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Leaf Choice of Herbivorous Mangrove Crabs

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Abstract: Leaf consuming mangrove crabs play an important role in the initial processing of litter in low to mid intertidal riverine and fringing forests. In Pichavaram mangrove, the sesarmid crabs are dominant, leading mostly herbivorous mode of life and play a vital role in the process of leaf degradation and thus in biogeochemical cycles. The gut content analysis also showed they are mainly consumed vascular plant matter (58.33 to 72.54%). Sesarmid crabs strongly preferred 40 day decomposed *Avicennia marina* leaves when both fresh and 10, 20, 40, 60, 80, 90 and 100 days decomposed leaves of *A. marina*, *Rhizophora mucronata* and *Acanthus ilicifolius* were offered. Sesarmid crabs are important not only because of their burrowing activities, which can affect nutrient cycling and forest productivity but also their role as a link in the food web in the mangrove ecosystem.

Key words: Mangroves, herbivorous crabs, gut content analysis, leaf preference, litter processing, nutrient cycling

Introduction

Herbivores utilize plant material as a food source and although plants have a more predictable mass and availability than animal foods, they are nutritionally inferior. Degradation of mangrove leaf litter by sesarmid crabs play a key role as a major link between primary and secondary productions. Sesarmid crab species select particular litter types of the mangrove leaf species available, thus leading to variable rates of litter mineralization. Dahdouh- Guebas (1997), Ashton (2002), Buck *et al*. (2003), Thongtham and Kristensen (2003) and Schwamborn *et al*. (2006) analyzed the diets of sesarmid crabs and showed that their diet mainly consisted of mangrove leaves and in addition to bussle of animal matter. The sesarmid crabs may select particular litter types of the mangrove leaf species available, leading to variable rates of litter mineralization.

However, studies on herbivores crabs and their dietary and nutritional aspects in the mangrove environment are lacking for Indian mangroves. Hence the present study has been carried out to assess the leaf preference and to know the role of grapsid crabs in mangrove litter processing including the analysis of gut contents in different crabs. Further the food preference of five different mangrove crabs with six different mangrove diets are also reported here.

Materials and Methods

Leaf Preference Experiments

Individuals of the grapsid crabs such as *S. brockii*, *S. plicatum*, *S. andersoni*, *Metopograpsus maculatus* and *M. messor* were collected during the period of 2004-2005 from the Pichavaram mangrove environment, southeast coast of India (Lat.11°27'N; Long.79°47'E). Fresh green leaves and senescent ones were collected from the canopy of *A. marina*, *R. mucronata* and *A. ilicifolius*.

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In order to recognize leaf identity after crab consumption, the leaves of the six types were cut into different geometric shapes of the same area (4 cm^2). The leaf pieces were offered to the crabs and the consumption rates of three leaf types were compared after 24 h. The amount of leaf biomass offered for each leaf type was smaller than the expected consumption by the crabs in 24 h, for encouraging the crabs to feed on progressively less desirable leaf types after exhausting the more desirable leaf types.

Gut Content Analysis

Sesarma brockii, *S. andersoni*, *S. plicatum*, *Metopograpsus messor* and *M. maculatus* crabs were collected randomly from all over the mangrove. All the contents from the stomach and rectum were removed and stirred with distilled water in a square petri-dish. The samples were then smeared on a microscopic slide and five random samples were observed at 100 and 400 X magnifications for large and small organisms. The contribution of each food item from the total diet is expressed in terms of percentage of the field occupied by the different categories recorded. Fecal matter in the hindgut region were also analyzed and categorized.

Results

Leaf Preference

There was a strong tendency for most of the crab species to consume decomposed leaves of *A. marina*. The same pattern was found in all the cases, with a very high preference for decomposed leaves of *A. marina* and very low preference for fresh leaves of *A. ilicifolius*. All the experimental animals preferred decomposed leaves of *A. marina* and *R. mucronata*, more than other leaf types. *M. maculatus* did not consume fresh green leaves of *A. ilicifolius* during the experimental period (Table 1 and 2).

Table 1: Leaf preference of mangrove crabs fed with various stages of decomposed *A. marina* leaves

Day of decomposition	Amount of leaf consumed by crab species (g/crab^{-1})				
	Sesarma brockii	*S. plicatum*	*S. andersoni*	*Metapograpsus maculatus*	*M. messor*
Initial	1.1	0.8	0.6	1.0	0.4
20	0.9	1.6	1.0	1.2	0.7
40	2.6	2.1	2.3	2.0	1.5
60	2.2	1.8	1.2	0.7	1.2
80	1.5	0.9	1.0	0.9	0.7

Table 2: Leaf preference by mangrove crabs

Crab species	A	B	C	D	E	F
Amount of leaf consumed (g)						
Sesarma brockii	2.6	1.8	1.3	1.7	1.7	0.6
S. plicatum	2.1	1.3	2.2	1.5	1.0	0.2
S. andersoni	2.3	0.7	1.9	1.2	0.2	0.3
Metapograpsus maculatus	2.0	1.8	2.0	0.6	0.3	-
M. messor	1.5	1.2	1.6	1.2	0.9	0.2
Carapace width (cm)						
Sesarma brockii	2.2	2.0	1.8	1.6	1.5	2.1
S. plicatum	1.9	1.6	2.4	2.2	1.5	2.0
S. andersoni	3.2	2.6	3.1	2.9	2.7	3.0
Metapograpsus maculatus	3.2	3.4	3.2	2.9	2.8	3.0
M.messor	3.1	2.6	3.9	4.1	2.8	3.5
Wet weight (g)						
Sesarma brockii	5.0	5.24	3.73	4.67	2.08	4.51
S. plicatum	3.2	5.68	5.53	4.32	2.01	4.32
S. andersoni	9.8	5.36	7.82	8.15	5.24	6.93
Metapograpsus maculatus	7.8	5.92	8.95	3.01	4.83	10.56
M. messor	16.61	5.58	20.14	23.42	10.34	18.37

A- *Avicennia marina* decomposed leaf, B- A. marina fresh leaf, C- *Rhizophora mucronata* decomposed leaf, D- *R. mucronata* fresh leaf, E- *Acanthus ilicifolius* decomposed leaf, F- *A. ilicifolius* fresh leaf, Sample size = 30

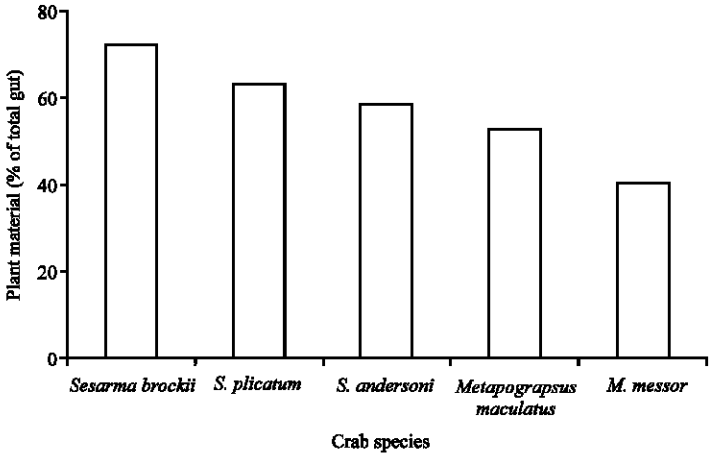

Fig. 1: Comparison of plant materials in the gut of mangrove crabs

In general, the experimental crabs strongly preferred 40 day decomposed *A. marina* leaves followed by 60 day decomposed *R. mucronata* leaves. Among the decomposed mangrove leaves, *S. brockii* preferred *A. marina* leaves first and eagerly fed on 40 day submerged leaves. Secondly they preferred 60 day submerged *R. mucronata* leaves. Most of the crabs moved away from the fresh *A. ilicifolius* leaves and preferred leaves of 40 to 60 days of decomposition.

Proportions of Materials in the Gut

The crabs exhibited greater variability in the amount of food in foreguts. The foregut content consisted of vascular plant matter ranging from (40.27 to 72.54% of total, Fig. 1). *S. brockii, S. andersoni* and *S. plicatum* showed almost similar diets and they consumed high amount of vascular plant matter (58.33-72.54%). However, *M. maculatus* (52.94%) and *M. messor* (40.27%) consumed low amount of plant materials. The second most important category was sediments, i.e., sand, silt and clay particles, constituting the gut content ranging from 6.66 to 17.64%. Maximum amount of sediment (17.64%) was collected from the gut of *M. maculatus.* Other gut contents were found to be less quantity and they include unidentified debris (5.08-16.58%), filamentous algae (1.66-5.0%), leaf associated fungal hyphae (1.3-4.41%), micro algae (1.6-5.0) and macro-algae (2.84-8.33%).

Faecal pellets observed in the hindgut were mostly of degraded leaf containing fine particles. Further, leaf material ingested by *S. brockii* was completely digested into fine particles and released back into the environment. The difference in the food items of *S. brockii* in the foregut and hindgut is statistically insignificant ($p>0.05$, t-test).

Discussion

In Pichavaram mangrove, the sesarmid crabs are dominant, leading mostly herbivorous mode of life. Although plants have a more predictable mass and availability than animal foods, they are nutritionally inferior. Plants have low nitrogen content which can prove to be an important limiting nutrient for herbivores, since energy (in the form of carbon) is readily available in plants (Boyd and Goodyear, 1971; Mattson, 1980). From the present findings, crabs strongly preferred 40 day decomposed *A. marina* leaves. The preference was for *A. marina* leaves over *R. mucronata* and *A. ilicifolius* as *A. marina* have high protein and low tannin contents (Kathiresan, 2000; Ravichandran *et al*., 2000; Ravichandran and Kannupandi, 2004, 2005).

Preference of sesarmine crabs for decaying mangrove leaves is expected, since only the food materials which are having C: N ratios lower than 17 are considered nutritious to marine invertebrates (Russel-Hunder, 1970). The fact that senscent mangrove leaves generally have high initial C: N ratios (up to 100) which decreases for decaying leaves. The feeding activities of crabs speed the decomposition of leaf litter and may facilitate the release of nutrients to mangal system (Robertson and Daniel, 1989; Lee, 1997; Nordhaus *et al*., 2006). Giddins *et al*. (1986) discovered that assimilation efficiency of *Neosarmatium smithi* for carbon, nitrogen and organic matter increased rapidly with the age of the decaying leaf litter they consumed. Crabs prefer *A. marina* leaves because of low soluble tannin and rich nutrient contents as mentioned earlier.

The analysis of gut contents indicated that most of the sesarmid crabs are primarily herbivores. The proventricules and rectum contain very high percentage of mangrove leaf material. Small-sized detrital particles occur more in the hindgut than in the foregut region. The proventricule is a site of particle reduction, where much of the materials are reduced. Similar results were observed in the proventriculus of sesarmid crab, *Chiromanthes oncychophorum* (Malley, 1978).

In the Pichavaram mangrove forests, sesarmid crabs descend from their burrows above the high tide mark to feed on mangrove leaves which are then taken back into their burrows. Storage of mangrove litter within the crab burrows, however, does not seem to be the common feature of all sesarmid species found in the mangroves suggesting that this behavior might be influenced by ecological constrains rather than food quality. This species consumes significantly more aged (6-weeks old) litter, as compared to fresh litter, which indicates that leaves are stored in burrows to leach tannins before consumption (Nielson *et al*., 1986). In the present study also, *S. brockii* stores leaves in the artificial burrows soon after the leaves are offered. Approximately 50% of original leaf tannin content is lost by leaching process during the first week of decompositions and increasing palatability of litter (Robertson, 1988; Ravichandran and Kannupandi, 2004). Grapsid crabs are helpful for the production of plant detritus. They are linked most closely to detritus, which may be linked most closely to secondary production of crabs in the offshore mangroves where grapsids are abundant. The present study clearly shows that *S. brockii* plays a key role for major link between primary and secondary productions. Grapsid crabs are mainly responsible for leaf litter production and there fore the species link the detritus food chain in the mangrove environment.

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References

Ashton, E.C., 2002. Mangrove sesarmid crab feeding experiments in Peninsular Malaysia. J. Exp. Mar. Biol. Ecol., 273: 97-119.

Boyd, C.E. and C.P. Goodyear, 1971. Nutritive quality of food in ecological systems. Arch. Hydrobiologie, 69: 256- 270.

Buck, T.L., G.A. Breed, S.C. Pennings, M.E. Chase, M. Zimmer and T.H. Carefoot, 2003. Diet choice in an omnivorous salt-marsh-different food types, body size and habitat complexity. J. Exp. Mar. Biol. Ecol., 292: 103-116.

Dahdouh-Guebas, F., M.J.F. Verneirt, Tack and N. Koedam, 1997. Food preference of *Neosarmatium minerti* de Man (Decapoda : Sesarminae) and its possible effect on the regeneration of mangroves. Hydrobiologia, 347: 83-89.

Giddins, R.L., J.S. Lucas and M.J. Neilson, 1986. Feeding ecology of the mangrove crab *Neosarmartium smithi* (Crustacea: Decapoda: Sesarmidae). Mar. Ecol. Progr. Seri, 33: 147-155.

Kathiresan, K., 2000. A Review of Studies on Pichavaram Mangroves, Southeast India. Pandian, T.J., (Ed.) Recent Advances in Indian Aquatic Research, Hydrobiologia, 403: 185-205.

Lee, S.Y., 1997. Potential trophic importance of the faecal material of the mangrove Sesarmine crab *Sesarma messa*. Mar. Ecol. Progr. Seri., 159: 275-284.

Malley, D.T., 1978. Degradation of mangrove leaf litter by the tropical Sesarmid crab, *Chiromanthes onchophorum*. Mar. Biol., 49: 377-386.

Mattson, W.J.Jr., 1980. Herbivory in relation to plant nitrogen content. Ann. Rev. Ecol. Sys., 11: 119-161.

Nielson, M.J., R.L. Giddins and G.N. Richards, 1986. Effects of tannins on the palatability of mangrove leaves to the tropical Sesarmid crab *Neosarmatium smithi*. Mar. Ecol. Prog. Ser., 34: 185-186.

Nordhaus, I., M. Wolff and K. Diele, 2006. Litter processing and population food intake of the mangrove crab *Ucides cordatus* in a high intertidal forest in northern Brazil. Estu. Coast. Shelf Sci., 679: 239-250.

Ravichandran, S., P. Soundarapandian and T. Kannupandi, 2000. Zonation and distribution of crabs in the Pichavaram mangrove swamp, southeast coast of India. Ind. J. Fish, 47: 73-78.

Ravichandran, S. and T. Kannupandi, 2004. Biochemical changes in decomposing leaves and crabs of Pichavaram mangroves. Biochem. Cell. Arch., 24: 79-88.

Ravichandran, S. and T. Kannupandi, 2005. Total heterotrophic bacterial load in decomposing mangrove litter and gut of crabs. Asian J. Microbiol.,7 : 861-864.

Robertson, A.I., 1988. Decomposition of mangrove leaf litter in tropical Australia. J. Exp. Mar. Biol. Ecol., 116: 235-247.

Robertson, A.I. and P.A. Daniel, 1989. The influence of crabs on litter processing in high intertidal mangrove forests in tropical Australia. Oecologia, 78: 191-198.

Russel-Hunter, R., 1970. Aquatic productivity: An introduction to some basic aspects of biological oceanography and Limnology, London: Collier-Macmillion. pp: 306.

Schwamborn, W., E.A.P. Silva, S.H.L. Schwamborn,T.E. Silva, S. Neuman Leitao and Saint Paul, 2006. Ingestion of large centric diatoms, mangrove detritus and zooplankton by zoeae of *Aratus pisonii* (Crustacea: Brachyura:Grapsidae), 560: 1-13.

Thongtham, N. and E. Kristensen, 2003. Physical and chemical characteristics of mangrove crab (*Neoepisesarma versicolor*) burrows in the Bangrong mangrove forest, Phuket, Thailand with emphasis on behavioural response to changing environmental conditions. Vie et Milieu. 53: 141-151.