THE OCCURRENCE OF THE SEMI-TERRESTRIAL SHRIMP *MERGUIA OLIGODON* (DE MAN, 1888) IN *NEOSARMATIUM SMITHI* H. MILNE EDWARDS, 1853 BURROWS IN KENYAN MANGROVES

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The ecology of *Merguia oligodon* (De Man, 1888) is not well documented. This semi-terrestrial shrimp is one of two species within the genus *Merguia* and has been found in the Malay Archipelago and surrounding areas (Kemp, 1914; Holthuis, 1947, 1958) and Mida Creek, Kenya (Bruce, 1993; Vannini & Oluoch, 1993). Abele (1970) described the ecology of the other member of this genus, *M. rhizophorae* (Rathbun, 1900). Vannini & Oluoch (1993) describe the habits and habitat of *M. oligodon* as nocturnal mangrove dwellers, which graze the algal carpets blanketing mangrove roots. They found that the shrimp remain out of water at high tide, and during the day retreat into suitable hiding places.

This brief note reports, for the first time, the occurrence of *M. oligodon* in crab burrows and proposes possible benefits and consequences of this behaviour. Although over recent years numerous non-burrowing species of Alpheidae have been reported from burrows constructed or inhabited by other decapod species (see De Grave & Anker, in press), the present record concerns the first species of Hippolytidae that has been found to take part in such an association.

Burrows of *Neosarmatium smithi* H. Milne Edwards, 1853 were studied during September and October 1999 in the *Rhizophora mucronata* Lam. forests of Gazi Bay and Mida Creek, Kenya. On two occasions in both forests, surveys were performed to assess relative density and/or presence of *M. oligodon*. Using a torch, the mangrove floor and trees were inspected for the presence of the shrimps' reflective eyes.

Numerous burrows of *N. smithi* in both Mida Creek and Gazi Bay were inhabited by *M. oligodon*, with densities reaching up to 60 individuals. m^{-2}.

They were always found in the horizontal shaft of the burrow. Furthermore, *M. oligodon* were observed consuming *N. smithi* faeces within the burrows. Both

forests host large populations of *M. oligodon*. In Gazi Bay they were observed in high densities in both the *Avicennia marina* (Forsk.) Vierh. and *Rhizophora mucronata* zones. Those in the *A. marina* zone were found climbing and grazing on the pneumatophores. In the mangroves of Mida Creek, near Dabaso, they were also observed in high densities in the *R. mucronata* zone.

Additionally, four *M. oligodon* individuals were returned to a field laboratory and were kept alive in 32‰ seawater for one month on a diet of *N. smithi* faeces alone. The animals were fully submerged and were not allowed to respire air. At the end of the month, all specimens in the laboratory appeared healthy and were actively eating faeces as soon as these were offered. They were observed to be powerful swimmers.

The observation of *M. oligodon* inhabiting many *N. smithi* burrows in both Gazi Bay and Mida Creek is interesting. Vannini & Oluoch (1993) describe the shrimp as being nocturnal and never venturing far from mangrove roots. During the day, they found some specimens under the bark of dead trees, in rotting aerial roots, in split trunks, and in holes in limestone outcrops. This is the first time they are reported in crab burrows. This observation could imply that they are coprophagous, feeding on the faeces of *N. smithi*, which could have a low C : N ratio (*Sesarma messa* Campbell, 1967; field faeces C : N = 18.9; cf. Lee, 1997). Our findings corroborate this supposition, because after one month the shrimp appeared healthy, living on a diet of crab faeces only, suggesting that this is a nutritious food for this species. Similarly, Lee (1997) found that amphipods fed on crab faeces (from a laboratory experiment), which had a C : N ratio of 48.6, survived better than those fed on a leaf-litter diet.

Being that these shrimp are strictly nocturnal, the burrows make a perfect diurnal microhabitat. They are protected from the tide, which Vannini & Oluoch (1993) found they prefer to avoid, and are provided with a rich source of food. On the other hand, they may also play an important role in the diet of *N. smithi*. The shrimp are about 3 cm in length (Vannini & Oluoch, 1993) and 0.5 cm in height (pers. obs.), which would be just the right size for *N. smithi* to capture. *N. smithi* has claws with a relatively large gape, which could exclude smaller prey (e.g., amphipods) from their diet (Gillikin, 2000).

Stable isotope studies are starting to reveal that although mangrove crabs consume a large amount of leaf-litter, some assimilate very little of it and rely on animal tissue and sediment for more than half of their nutrition (S. Bouillon, pers. comm.). *N. smithi* burrows provide *M. oligodon* with a suitable habitat and a rich food source, whereas *M. oligodon* may provide *N. smithi* with an occasional, highly nutritious food source. However, the frequency of *N. smithi* predation on *M. oligodon* must remain low in order for the burrows to remain an attractive habitat for the shrimp. Additionally, by consuming crab faeces and preventing it

from being flushed out by the tide (cf. Lee, 1997), these shrimp also play a role in trapping energy within the mangal.

Furthermore, the shrimp must have interesting physiological adaptations in order to be able to respire both in water and air. As it has been demonstrated in the present study that they can survive long periods submerged, the avoidance of tidal immersion is most likely a form of predator evasion behaviour.

This finding also illustrates the importance of the abundant *N. smithi*, which can occur in densities of up to 25 individuals.m^{-2} (Gillikin, 2000). These crabs are not only important due to the plethora of ecological services provided from their burrowing behaviour, but may also be the basis of a coprophagous food chain supporting significant secondary production. Although *M. oligodon* occurs in high densities in Kenyan mangroves, little ecological work has been done on this species. The relationship between this shrimp and burrowing crabs may be significant for both the burrow owner and the co-inhabitant.

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