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ECOBIOLOGICAL STUDY ON BURROWING MUD LOBSTER *THALASSINA ANOMALA* (HERBST, 1804) (DECAPODA : THALASSINIDEA) IN THE INTERTIDAL MANGROVE MUDFLAT OF DELTAIC SUNDARBANS

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ABSTRACT: Populations of mud lobster *Thalassina anomala* were studied on tidal flats in the Sagar island of Indian Sundarbans. Ecologically they are recognized as the 'friends of mangrove' and a 'Biological Marvel' of the system. They turn up the deep soil to the surface by regular night shift burrowing exercise and help to import aerated tidal water in the burrows 2 to 2.5 meter deep. They have extra ordinary morphological adaptation and structural changes and completely resort to detritivore diet. Being thigmotactic it seldom exposes to atmospheric oxygen and forms its palace underground with a central chamber having 5 to 6 radiated tunnels opening to the surface covered with earth mounds. It displays its engineering skill of bioturbation in tunneling. During tunneling the shrimp feeds on the mud packed with detritus and derived its required micronutrients. Being mud dwelling and mud eating habits, it's respiratory and food manipulating apparatus underwent transformations which demands intensive investigation. Thalassinid burrow associates comprising mieo and microorganisms also provide good subject of study of species specific interaction, exchanging of materials between associate partners.

Key Words: Thalassinidea, Sundarbans, Bioturbation, Infauna, Mangroves.

INTRODUCTION

Deltaic Sundarbans of coastal West Bengal shelters the largest mangrove chunk, a "World Heritage Site" and a Biodiversity Hotspot of global interest. Mangrove canopy, mangrove floor substratum, coastal sand and mudflats, salt marshes and inshore-offshore mangrove wetlands are packed up with myriad of benthic fauna, macro-, mieo- and microorganisms, a majority of them are burrowing. Entire

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mangrove habitat is inundated twice in twenty four hours by tidal waters with varying intensity of salinity through seasons. The Thalassinidea (Decapoda) are among the most common burrowing organisms in littoral and sublittoral sediments; they are found sometimes in very high densities from the intertidal zone down to at least the self break, and occur in all types of environments from brackish or euryhaline to stenohaline (Dworschak 1998). Members of the mud lobster species *Thalassina anomala* are the most common shy and nocturnal decapod crustaceans often found to dominate the littoral mudflats of Sundarbans. The thalassinidean shrimps are a ubiquitous component of burrowing megafauna in marine and estuarine sediments but due to their elusive lifestyle and complex nature of their burrows, they have often been overlooked by traditional sampling techniques (Nickell and Atkinson 1995). As a permanent residential infauna of Sundarbans mangrove littoral mudflats, it is of immense interest to mangrove naturalists. It is often considered as a "Biological Marvel" for its tunneling engineering skill to build its subterranean residential abode. Burrows are used for shelter, reproduction and feeding except for a brief pelagic larval stage (Griffis and Suchanek 1991). During its daily nocturnal exercise, it upturns the sub soil forming earthen mound excavation on the surface substratum, fertilizing unknowingly the top soil charged with mangrove based innumerable rhizospheric microbes. Because of their cryptic life style, the natural history of these organisms has not been well investigated. The difficulties in capturing specimens and observing them *in situ* in laboratory are such that many aspects of their biology are poorly understood and unknown.

MATERIALS AND METHODS

Live mud lobsters, *Thalassina anomala* were sampled from two study sites *viz.* Harinbari and Chemaguri of Sagar island in Indian Sundarbans during pre and post monsoon period of the year 2011. The animals were caught by digging of their mounds using spade. Burrow morphology were studied by 'archeological' method (Griffis and Suchanek 1991) of burrow excavation which involves direct observation of the burrow features while carefully removing layer by layer of sediments (Vaugelas 1984) as well as artificially in laboratoty. Bio associates were examined in the wall of burrows while removing layer of sediments. Total 14 specimens (TL; 12.7- 19.3 cm) were measured using calipers and scales. Measurements provided are of the total length (along the midline from the tip of rostrum and tip of telson). Critical examination and dissection of mouthparts and respiratory apparatus of live samples were done in field laboratory of S.D. Marine Biological Research Institute immediately after collection at Sagar Island.

RESULTS AND DISCUSSION

Respiration

Spiny lobster evolved intricate gill cleaning apparatus just below the branchiostagite membrane to ensure its respiratory function from the constant mud bath during tunneling. Various rows of setae on the legs and gills are used to prevent sediment from reaching the gills and for expelling any of which reaching them. *Thalassina anomala* also makes use of 'respiratory reversal' to keep the gill free of dirt.

Feeding apparatus and mechanism

As the animal feeds detritus rich mud, the

Fig 1: The mud lobster, *Thalassina*

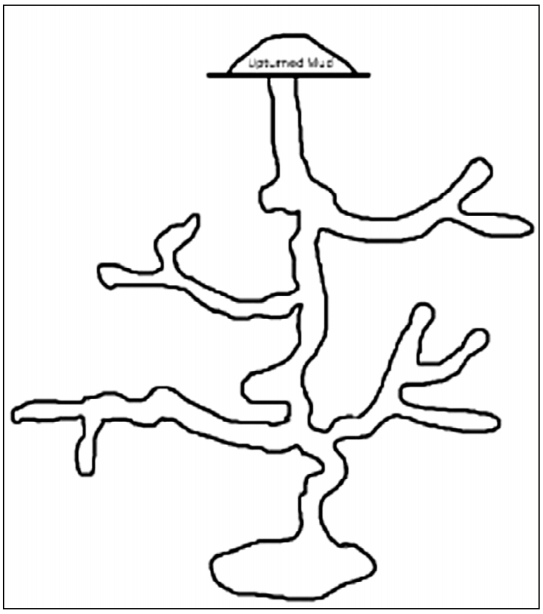

Fig 2: Drawing of burrow architecture.

mud particles are meticulously manipulated and sorted out by very specialized mouth apparatuses namely mandible and mandibular palp, 1^{st} & 2^{nd} maxilla and 1^{st}, 2^{nd} & 3^{rd} maxilliped. These apparatuses are marvelously modified for providing successive selected grades of setal sieves. Through these animated sieve apparatus finest food particles impregnated with organic micronutrients are passed through gut. Functional morphology of burrows is related with tropic modes of the animal.

Functional morphology of burrow construction and burrowing behavior

This endobenthic and probably bearing solitary mode of habit, *Thalassina anomala* rely on self constructed burrows for a wide variety of mud including shelter, reproduction and feeding. Except for a larval phase which may be pelagic, most Thalassinidean shrimp spread their life within the burrow (Griffis and Suchanek 1991). The animal burrows with the first pair of leg, the dactyls of these appendages being used somewhat like trowels to pull the dirt loose. It works a load free and then carries the mass before it to the mouth of the burrow. The load is carried by the first pair of leg between the dactylus and the propodus, and it may be supported below to some extent by the second pair of leg which are held in a horizontal position. The first two pairs of leg form a sort of basket which is an admirable instrument for sweeping all loose mud before the animal as it moves through its burrow. The loads of the mud are dumped at the mouth of the hole, the first pair of leg being stretched forward while the sticky mass is pushed from them with the second pair of leg. It tunnels 5 to 7 feet having 10 to 13 cm periphery with many multiple 'U' and 'Y' gallery branching with vertical and helical shaft ending with a central chamber. Reproductive burrows are considered burrows with additional tunnels extending from the 'U' and 'Y' portion of the burrow, which are thought to be made by males to search and connect with burrows of females with which copulation can takes place and individuals leave the burrow to reproduce.

Intraspecific behavior

Thalassina anomala constructs species specific burrow and single individual was entrapped from burrow, exhibiting intraspecific behaviour. The Thalassina is probably nocturnal digger or becomes active in the twilight and most of the burrows are closed during the day, but more are open on rainy or cloudy days than when weather is clear. This is probably due to shortage of oxygen availability for respiration in those seasons. When handled or placed on the ground this crustacean is slow moving and cautious rather than pugnacious, attempting to hide or creep away. Though Thalassina depends largely on its secretive habit to protect it from its foes, ones it is in hand of its enemy, many spines on the surface of the body and legs form an admirable adaptation to escape. Those on the body wall point toward the anterior end and when in the grasp of an enemy serve to prevent the body from slipping forward but facilitate movement in the opposite direction. It is surprising how hard the animal pushes forward fractionally with its legs; the spines do not allow the fingers to regain their hold easily. Thus it often slips to the ground and backs into the nearest burrows. When animal were placed into the modified glass aquarium containing sediment from the study site in order to observe their burrowing behavior, most individuals performed digging just after introduction of one to two hours into the tank. During burrow excavation, the larger animal occupies the burrows, and the animal usually began to fight, normally than smaller. They typically displayed aggressive behavior, regardless of whether they were of the same or opposite sex. The other most important behaviour of the mother lobster is the release of developed juveniles in the adjacent creek waters from its abdominal pleopod basket during the outbreak of first monsoon leading a short pelagic life.

Bio-association

Biogenic structures (burrows) of benthic organisms have been shown to have contrasting effects on infauna enhancing the presence of smaller infauna by providing suitable micro habitat in sediment depth (Dittmann 1996). This process termed 'accommodation' is one of the major promotive interactions structuring benthic communities. Thalassinidean burrows can (may) provide refuge from predation and facilitate larval settlement. Among the associates, various categories of macrofauna (Echiurus, Pea Crabs, Isopods and small Lamellebranchs), mieofauna (small Annelids, Nematodes, Trematodes etc.) and microfauna (Protozoans and micronematodes) are found. The interactions may be complex and the burrow host may exert contradictory effects on associated fauna. More studies are needed to elucidate the deeper realms of the thalassinidean burrows that still remain cryptic.

Thalassinideans are the most extra ordinary and proficient diggers among burrowing decapod crustaceans (Rodrigues and Hodl 1990). It constructs unique burrows of extreme architectural and functional complexity that

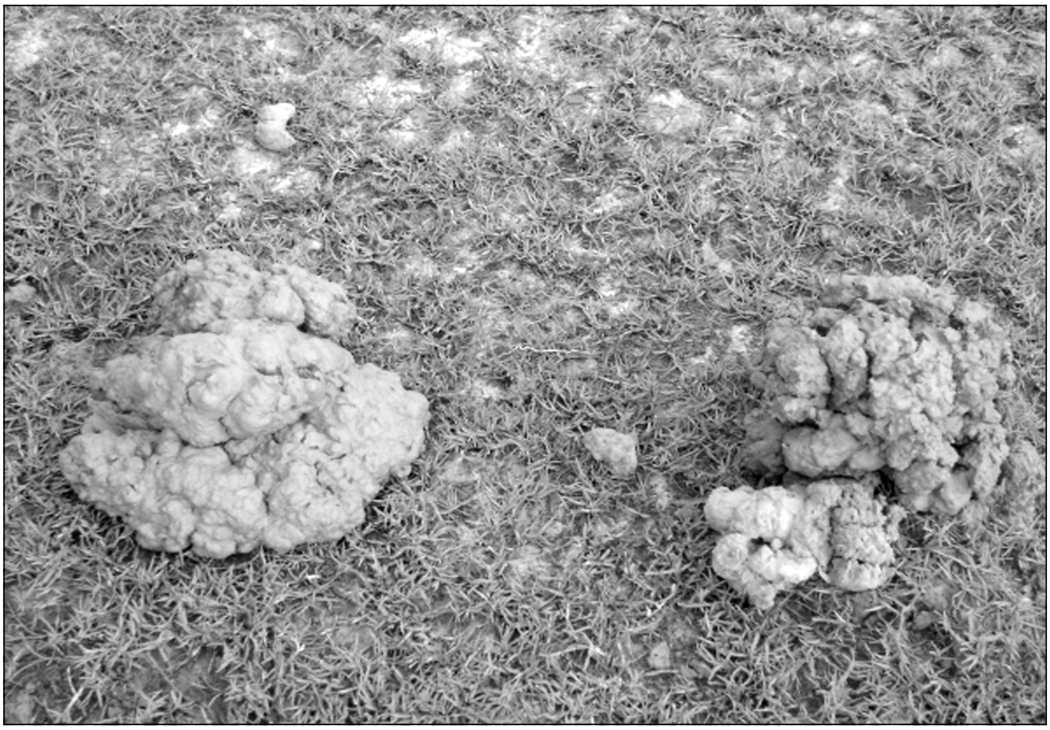

Fig 3: Excavated mud; key to identification.

influence the whole sedimentology and geochemistry of the mangrove bed. Burrowing and irrigation activities of the shrimp must exert significant influence on increased oxygenation, decomposition of organic materials in sediments and on nutrient recycling from the sediment. In the sediment, benthic animals produce ammonium and phosphate directly as excreted metabolites and these essential nutrients recycle to the water coloumn, sustaining primary production in the upper layers (Koike and Mukai 1983). Burrow architecture of this animal may be related not only feeding but to other aspects of biology like reproduction, protection etc. This bioturbator considered as a meticulous environmental engineer but it creates a negative impact on fishery and aquaculture. Their constant burrowing adaptation cause dyke damage in aquaculture farms and create holes from where farm species can escape. This may also play as carrier or vector of aquatic diseases in brackishwater farm and needs through study. They often cause damage in earthen floor of house situated nearby creeks.

CONCLUSION

The biodiversity of Sundarbans are in pressure due to climate change and other physical anthropogenic factors in last few decades. Changing of key environmental factors like temperature, precipitation, salinity, nutrients etc. which alters habitat patterns and abundances of many species including thalassinidians. Warm sea current, wave action, sedimentation, fresh water flow etc. also affects this infaunal population. As macrobenthos tubes can provide accommodation, refuge from predation, facilitate larval settlement and other promotive interactions of many smaller infaunal communities, disturbing this key species alters habitat patterns and biodiversity of many species. The fossorial existence of these organisms makes it difficult to quantify their behavior and activity without disturbing the burrow environment, and thus we explore relatively little about this species. Conservation of these burrowing shrimp communities requires thorough understanding of their life histories, habitat dependencies, symbiotic relationships and population responses to environmental perturbations.

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