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Ecological Relationship between Mud Crab *Scylla serrata* (Forskal) and Mangroves and the Pattern of Utilization

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Abstract The ecological relationship between mud crab *Scylla serrata* (Forskal) and mangroves was described in this paper. Mangrove swamps are important reproductive places for mud crabs, where zoeae, megalopae, juveniles from 1st to 14th instar, adult crabs and ovigerous female crabs were found. Mangrove roots and the leaf litter are the shelters of the mud crab. The zoeae and megalopae of mud crab can normally grow and develop on the plankton and debris that are well —supplied in mangrove swamps. There are a lot of Phascolosoma, Mollusca and Crustacea which constitute the delicious foods of the mud crab in mangrove swamps. The larger crabs have a preference for *Ostrea*, *Balanus* and *Vignadula* which usually amply adhere and endanger the mangroves, so the mud crab is helpful for the development of the mangrove communties. Finally a pattern of ecological culture of the mud crab in mangrove swamps was suggested.

Key words Mangroves, *Scylla serrata* (Forskal), Ecological relationship

Mangroves are the woody plants growing along subtropic and tropic intertidal zones. There are rich foods and favourable habitats of animals in mangrove swamps, many animals are invited up to there to feed and to inhabit, so the mangrove forest is a good searanch. Most of mud crabs *Scylla serrata* (Forskal) which have a high economic value spend whole cycle of their life in mangrove swamps. The ecological relationship between the mud crab and mangroves is described in detail from results of our studies and previous informations, a pattern of ecological culture of the mud crab in mangrove swamps is proposed in this paper.

1 Materials and Methods

In June 6, 1984 the quantitative studies of the mud were performed in the mangrove waterways at Baihutou, Beihai, China (21°25′N, 109°10′E). The area of mangroves is about 40 hm^2., the size of waterways is 1/6 size of mangroves. The waterways were average averagely divided into landward region, middle region and seaward region. The specimens were collected in the three regions mentioned above, respectively. There random quadrats were placed in each region and the size of quadrat is 5×5m^2. The larvae of crab were caught with planktonic net in mangrove waterways. The mangrove leaves were pulled out of the seawater, the megalopae and 1st juveniles attaching to mangrove leaves were

collected. The mud crabs under mangrove leaves and mudsoil were captured. Finally the quadrat was blocked up with mudsoil and the seawater within it was completly removed in order to catch all mud crabs. The megalopae, the early juveniles (1st to 6th), the postjuveniles (7th to 14th instar), the males, females were well noted respectively.

The qualitative studies were perfermed in mangrove swamps along Guangxi coast from 1984 to 1992. The study sites involved Baihutou, Daguansha, Henglushan, Shuier, Yingluo, Dandao, Shuijingkeng and Jiangping. The distribution of mud crabs was surveyed and their ecological behaviours were observed.

Data on feeding types of the mud crab were determined on the basis of the published informations (Hill, 1976, 1979; Williams, 1978; Luo et al., 1986; Prasad et al., 1988; Wei, 1990) and the field observations, no gut content analysis were attempted.

2 Results

2.1 Resource of the Mud Crab in Mangroves

111 megalopae, 41 early juveniles, 13 postjuveniles of the mud crab were found in 225m² mangrove waterways situated at Baihutou, Beihai (Table 1).

Table 1 The statistical table of the quantitative *study of* the mud crab (*Scylla serrata*) in Baihutou mangrove waterways in June 6, 1984

	1st specimen				2nd specimen				3rd specimen				Average			
	me.	ej.	pj.	to.	me.	ej.	pj.	to.	me.	ej.	pj.	to.	me.	ej.	pj.	to.
lr.	5	3	1	9	15	4	0	19	11	7	2	20	10.3	4.7	1	16
mr.	8	4	2	14	13	5	1	19	16	3	1	20	12.3	4	1.3	17.7
sr.	15	7	3	25	17	6	2	25	11	2	1	14	14.3	5	2	21.3

Note: me. —megalopae; ej. —early juveniles; pj. —postjuveniles; to. —total; lr. —landward region; mr. —middle region; sr. —seaward region

45 zoeae of the mud crab were collected in 3 nets in mangrove waterways seaward at Baihutou in May 8, 1984. All zoeae were 3rd instar by microscope determination. The embracing crabs, mating crabs and ovigerous female crabs were observed in mangrove swamps at Shuijingkeng, Henglushan and Baihutou respectively in 1984—1992 period.

2.2 Food—resources of the Mud Crab in Mangroves

The Polychaeta, Sipunculidae, Mollusca, small Crustacea, etc. are the foods of mud crabs in mangrove swamps (Hill, 1976, 1979; Williams, 1978; Macintosh, 1982; Luo et al., 1986; Prasad et al., 1988; Wei, 1990). 96 species, 147.09g/m² (fresh weight) of benthic animals which are the possible foods of mud crabs were collected in 1992 at Yingluo Bay, one of the major mangrove swamps along Guangxi coast. They include 49 species, 80.17g/m² of Mollusca, 41 species, 33.69g/m² of Crustacea and 6 other species, 32.96g/m².

45 species of benthic animals on which the mud crabs feed were found in mangrove swamps at Shuijingkeng in April 23, 1992. They consist of 29 species of Mollusca, 13 species of Crustacea and

3 other species.

43 species of benthic animals on which the mud crabs eat were discovered in mangrove swamp at Daguansha in 1992 . They include 25 species of Mollusca, 17 species of Crustacea and one other species.

3 Discussion

3.1 Mangrove Swamps Are Important Reproductive Places of Mud Crabs

Gao et al. (1985) reported that there were mud crabs in mangrove swamp in the Jiulongjiang estuary. Nandi et al. (1983) discovered the mud crabs in mangroves of Sagar island, intertidal zones, Sunderbans, India. Heasman et al (1983, 1985) and Wei (1990) collected mud crabs from mangroves for experiments. There were mud crabs in all mangrove swamps of Guangxi on the basis of survey.

Hill et al. (1974, 1975, 1982) indicated that the mud crab spends much of its life cycle in mangrove swamps. Juveniles (20 to 99 mm carapace width) were resident in the mangrove zone, remaining there during low tide. The majority of subadult crabs (100 to 149 mm) migrated into the intertidal zone to feed at high tide and retreated to subtidal waters at low tide. Adults (150mm and larger) were mostly caught subtidally and only small numbers were captured in intertidal zone at high tide. After mating, the mature females migrated into the open sea where they extrude their eggs. Arriola (1940) reported that the female crabs migrate to sea to release their eggs. The larger mud crabs are easy caught by predatory birds and predatory mammals in mangrove swamps during low tide because they have a higher nutrition. As a result, most postjuveniles, adults and ovigerous females retreat to subtidal waters during low tide and go into mangrove swamps to feed during high tide. Migrating to deeper waters to escape from predators is a result of competition for existence. A few of postjuveniles, embracing crabs, mating crabs, ovigerous females were discovered in Guangxi mangrove swamps, and most of them sheltered in holes. If the predators were prevented from going into mangrove swamps, mangrove swamps would be favourable places for reproduction of mud crabs.

3.2 Mangroves Are Nurseries of Food—organisms for Mud Crabs

Mud crabs have been found to be omnivorous, feeding on mollusca, fishes, crustacea and a moderate amount of plant. Mud crabs have large, very powerful dimorphic chelae, mandibula and maxilla, having the ability to crush the hard shells and pick the flesh of mollusca (Williams, 1978; Luo et al, 1986; Prasad et al, 1988; Wei, 1990) . The mud crab is a predator of sessile or slow—moving benthic macroinvertebrates, chiefly mollusca and smaller crabs. Food location was found by contact chemoreception, using the dactyls of the walking legs. Mobile prey such as small crabs were trapped by the legs, which pulled them forward to where they could be picked up by the chela (Hill, 1976, 1979) . The mangrove leaf litter, which are decomposed by bacteria, increase the mineral nutrition of the seawater in which the plankton exist. The plankton and mangrove debris are the good foods of Polychaeta, Sipunculidae, larvae of the Crustacea. Foods of the mud crab are greatly nursed in mangrove swamps on the basis of pioneer informations and our studies (Gao et al, 1985; Zhou et al. , 1986; Nandi et al. , 1983). Mud crabs prefer *Ostrea*, *Balanus* and *Vignadula* which adhere to

mangrove trees and have a negative effect on mangrove growth. This implied that the development of mud crabs in mangrove swamps would enhance the expansion of mangrove community.

3. 3 Mangrove Forests Are Shelters of Mud Crabs

The branches, leaves of mangroves are very luxuriant and the roots of mangroves are extremely complex. For example, besides large underground roots, there are highly developed aboveground pneumatophore and prop roots. The holes formed by the roots were regarded as the shelters for mud crabs. The leaf litter that arrange over ground are also the shelters for the mud crabs, such as the megalopae and juveniles. Wehrtmann et al. (1990) reported that meglopae and juvenile stages of decapods were attached to the drifting mangrove leaves and utilized floating mangrove leaves as a transport mechanism. This transport mechanism may minimize both the risk of predator and the energy required to immigrate into the preferred habitat. Prasad et al. , (1989) believed that mangrove swamps offer a congenial environment with diversified feeding habitats for the mud crabs. The mud crabs may shelter under mangrove leaves, or in holes of mangrove roots, or under the mud during ebb, so the mud crabs are difficult to be found by predators. Mud crabs can easily escape from the predatory fishes for the protection of mangrove pneumatophore and prop roots (Hill, et al. , 1982).

3. 4 The plan of ecological culture of mud crabs in mangrove swamps

As the former description, there is a close ecological relationship between the mud crabs and mangroves. This is why mud crabs are usually named"mangrove crabs"in many countries (Macintosh, 1982; Heasman et al. , 1983). The ecological culture of the mud crab in mangrove swamps is expected to obtain a higher community—economy—ecological effect. Macintosh (1982) pointed out that the mud crab cultured in mangrove pond is a fairly opportunistic feeder on slow — moving benthic invertebrates and a preference for small crabs and bivalves. The mud crab can reach a marketable size 10～15cm (carapace width) in 7～8 months. Mangrove pond culture of the mud crab have been practised in several Southeast Asian countries, usually in polyculture with milkfish or penaeid prawns. Li et al. (1989) suggested the culture of the mud crab in mangroves. We consider that the ecological culture of the mud crab should be conducted in the region where the mangroves is luxuriant, soil is muddy or sandy—loam, water is less during ebb. The region with sallow water during low tides, small wave during high tides in mangrove swamps is selected and surrounded with denser nets for the interculture of the juvenile crabs. The megalopae and 1st—instar juveniles are cultured 4th—to 5th—instar juveniles then they are opened to whole mangrove swamps to be cultured to commercial size. (Fig. 1)

Although the culture of mud crab has been developed early in Guangxi , most of the culture activities were carried out in man—made ponds. The ecological culture of mud crabs with enclosing net in mangrove swamps not only decrease the building expenditure, but also offer a natural living environment and enough living space to the mud crabs.

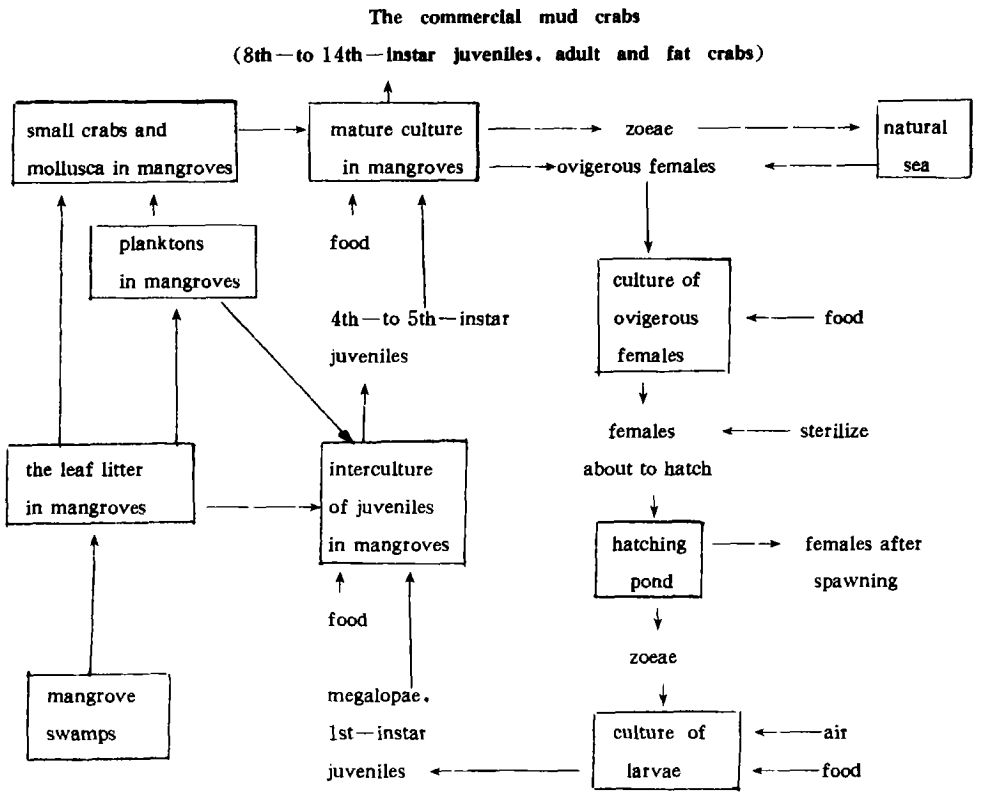

Fig. 1 The patches of the ecological culture of mud crab, *Scylla serrata*, in mangrove swamps.

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