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Semi-terrestrial Shrimp (*Merguia rhizophorae*)

IT is widely believed that there are no semi-terrestrial or terrestrial species of shrimps and prawns (order Decapoda: suborder Natantia)[1], but I now report that the shrimp, *Merguia rhizophorae* (Rathbun, 1900) (family Hippolytidae), is semi-terrestrial. It seems to have evolved behavioural adaptations which have allowed invasion of the terrestrial environment.

This shrimp was originally described from the State of Alagoas, Brazil, where it was found "on mangroves"[2]. Holthuis[3] redescribed and illustrated this shrimp from specimens collected in Suriname and determined its correct generic position, and his detailed notes support my observations on the semi-terrestrial habits of this species (see also his remarks on *M. oligodon*).

I first observed and collected *M. rhizophorae* in a mangrove area on the Atlantic coast of Panama in May 1969. A specimen was found under a dry piece of driftwood approximately 1 m above the high tide mark. When I tried to grasp it, the animal leapt onto some nearby mangrove roots, and moved up and down the roots and leapt from one root to another.

During July, I observed nineteen shrimps during the day and night, at high and low tides (representative specimens are in the US National Museum, No. 127510). All the specimens were found above the high tide mark among piles of driftwood, 0·3 to 0·5 m off the ground. The substrate, damp sand with mats of algae present, was probably wet by rainfall, seepage, or an occasional spring tide, normal tides not reaching this level. The shrimps were found under the driftwood during the day and out on the wood at night. They remained motionless when first observed, but when disturbed they leapt onto other pieces of driftwood and mangrove roots. The shrimp did not appear to orient towards the water while attempting to escape, and no specimens were seen in water nearby.

Four shrimps were placed on an unprotected cemented area for further observations. The air temperature was 31° C, wind velocity 12 m.p.h., on a partly cloudy day. The shrimps moved about in an apparently random manner. They walked in a forward direction using the last three pereiopods in a manner resembling insect locomotion. The abdomen was arched so that the body and telson were raised off the ground. Before movement, the elongate and spiniferous third maxillipeds were pressed together and extended in front of the shrimp. They were then lowered onto the substrate, and contracted. The shrimp climbed mangrove roots and wood in the same manner. The third maxillipeds were pressed together during the entire process and were re-extended onto the substrate when the shrimp became motionless. Shrimps, 10–20 mm in length, were able to leap in any direction over distances of 20–30 cm and 10–15 cm in height, the forward leaps being the longest and highest. Their motion was too rapid to determine to what extent flipping of the abdomen and using the walking legs played in leaping. The abdomen was arched high so that flipping the telson against the substrate probably began the leap, the legs then being used to direct it. The shrimps walked about until a shaded, protected area was located; then they became quiescent. They could be made to move by moving a small net to within a few centimetres of them. One specimen leapt thirty-six times during a 4 min period, sometimes without apparent provocation. Holding them in a moist beaker for 4 h did not affect their previously observed behaviour.

The general morphology of *M. rhizophorae* does not seem to be specially adapted for terrestrial habits. The eggs, however, are large (0·9 mm) compared with a closely related hippolytid *Hippolysmata wurdemanni* (0·28 mm). This suggests an abbreviated larval development, perhaps similar to *Thor* sp., another hippolytid which has a comparable egg size and undergoes metamorphosis within 48 h after hatching[4]. The pereiopods of *M. rhizophorae* are more robust than in most marine shrimps and are able to support the body on land (most shrimps, if they are able to move on land at all, drag their body). The eyes are large and may be adapted for a nocturnal existence because they possess a strong reflecting layer.

This shrimp's behaviour may be defensive. The animal seemed to avoid water, and the ones observed in Panama were never found directly on the ground. The waters surrounding the mangrove are heavily populated by predacious fish (*Lutjanus* sp.) while predacious crabs (Xanthidae) are on the ground. When pursued, the shrimp avoided these areas. The shrimp was motionless when first observed and relied on its cryptic attitude and coloration as a primary defence. Its secondary defence, leaping, was used only when the "predator" was very close. This extremely rapid leap was very effective. The shrimps can maintain this type of avoidance behaviour for more than 4 min. This is interesting because several brachyuran crabs which I examined could maintain an avoidance behaviour for only 40–90 s (ref. 5).

Merguia rhizophorae probably enters the sea occasionally, but only at certain times and for brief periods. My studies indicate that it remains in a moist habitat during the day and only comes out at night. It thus seems that *M. rhizophorae* avoids most problems accompanying terrestrial life through behavioural adaptations.

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