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Researchers capture images for practical molt stage analysis in shrimp

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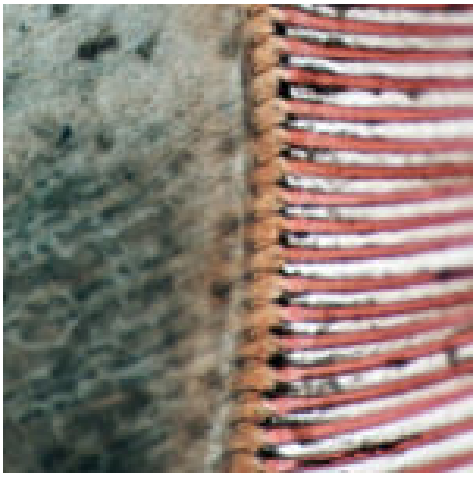
Molt stage impacts mating in closed-thelycum species, market value, ablation



The molting cycle influences many aspects of crustacean biology, including animal morphology, cellular metabolism, physiology, and behavior. In shrimp culture, many production aspects are also related to molting, such as mating in closed-thelycum species, market value (affected by exoskeleton hardness), and successful eyestalk ablation to induce ovarian development in broodstock animals. In addition, because of the high prices paid for live shrimp in some markets, it is important to plan the harvest operation to achieve the best survival rate.

The ability to accurately determine the molting stage in cultured shrimp populations can be a highly useful management tool.

Fig. 1: Early postmolt (stage A).

Crustacean growth and molting

Growth in crustaceans is not a continuous process. Decapod crustaceans must first loosen the connections between their living tissue and the cuticle. Then they must move out relatively rapidly from the confines of this cuticle, take up water to expand the new, flexible exoskeleton, and quickly harden it so it provides protection and support for locomotion.

The actual act of shedding the old exoskeleton, ecdysis, is the most obvious manifestation of the molt cycle. However, it comprises only a few minutes of a cycle that in some crustacean species takes a year or more to complete, and is divided into several major stages with numerous substages.

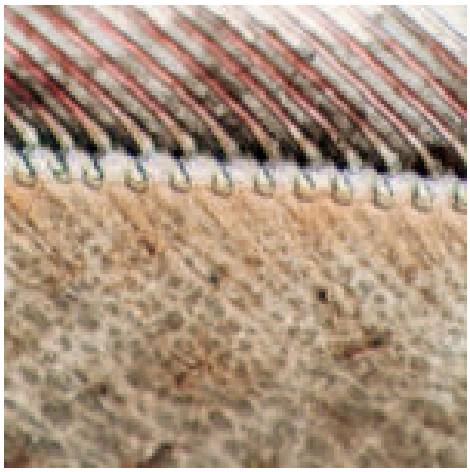


Fig. 2: Late postmolt (stage B).

Penaeid molting stages

Penaeid shrimp molt at intervals of a few days or weeks. Their molt cycle is divided into six stages: early postmolt (stage A), late postmolt (stage B), intermolt (stage C), early premolt (stage D0-D1), late premolt (stage D2-D3), and ecdysis (stage E). Available literature on the molt staging of penaeid shrimp is somewhat difficult to interpret and generally not useful for practical applications.

In 1987, Robertson et al. described a straightforward method to determine the molt stages in the *Journal of the World Aquaculture Society*. The method was based on the morphological changes in the uropods. However, clear images of these morphological changes were not available.

A recent study by the authors was designed to produce clear illustrations of the major molt stages and ecdysis that could be used as a reference to readily determine molt stage.

Fig. 3: Intermolt (stage C).

Shrimp acclimation

Live 30- to 50-gram cultured Kuruma prawns, (*Marsupenaeus japonicus)*, from Acquatina Lake in Frigole, Lecce, Italy, (location of the Marine Aquaculture and Fisheries Research Centre) were acclimated in three sand-bottom aquariums under controlled conditions for one week before the

experiment. The general health of the animals was assessed daily, and any dead animals and shrimp shells were recorded and removed along with leftover food. Water chemical and physical parameters were maintained within optimal ranges, and no evidence of disease was observed.

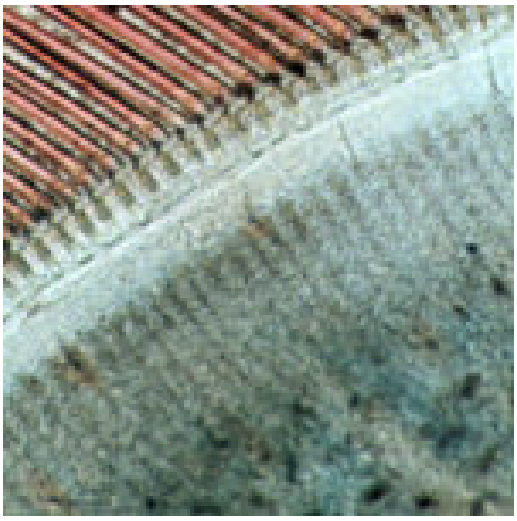


Fig. 4: Early premolt (stage D0-D1).

Observation results

To perform the molt staging, shrimp uropods were placed gently on a glass slide and observed at 10x magnification under an optical microscope equipped with a photo camera. Pictures were taken of the internal uropod morphology at each of the molting stages.

In stage A (Fig. 1), which occurred immediately after ecdysis, a pigmented cellular matrix completely filled the setal bases. During stage B (Fig. 2), the cellular matrix retracted from the setal base and a clear space was easily recognized in the bases. In stage C (Fig. 3), the matrix was absent from the setal bases and the pigment seemed to form an epidermal line at the bases of the setal nodes.

At the D0-D1 stage (Fig. 4), the pigment retracted from the bases of the setal nodes, leaving the old cuticle. During D2-D3 (Fig. 5), the new developing setae were observed. Stage E, the actual shedding of the exoskeleton, occurred at night in less than one minute, which made it very difficult to find animals in this molting stage. Fig. 6 shows the new setae that were extruded from the matrix.

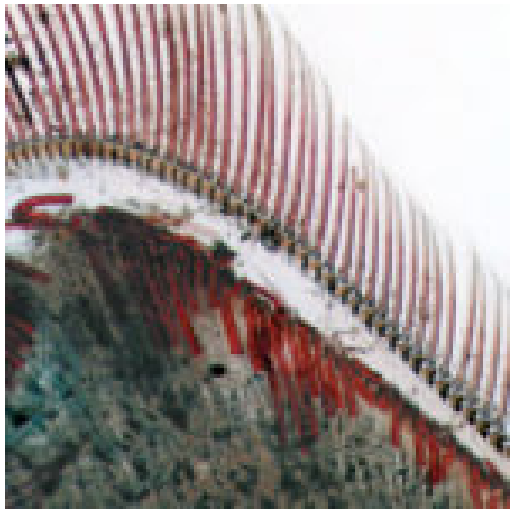


Fig. 5: Late premolt (stage D2-D3).

Conclusion

For various activities in shrimp culture operations, it is important to correctly determine the molting stages of animals. The high-quality illustrations produced during this study provide a practical visual aid that can be used to readily determine the molt stages of shrimp.

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Fig. 6: Ecdysis (stage E).

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