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## The complete larval development of *Pagurus lanuginosus* De Haan, 1849 (Decapoda, Anomura, Paguridae) reared in the laboratory, with emphasis on the post-larval stage

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### Abstract

The complete larval development of *Pagurus lanuginosus* is described and illustrated including the first description of the post-larval stage. Specimens were reared in the laboratory at 15°C and 33.5–35.02 PSU. Newly hatched larvae passed through a short prezoal stage (10 minutes to 2 hours), four zoeal stages (6, 6, 6, 8 days), and one megalopal stage (10 days). We compared the morphological features of each larval stage with those of the preceding two descriptions on the same species, and found many differences in morphology and the duration between zoeal stages. We concluded that significant diagnostic characters separating this species from other congeners in Japanese waters include the presence of two pairs of yellowish chromatophores on the carapace in the zoeal stages, a translucent body flecked with red chromatophores, and two pairs of red chromatophores on the carapace in the megalopal stage.

**Key words:** larval development, prezoaea, zoea, megalopa, labrum, paragnaths, *Pagurus*

### Introduction

*Pagurus lanuginosus* De Haan, 1849 is an intertidal hermit crab commonly found on the rocky shores of temperate regions of the western Pacific, including Japan, Korea, and the Russian Far East (Komai & Imafuku 1996). The original description by De Haan (1849) for this species was very brief and based only on characters of the chelipeds that had dense setae on the surface. To eliminate confusion between this species and other hairy pagurid hermit crabs abundant in shallow Japanese waters, such as *Pagurus brachiomastus* and *Pagurus pectinatus*, Miyake (1978) described morphological characteristics of *P. lanuginosus* (s. l.) in greater detail and reported that one of the important diagnostic characteristics of this species was the presence of brownish black chromatophores scattered on the ambulatory legs. Later, Miyake (1982) reported another color morph of *P. lanuginosus*, which had white chromatophores on the same portions. Finally, based on detailed morphological observations along with the geographical distribution and pre-mating behavior of these two color morphs, Komai & Imafuku (1996) described the white-spot type as a new species, *Pagurus maculosus*, and referred the black-spot type to *P. lanuginosus* (s. s.). For a better understanding of the phylogenetic relationship between these closely-related species, it is useful to observe the morphology of larval instars. Since the morphological features of larvae are functionally and structurally different from those of adults, they could provide additional useful information and diagnostic characters of the species (Pohle & Marques 2000).

The complete larval development of *P. lanuginosus* was first described by Hong (1969) based on the specimens from Korea. Later, Konishi & Quintana (1988) made complementary descriptions of the first and fourth zoeal stages of this species based on the Japanese specimens. But, when these studies were made, *P. maculosus* was not distinguished from *P. lanuginosus* (s. s.). Although some inconsistencies were found in descriptions in these two reports, Konishi & Quintana (1988) claimed that they were intraspecific variation and could be attributable to differences in geographical locations and/or laboratory condition in each study.

As suggested by the present comparison among pagurid larvae, the distinguishing characters of *P. lanuginosus* larvae proposed by Hong (1969) are not always appropriate. The more reliable characters identifying the larvae of *P. lanuginosus* could be the presence of 5 plumose setae on the antennal exopod and 7+7 telson processes that are constant through the all zoeal stages; the mandibular palp is present at the fourth zoeal stage. The 3+3 telson processes in the megalopal stage, and an adult-like feature of 1 spine present on the ischium of the third maxilliped in the crab 1 stage (Fig. 12A) also could be helpful to identify the larvae of *P. lanuginosus*. Furthermore, the persisting color pattern of the larvae (two pairs of yellowish chromatophores: one pair on the mid-dorsal surface of cephalothorax and the other is on the ventrolateral margin of cephalothorax) throughout the zoeal stages could be one of the useful characteristics identifying the *P. lanuginosus* larvae. Studies describing morphological features of the crab 1 in the genus *Pagurus* are still inadequate. The descriptions of the zoeal, megalopal, and first crab stages of *P. lanuginosus* in this study, will contribute to the accurate identification of the planktonic larval stages of *P. lanuginosus* among closely-related species.

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