under a light microscope. Drawings of body shape and setae on the limbs (antennules, antennae, mandible) were made. Some samples were observed using scanning electron microscope.

To test phototaxis of nauplius larvae II to VI, we designed an acrylic tank (120 cm long× 10cm wide× 10cm deep) with three dark walls and one transparent wall. The tank was divided into 12 blocks. Nauplii of the same stage were placed at the center of the tank (i.e. between 6th and 7th block) in a dark room and lights with different spectrum (i.e. white, red, green, blue) were projected from the transparent side for 15 minutes, respectively. The number of nauplii at each block were then counted.

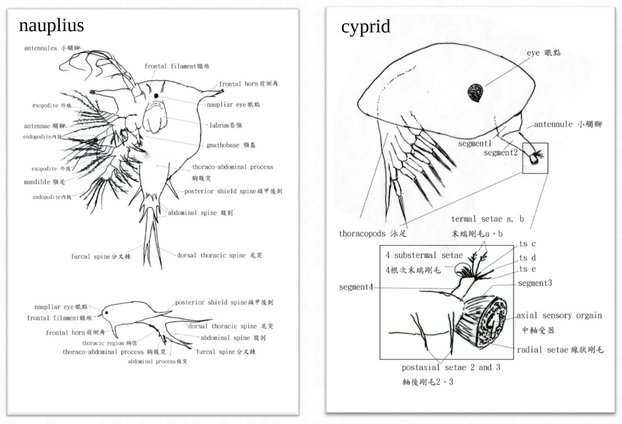
▲ *S. tenuis* is commonly found as a bycatch of bottom trawl in Taiwan



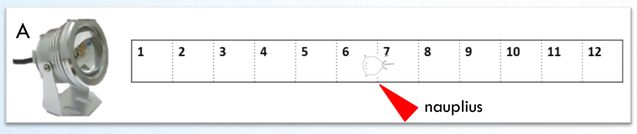
▲ Fertilized egg masses. Egg masses in gray usually hatch in a few hours to one day.

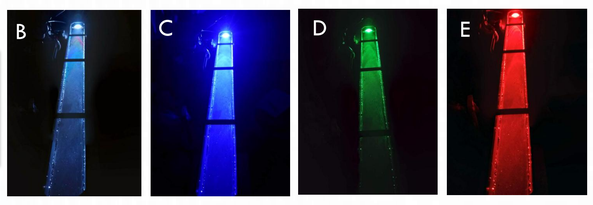


▲ *S. tenuis* on hermit crabs, *Dardanus impressus* .The barnacle and its host (white circle) were coated with zoanthid, *Epizoanthus* sp.



▲Descriptive terminology of barnacle nauplius and cyprid; all the body are observed using light microscope and SEM.



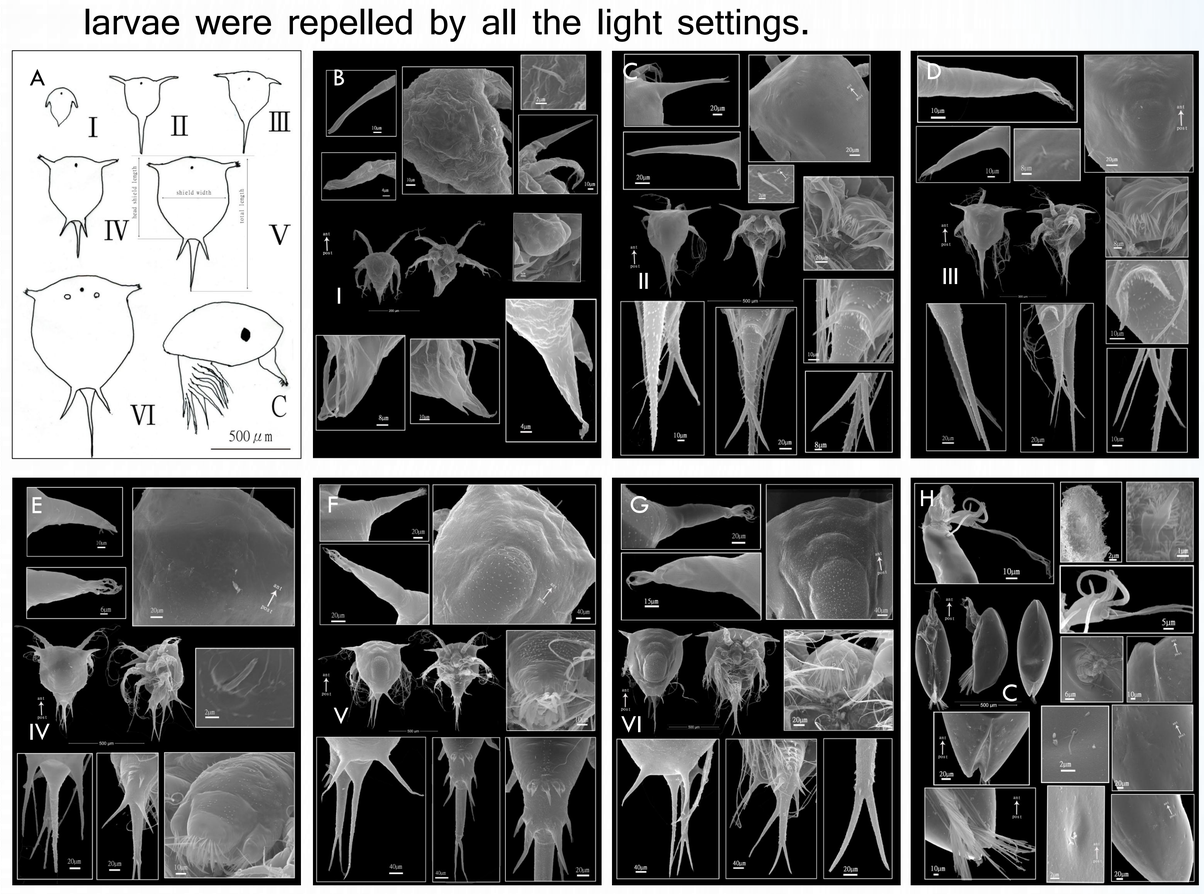


▲ A) Nauplii are placed in the center of the tank in a dark room for testing phototaxis; B) whit light; C) blue light; D) green light; E) red light are projected from the transparent side of the tank.

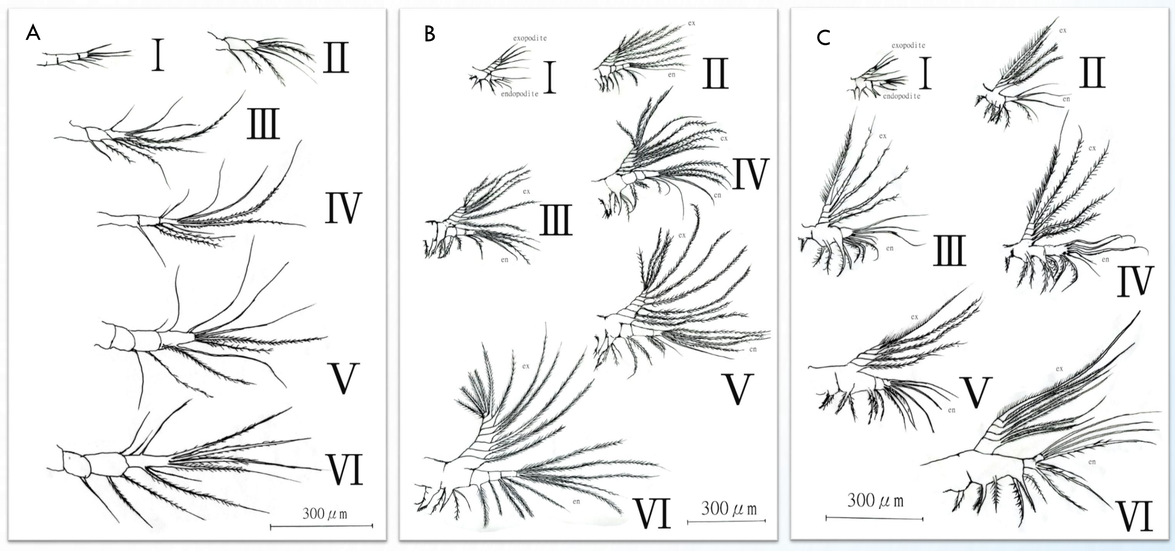
Results

Six stages (NI-NVI) of swimming nauplius larvae and one stage of non-swimming cyprid larvae were successfully observed. Different nauplius stages of *S. tenuis* showed morphological features corresponding to "normal" developmental sequence of barnacles. The cyprid was narrower and shorter in profile than the preceding stages.

In phototaxis experiment, NII and NIII larvae were attracted by all the light settings. NIV and NV larvae showed positive phototaxis to all the light settings except blue light, which was negative. NVI larvae were repelled by all the light settings.



▲ *S. tenuis,* A) larvae shield outline of naupliar stage I~VI and carapace profile of cyprid; Larvae of each stage were observed using SEM. B) NI; C) NII; D) NIII; E) NIV; F) NV; G) NVI; H) cyprid. Larvae of each stage could be identified by size, shape, poster shield spine, abdominal spine and some characters.



▲ Setae on the limbs of *S. tenuis*. The number and types of setae are regarded as morphological characters for identifying the naupliar stage and the species. A) naupliar antennule; B) naupliar antenna; C) naupliar mandible

Discussion

In our study, larval development was most successful at 20 °C. Lower survival rate and longer development were observed at 9, 15, 26, and 28°C. 20°C corresponds to the temperature of about 100m depth in South China Sea and Taiwan Strait. Based on the data of R/V OR III, phytoplankton is most abundant around 100 m. We suggested that S. tenuis larvae migrate from 300-400m to 100 m to feed, then migrate back to the deep for settlement. This migration behavior was already reported from larvae of a deep-sea prosobranch, Benthonella tenea, from 975- 4800m to 100m (Bouchet and Waren, 1979). In phototaxis experiment, early stage nauplius larvae showed positive phototactic behavior thus suggests migration to shallower water, but late stage nauplius larvae were opposite. The results comply with our earlier assumption of migration. As we know shallow water temperature is not suitable for S. tenuis larvae, there must be some mechanisms that limit further elevation. It may be barokinesis, the capability of detecting and responding to pressure changes, or UVB, which damages eyes of barnacle larvae (Chiang et al, 2003). Of course, further experiments are required to test our hypothesis.

▲ Life cycle of *S. tenuis*. NI larvae are nonfeeding and short-lived, sometimes molting to stage NII before release. NII and NIII larvae migrate to shallower water, about 100m deep, to feed on phytoplankton. NIV~NVI larvae migrate back to the deep water and molt into cyprid. Cyprid search for suitable host for settlement.

Reference

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Bingham, B. L. and Young, C. M.(1993) Larval phototaxis in barnacles and snails associated with bathyal sea urchins. —Deep Sea Res., Vol. 40, pp. 1-12.
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