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Moulting of a deep-sea galatheid crab (Anomura, Galatheidae) at a depth of 3572 m

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Abstract

The moulting of the deep-sea galatheid crab, *Mundopsis* sp. was observed using a seafloor observatory at a depth of 3572 m in Nankai Trough, western Japan. The duration of the ecdysis was 147 seconds. The crab rested on the substratum until ecdysis was complete. After ecdysis, it flicked and moved away from its exuviae. The newly moulted galatheid crab did not consume its cast exoskeleton.

Introduction

In recent years, analysis of deep-sea organisms and their ecology has been made possible by the development of advanced observation equipment, such as manned and unmanned submersibles (Gage & Tyler, 1991). We were successful in making the first observations ever of the moulting behaviour of the deep-sea galatheid crab, *Munidopsis* sp. (probably *M. subsquamosa*) using a seafloor observatory designed for monitoring submarine earthquakes (Momma et al., 1996).

Materials and methods

The observatory is located 100 km off Cape Muroto in Nankai Trough (32° 21.094′N, 134° 32.207′ E), in western Japan at a depth of 3572 m. It is equipped with a 1/2″ 3-CCD color video camera which has a pan/tilt and zoom capability and six 100-watt underwater lights (Fujiwara et al., 1997). A video image is sent to a laboratory on land in real time through an optical cable. Observations by video camera were carried out once a week from February to October, 1998. The observation of the moulting behaviour reported here was made on three occasions, viz. 27 February, 11 September and 7 October, 1998. We followed newly moulted galatheid crabs and their exuviae after each ecdysis for 4 h 15 min, 25 h 20 min and 134 h 26 min periods, respectively. For the observation of 11 September, we were able to obtain a video recording 2 h 18 min before ecdysis occurred. In this paper, we describe this moulting, which was very clearly observed.

Results and discussion

The video camera filmed the premoult galatheid crab at 9:28 a.m. The galatheid crab was already at moult stage E, as defined by Drach (Passano, 1960), that is, a lateral split between the pterygostomian region and coxae had developed, and the abdomen had lifted slightly off the substratum. At 10:45 a.m., the video camera recorded the side of the premoult galatheid crab, with the abdomen, the chelipeds, and all walking legs except for the 4th pair touching the substratum. The galatheid crab fell on its back at 10:57 a.m. (Figure 1A), but after about 2 min it got up again. Until ecdysis, it rested on the substratum. The chelipeds, the walking legs except for the 4th pair which extended

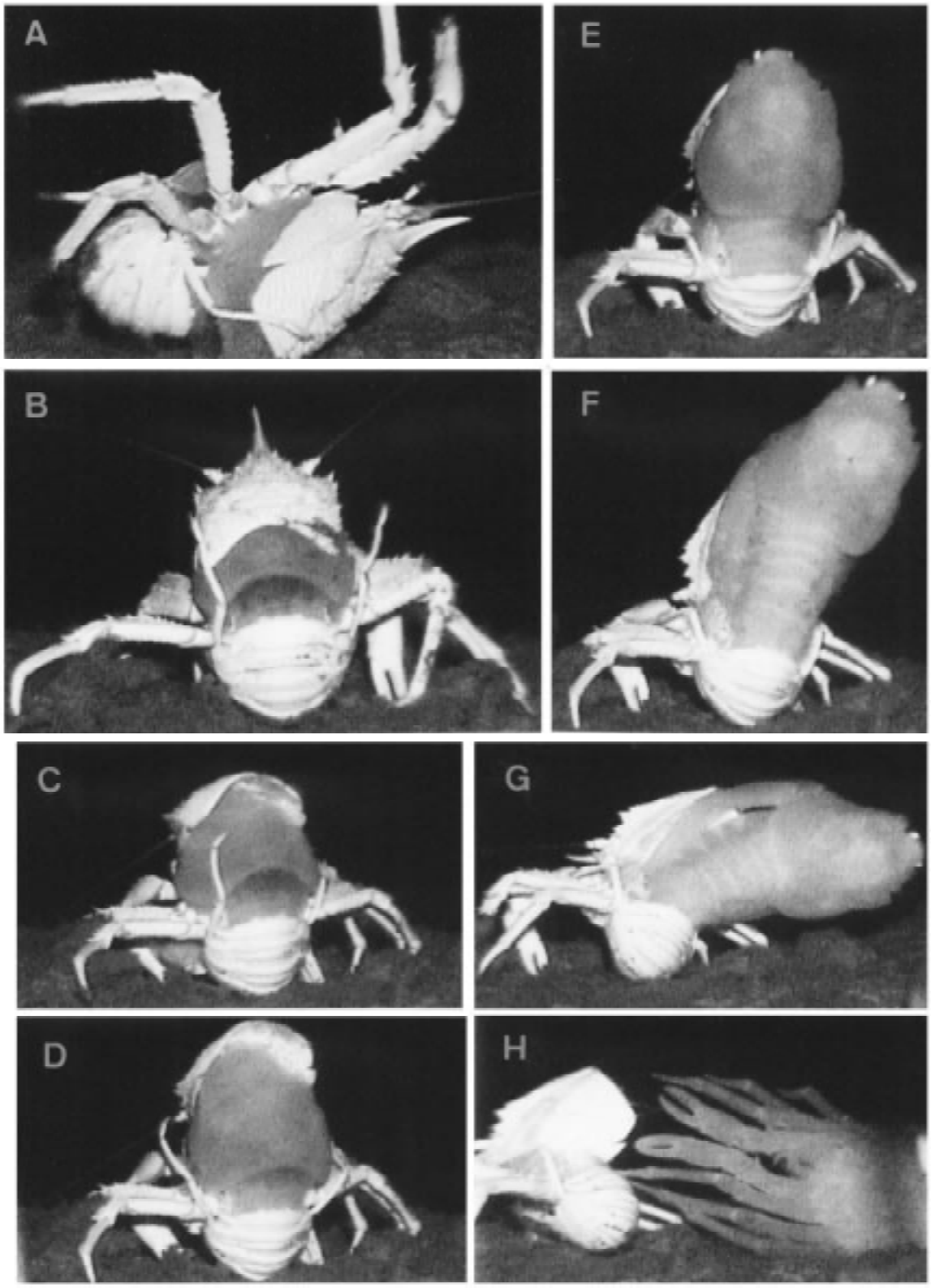

Figure 1. Moulting behaviour of a deep-sea galatheid crab, *Munidopsis* sp. observed on 11 September, 1998. (A) 10:57:26 a.m. (B) 11:00:02 a.m. (C) 11:13:34 a.m. (D) 11:21:09 a.m. (E) 11:34:08 a.m. (F) 11:43:11 a.m. (G) 11:45:18 a.m. (H) 11:45:56 a.m.

upwards, and the abdomen touched the substratum. A dorsal transverse split developed between the carapace and first abdominal segment, and the new carapace began swelling (Figure 1B). The carapace emerged slowly from the old exoskeleton (Figure 1C, D). At 11:34 a.m., the dorsal surface of the carapace and the first and second abdominal somites were exposed (Figure 1E). The eyes were also exposed and were white, although the eyes of the premoult crab were black. It slowly bent its body (Figure 1F) and fell on its side onto the substratum, where it removed the old exoskeleton (Figure 1G, H). After ecdysis, the galatheid crab lay on its back for 13 s. It then tried to right itself by a violent bending and flexing of the abdomen (three beats of the abdomen). However, it failed and lay on its back again for 21 s. It bent and flexed its abdomen twice more (six beats of the abdomen) and was then able to scramble to its feet. The full duration of ecdysis (Figure 1F–H) was 147 s.

The newly moulted animal moved backwards and away from the exuviae step by step by beating the abdomen at 24, 64, 123, 140 and 178 min after the ecdysis. At 213 min postmoult, it swam backwards by means of a violent bending and flexing of the abdomen, stretching its chelipeds and walking legs forwards.

The moulting of crustaceans is a risky but inevitable growth process. Accordingly, many premoult crustaceans take refuge in a burrow, rocky crevice, etc. to avoid cannibalism and predators (McLay, 1985; Bliss, 1990). In our observations, however, premoult and postmoult galatheid crabs did not disappear into hiding places except during the first observation, in which the postmoult crab was hidden under the observatory. It is known that deep-sea macrourid fish feed on *Munidopsis* sp. (Pearcy & Ambler, 1974). Near the observatory, large animals that seem to prey on galatheid crabs include zoarcid, macrourid and ophidiid fish. However, these did not attack the premoult and postmoult galatheid crabs during the observation. Their presence was rare and only 21 individuals were observed in the total of 461.32 observant hours during this study. Therefore, it seems that the probability of premoult and postmoult galatheid crabs being attacked by fish is low, though they are defenseless during the process. Furthermore, postmoult galatheid crabs seem to be able to flick their abdomen which would allow them to escape from predators.

Pelagic moults are a component in the vertical flux of particulate organic material that is transported from the euphotic zone to the deep-sea bottom, with amorphous aggregates and faecal pellets (Gage & Tyler, 1991). Although benthic moults are also probably used as food on the deep-sea bottom, other galatheid crabs and a zoarcid fish were not interested in the galatheid crab's cast exoskeleton. Only a caridean shrimp, *Nematocarcinus* sp., was observed to pick up the cast shells. Additionally, the newly moulted galatheid crabs did not consume their own cast shells. Therefore, it is doubtful whether cast shells have food value for megabenthos.

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References

Bliss, D. E., 1990. Shrimps, Lobsters and Crabs. Columbia University Press, New York: 242 pp.

Fujiwara, N., H. Momma, T. Takahashi & H. Kinoshita, 1997. System laying report of comprehensive seafloor monitoring system off Cape Muroto. JAMSTEC J. Deep Sea Res. 13: 733–768 (in Japanese with English abstract).

Gage, J. D. & P. A. Tyler, 1991. Deep-Sea Biology: a Natural History of Organisms at the Deep-Sea Floor. Cambridge University Press, Cambridge: 504 pp.

McLay, C. L., 1985. Moulting and growth in *Pagurus traversi* and *P. novizealandiae* (Decapoda: Anomura: Paguridae): the effects of neighbours. New Zealand J. mar. Freshwat. Res. 19: 327–337.

Momma, H., H. Kinoshita, N. Fujiwara, Y. Kaiho & R. Iwase, 1996. Recent and future developments of deep sea research in JAMSTEC. Int. J. offshore polar Engineer. 6: 262–267.

Passano, L. M., 1960. Molting and its control. In Waterman, T. H. (ed.), The Physiology of Crustacea. Academic Press, New York: 473–536.

Pearcy, W. G. & J. W. Ambler, 1974. Food habits of deep-sea macrourid fishes off the Oregon coast. Deep Sea Res. 21: 745–759.