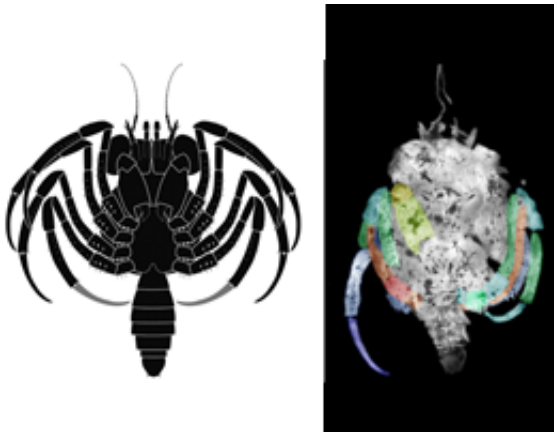
The oldest crab larva yet found

March 10 2015



Credit: Haug/LMU/Nature Communications

A study of a recently discovered fossil published by LMU zoologists reveals the specimen to be the oldest known crab larva: The fossil is 150 million years old, but looks astonishingly modern.

To catch living crab larvae, all you have to do is trawl a plankton-net in the nearest bay or tidal pool. Finding fossilized crab larvae is rather more difficult – as witnessed by the fact that the specimen described in *Nature Communications* today by LMU zoologists Joachim and Carolin Haug, and Joel Martin of the Natural History Museum of Los Angeles, is only the second such finding ever uncovered. Furthermore, the new find is no less than 150 million years old and is far better preserved than the first one. The specimen was actually discovered by a private collector in the famous limestone beds of Solnhofen in the Franconian Jura. "Much to

our surprise, its morphology looks quite modern. Indeed, in terms of its external anatomy, it is barely distinguishable from many of its present-day counterparts," says Joachim Haug.

True crabs (Brachyura) have a complex life-cycle, which includes two larval phases that are morphologically highly specialized and quite distinct from each other. The first of these is the planktonic zoea phase, which goes through several molts before metamorphosing into the so-called megalopa. The megalopa subsequently gives rise to the immature bottom-dwelling crab. "Each developmental stage occupies a different ecological niche, and this is probably one of the reasons why crabs as a group have been so successful and become so diverse. Our specimen is the first fossilized megalopa yet found anywhere in the world and, as such, it provides unique insights into the evolution of brachyurans," Haug explains.

Independent evolution of larvae and adults

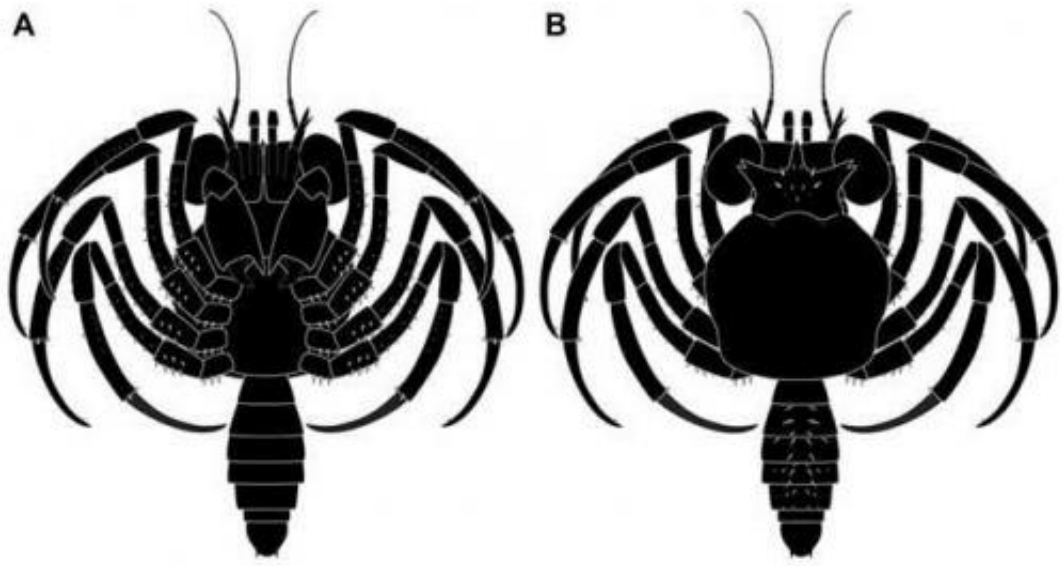
The oldest brachyuran fossils date back to the Middle Jurassic, about 180 million years ago. However, the narrow range of variability found among the early forms indicates a low level of functional and ecological differentiation. The first signs of rapid diversification appear during the Cretaceous, beginning approximately 100 million years ago, when the group underwent an adaptive radiation, diversifying into many specialized forms. A second significant burst of speciation set in some 50 million years ago, and the group has continued to differentiate both morphologically and ecologically ever since. "The early forms of adult brachyurans show little sign of specialization and look very archaic," says Haug. "But the new fossil larva would fit very well into one of the modern groups of crabs. Its tail-fan, legs, eyes and shield closely resemble those seen in many modern species." This suggests that, in the Late Jurassic, the megalopal lifestyle was very similar to that seen in many extant crab species. Like them, it was apparently a predator and a

scavenger, and exploited the same ecological niche as modern megalopae. Its strikingly modern morphology thus reflects a very early specialization of larval stages within the crab lineage.

A 'living' megalopa larva. Credit: Hsiu-Lin Chin.

Based on the discrepancy between the conservative and still quite primeval morphology of the adult forms and the remarkably modern appearance of the new larval specimen, the researchers conclude that the evolution of larval stages and adults in the brachyuran lineage proceeded along quite different trajectories. While the larvae apparently diverged into highly specialized forms very early on, the morphology of the adults has remained very similar to that seen in the earliest known fossil representatives of the group. – In this case, the juveniles stole a march

on their parents.



A reconstruction of fossil crab larva (a) ventral aspects, (b) dorsal aspects. Credit: Jody Martin/ Natural History Museum of Los Angeles County

Provided by Ludwig Maximilian University of Munich