ORIGINAL PAPER

**Settlement and upstream migration of the Japanese mitten crab
Eriocheir japonica (de Haan)****Satoshi KOBAYASHI**

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Abstract : Upstream migration in the Japanese mitten crab *Eriocheir japonica* was investigated in the lower region of the Saigo River and the adjacent seas in Fukuoka Prefecture, Japan. Megalopa larvae settled and metamorphosed to the crab stage in the upper tidal area in the river. The youngest crabs were nearly 2 mm in carapace width (CW). After attaining a minimum of 3.6 mm CW, the crabs began to migrate upstream and reached the freshwater area. Settlement of megalopa larvae occurred mainly in mid autumn (October) and late spring (May to June), while small numbers also settled in November and January - February. However, the majority of larvae that settled in winter did not survive and metamorphose to the crab stage due to low water temperatures ($< 10^{\circ}\text{C}$). The young crabs that metamorphosed in autumn and winter remained in the tidal area and did not grow throughout winter. Upstream migration of the autumn settlers to the freshwater area was observed from March until June. They started to grow in March, and reached nearly 10 mm CW by June (about 8 - 9 months after settlement). In contrast, the larvae that settled in May to June grew very fast, reaching nearly 10 mm CW in September (about 4 months after settlement). Their upstream migration to the freshwater area began in July and ended by August. Thus, the growth and upstream migration of *E. japonica* seemed to be strongly influenced by water temperature in the estuary. This mode of settlement with two peaks in autumn and early summer reflected the temporal pattern of reproduction observed in the sea. With respect to engineering works in river estuaries and the release of the crab to rivers, it is recommended that we take into account the processes of settlement and migration of young crabs. We may also require information on the migratory processes of other diadromous crustaceans for their effective conservation and management.

Key words : Japanese mitten crab, *Eriocheir japonica*, settlement, upstream migration, megalopa larva.

Introduction

The Japanese mitten crab *Eriocheir japonica* (de Haan) is a grapsid crab widely distributed in freshwaters and shallow sea areas of Sakhalin, east Korea,

Japan, Taiwan and Hongkong (Miyake 1983). The adults of this catadromous species migrate downstream from the freshwater area of a river to the sea to mate and lay eggs (Kobayashi & Matsuura 1991, 1997). Zoea larvae of this species can live only in the sea water (Ishida 1976). In Japanese rivers, this crab is abundant and seems to constitute an important

member of river communities. Furthermore, the crab is one of the main targets of inland fisheries in many areas of Japan, and the effect of fishing on the population structure may be substantial. Restocking of *E. japonica* by the release of cultured crabs is in progress in several regions to protect natural population from over-exploitation by fishing. Development of effective methods for maintaining or increasing the population of this crab has been anticipated by fishermen (Kobayashi et al. 1997). This requires an elucidation of the entire life cycle of this species. The process of downstream migration, distribution pattern along a river, mating behaviour and reproduction in the sea have been clarified by Kobayashi & Matsuura (1991, 1994, 1995a, 1995b, 1995c, 1996, 1997). However, the process of upstream migration from estuarine to freshwater areas has not been revealed yet.

The environments surrounding aquatic organisms including *E. japonica* have not been in ideal states for their survival. Most Japanese rivers have been modified through engineering works for the sake of water resource development and disaster prevention. Fortunately, the recent social trends of promoting amenity and nature conservation of riverfront areas have begun to place more importance on biotic habitats. River improvement works attempt to recover and conserve biotic communities and the improvement of fishways at the weirs and dams has been undertaken to provide more efficient pathways for migratory fishes (Tamai et al. 1994). Information on migratory species (time of migration, size of migrating animals and area passing through the migration) is required for improving fishways. Many diadromous animals (including anadromous, catadromous and amphidromous species; definition in McDowall 1992) use fishways constructed in estuarine areas; the ecology of those fishes which are important for fisheries (e.g., salmon and ayu) has been reported in detail (e.g., Tamai et al. 1994, Goto et al. 1994). However, the processes of migration have not been described for migratory invertebrates including decapod crustaceans, particularly brachyuran crabs (see Anger 1991, Ryan & Choy 1990, Kobayashi & Matsuura 1995b).

In the present paper, I describe the settlement of megalopa larvae and upstream migration of young

crabs of *E. japonica* in an estuary to provide some useful information for the conservation of this diadromous species.

Materials and methods

Study site

The study site was located in the lower region (from the river mouth to about 2 km upstream) of the Saigo River and the adjacent sea coast in Fukuma, Munakata Gun, Fukuoka Prefecture, Japan (33°46'N, 130°30'E, Fig. 1). The Saigo River is nearly 6 km long, and runs through the Munakata Gun into the Genkai-nada Sea. After preliminary sampling, the following sampling stations were chosen (see Table 1). Station 1 was the coastal area adjacent to the river mouth. Stations 2 - 4 were the tidal areas of the river, with Station 4 being the upper limit (located between the extreme high water of spring tide to the extreme high water of neap tide). Stations 5 - 7 were freshwater areas. On the upper borders of Stations 4 and 6, there were concrete weirs of about 1m and 0.5 m high, respectively. The former had a fishway (about 3 m wide and 6 m long), but the latter did not and was covered with green algae.

Fig. 1. Map of the study site and sampling stations.

Table 1. Environmental characteristics of sampling stations. The data at tidal stations (Stations 1 – 4) were obtained during the ebb tide. Salinity (%) of the interstitial water (5 cm deep under the ground) and the river water (5 cm below the water surface) is given as the range of values for 5 samples collected at each station on 10 July 1997.

Station	Distance from the river mouth (m)	Channel width (m)	Substrate	Water depth (cm)	Salinity (%)	
					interstitial water	river water
1	0-150 (lateral distance)		sand, pebble	0(above water) -60	2.6-3.0	2.6-2.9
2	50-250	12-20	sand, mud	0(above water) -50	1.4-1.8	0.2-0.4
3	400-650	11-19	sand, mud	5-50	0.6-1.2	0.0
4	700-800	3-10	sand, mud, concrete	15-30	0-0.4	0.0
5	1000-1200	8-15	sand, mud	5-50	0.0	0.0
6	1300-1500	5-12	sand, mud, clay	10-55	0.0	0.0
7	1750-2000	4-10	sand, mud, clay	5-55	0.0	0.0

Measurement of environmental factors

Salinity (%) of river water and interstitial water was measured at each station (five samples each) using a specific gravity meter (Sea Test, Aquarium Systems Co., USA) during the ebb tide on 10 July 1997. River water was sampled within 5 cm of the water surface in the flowing section, and interstitial water was sampled as the oozing water collected in the holes of 5 cm deep dug in the wet ground by the water's edge.

Water temperature (°C) within 5 cm of water surface was measured with a thermometer at Station 4 on each sampling day.

Sampling

Sampling was conducted twice a month (only once in August 1996) at each station, mainly during daytime spring tides. At the tidal stations, sampling was conducted during the ebb tide. Mitten crabs including megalopa larvae hiding under the rocks in the intertidal zone to the water depth of about 60 cm were captured using a hand-held net (mesh size = 1.0 mm) by turning over the rocks. Crabs buried in or wandering on the substrate were also collected. Other co-occurring animals were also collected and recorded. In the field the carapace width (CW) of each crab was measured with vernier calipers and each individual was sexed; crabs with CW < 11 mm were classified as unsexed juveniles. Crabs were released in the same area after measurements were taken.

Results

Salinity and water temperature

Salinity (%) of the interstitial water was zero at Stations 5, 6 and 7. It varied from zero to 1.8 at Stations 2, 3 and 4 and from 2.6 to 3.0 at Station 1. As regards river water, salinity was zero (Stations 3, 4, 5, 6 and 7), < 0.5 (Station 2) and 2.6 – 2.9 (Station 1) (Table 1).

Water temperature at Station 1 varied from 8.2°C (January) to 30.0°C (August) (Fig. 2). It was below 10.0°C between December and February.

Fig. 2. Seasonal changes in water temperature during the sampling period at Station 4.

Fauna of the sampling area

Invertebrates and vertebrates which occurred in the sampling area are shown in Tables 2 and 3. These animals were categorized into three groups: fresh-water species, salt water (including brackish and sea water) species and diadromous animals. Salt water species (e.g., *Balanus albicostatus*, *Anthopleura japonica*, *Neanthes japonica*, *Takifugu niphobles* and *Acanthogobius flavimanus*) were found in the four stations downstream of Station 4. Diadromous animals were collected in the stations within tidal and freshwater areas. For example, *Anguilla japonica* was collected from Stations 2 to 6, and settled juveniles (glass eels) were collected at Station 4. *Clithon retropictus* was collected from Stations 3 to 6. *Mugil cephalus cephalus* was observed from Stations 2 to 5. *Macrobrachium formosense* occurred from Stations 3 to 7, and ovigerous females were collected at Station 4. Fresh-water species occurred only at three stations upstream of Station 5 (e.g., *Neocaridina denticulata*, *Procambarus clarkii*, *Semisulcospira libertina*, *Zacco temminckii* and *Rhinogobius flumineus*).

Among six grapsid crabs, three species were collected in abundance from the salt water areas all the year round. *Hemigrapsus penicillatus* was most abundant in the estuarine and sea areas (Stations 1 to 3). *H. sanguineus* occurred at Stations 1 and 2, and *Gaetice depressus* was seen only at Station 2. In addition, three migratory grapsid species were collected together with *Eriocheir japonica*. Megalopa larvae and young crabs of *Varuna litterata* occurred in November only at Station 4. *Sesarmops intermedium* was collected from Stations 4 to 7, and *Chiromantes dehaani* occurred at Stations 3 to 5.

Among the invertebrates and vertebrates listed in Tables 2 and 3, only *Eriocheir japonica* occurred at all stations. A total of 457 females, 602 males, 812 unsexed juveniles and 68 megalopa larvae were collected at Stations 4 to 7 from July 1996 to September 1997. At Stations 1 to 3, 60 adult females including 34 ovigerous ones and 75 males were collected between September 1996 and June 1997. No megalopa larvae and unsexed juveniles were collected from these stations. In this paper only the data on megalopa larvae and unsexed juveniles are considered; the data on sexed crabs will be treated elsewhere.

Occurrence of young *E. japonica*

Figure 3 shows the frequency distributions of carapace width of megalopa larvae and unsexed juveniles collected at Stations 4 to 7 (CW < 11 mm) throughout the study period. Megalopa larvae of *E. japonica* (1.6 - 1.8 mm CW) were collected only at Station 4 where all size classes of crabs occurred, though small individuals were predominant (those with CW < 6.0 mm accounted for 80%). In contrast, only crabs of > 3.6 mm CW and those of > 5.6 mm CW were collected at Station 5 and Stations 6 - 7, respectively.

Temporal variation in the frequency distribution of CW is shown in Fig. 4. The occurrence of megalopa larvae and youngest crabs at Station 4 suggests that settlement of megalopa larvae occurred mainly in two seasons, mid autumn (October) and late spring (May

Fig. 3. Frequency distributions of carapace width in megalopa larvae and unsexed juvenile crabs of *Eriocheir japonica* collected at Stations 4, 5, 6 and 7.

Table 2. Occurrence of benthic invertebrates at different sampling stations.

Taxa	species	Japanese name	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7
Porifera									
Demospongiae	<i>Halichondria japonica</i>	Daidaiisokaimen	+						
	<i>Halichondria okadai</i>	Kuroisokaimen	+						
Cnidaria									
Anthozoa	<i>Anthopleura fuscoviridis</i>	Yoroiisoginchaku	+						
	<i>Anthopleura japonica</i>	Midoriisoginchaku	+						
Annelida									
Polychaeta	<i>Cirriformia tentaculata</i>	Mizuhikigokai	+						
	<i>Pomatoleios kraussi</i>	Yakkokanzashi	+						
	<i>Neanthes japonica</i>	Gokai			+	+			
Hirudinae	<i>Erpobdella lineata</i>	Shimaishibiru					+	+	+
Mollusca									
Polyplacophora	<i>Acanthopleura japonica</i>	Hizaragai	+						
Gastropoda	<i>Chlorostoma argyrostoma lischkei</i>	Kubogai	+						
	<i>Monodonta labio</i>	Ishidatamigai	+						
	<i>Patelloida (Chiazacmea) pygmaea</i>	Himekozaragai	+						
	<i>Siphonaria (Sacculosiphonaria) japonica</i>	Karamatsugai	+						
	<i>Clithon retropictus</i>	Ishimakigai			+	+	+	+	
	<i>Pomacea canaliculata</i>	Skumiringogai					+	+	+
	<i>Physa acuta</i>	Sakamakigai					+	+	+
	<i>Semisulcospira libertina</i>	Kawanina					+	+	+
Bivalvia	<i>Macra chinensis</i>	Bakagai	+						
	<i>Ruditapes philippinarum</i>	Asari	+						
	<i>Saccostrea kegaki</i>	Kegaki	+						
	<i>Mitilus edulis</i>	Murasakiigai	+	+					
	<i>Crassostrea gigas</i>	Magaki		+	+				
	<i>Corbicula (Corbiculina) leana</i>	Mashijimi					+	+	+
Arthropoda									
Crustacea									
Maxillopoda	<i>Balanus albicostatus</i>	Shirosujifujitsubo		+	+				
Isopoda	<i>Asellus hilgendorfi</i>	Mizumushi				+	+	+	+
Decapoda	<i>Pagurus filholi</i>	Honyadokari	+						
	<i>Gaetice depressus</i>	Hiraisogani	+						
	<i>Matuta lunaris</i>	Kinsengani	+						
	<i>Hemigrapsus sanguineus</i>	Isogani	+	+					
	<i>Laomedia astacina</i>	Hasamishakoebi		+					
	<i>Hemigrapsus penicillatus</i>	Kefusaisogani	+	+	+	+			
	<i>Eriocheir japonica</i>	Mokuzugani	+	+	+	+	+	+	+
	<i>Chiromantes dehaani</i>	Kurobenkeigani			+	+	+		
	<i>Varuna litterata</i>	Oohiraisogani				+			
	<i>Sesarmops intermedium</i>	Benkeigani				+	+	+	+
	<i>Macrobrachium formosense</i>	Minamitenagaebi			+	+	+	+	+
	<i>Neocaridina denticulata</i>	Minaminumaebi				+	+	+	+
	<i>Procambarus clarkii</i>	Amerikazarigani				+	+	+	+
	<i>Palaemon (Palaemon) paucidens</i>	Sujiebi						+	+
Insecta									
Diptera	Chironomidae spp.	Yusurika spp.				+	+	+	+
Ephemeroptera	Baetis sp.	Kokagerou sp.					+	+	
Odonata	<i>Anax partenope julius</i>	Ginyanma						+	+

Table 3. Occurrence of fishes and amphibians at different sampling stations.

Taxa	species	Japanese name	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7
Pisces									
Rajiformes									
Dasyatidae	<i>Dasyatis akabei</i>	Akaei	+	+					
Cypriniformes									
Cyprinidae									
	<i>Cyprinus carpio</i>	Koi					+	+	+
	<i>Carassius gibelio langsdorfi</i>	Ginbuna					+	+	+
	<i>Zacco platypus</i>	Oikawa					+	+	+
	<i>Zacco temminckii</i>	Kawamutsu					+	+	+
	<i>Pseudogobio</i> (<i>Pseudogobio</i>) <i>esocinus</i>	Kamatsuka						+	+
		<i>esocinus</i>							
Cobitidae	<i>Misgurnus anguillicaudatus</i>	Dojou						+	
Anguilliformes									
Anguillidae									
	<i>Anguilla japonica</i>	Unagi			+	+	+	+	+
Siluriformes									
Siluridae									
	<i>Silurus asotus</i>	Namazus						+	
Beloniformes									
Adrianichthyida									
	<i>Oryzias latipes</i>	Medaka					+	+	+
Pisces									
Perciformes									
Mugilidae									
	<i>Mugil cephalus cephalus</i>	Bora		+	+	+	+	+	
Centrarchidae									
	<i>Lepomis macrochirus</i>	Bruugiru					+	+	
Gobiidae									
	<i>Luciogobius guttatus</i>	Mimizuhaze	+	+					
	<i>Acanthogobius flavimanus</i>	Mahaze		+	+				
	<i>Mugilogobius abei</i>	Abehaze		+	+				
	<i>Tridentiger obscurus</i>	Chichibu			+	+			
	<i>Odontobutis obscura obscura</i>	Donko					+	+	+
	<i>Rhinogobius giurinus</i>	Gokurakuhaze					+	+	+
	<i>Rhinogobius</i> sp. CB	Shimayoshinobori						+	+
	<i>Rhinogobius flumineus</i>	Kawayoshinobori						+	+
	<i>Chaenogobius urotaenia</i>	Ukigori					+	+	+
Tetraodontiformes									
Tetraodontidae									
	<i>Takifugu niphobles</i>	Kusafugu	+	+	+	+			
Amphibians									
Anura									
Ranidae									
	<i>Rana catesbeiana</i>	Ushigaeru					+	+	+
	<i>Rana limnocharis</i>	Numagaeru					+	+	+

to June). Settlement also occurred in November and January to February, though the number seemed to be much less than in mid autumn and late spring. Occurrence of crabs in the freshwater areas (Stations 5, 6 and 7) suggests that upstream migration did not necessarily take place immediately after settlement. Young crabs which settled in autumn (October and November) did not migrate upstream to the freshwater area soon after settlement, but remained in the tidal area during winter. Only one individual was collected at Station 5 on November 6. Furthermore, the larvae that settled in winter (January to Febru-

ary) could hardly survive and metamorphose to the crab stage. The growth of crabs that settled in autumn was also suppressed from December to February. Their upstream migration to the freshwater area (i.e. Stations 5, 6 and 7) started in March and came to end by June. They resumed growth in March and grew up to nearly 10 mm CW by June (about 8-9 months after settlement). In Contrast, the growth of the larvae that settled in May to June was very fast; they reached nearly 10 mm CW by September (about 4 months after settlement). These individuals migrated upstream to the freshwater area in July - August.

Fig. 4. Frequency distributions of carapace width of megalopa larvae (left columns) and young crabs (right columns) of *Eriocheir japonica* from July 1996 to September 1997.

Discussion

There were two processes in the upstream migration of *E. japonica*: settlement in the upper tidal area of the river (the 1st process) and migration from the tidal area to the freshwater area (the 2nd process). Megalopa larvae settled in the upper tidal area where other brackish or diadromous species also occurred. They metamorphosed to the crab stage (the first instar was approximately 2.0 mm in CW) and stayed for a while in this area while moulting and growing. Crabs commenced upstream migration to the freshwater area after they reached a minimum of 3.6 mm CW and were mostly in the range of 5 - 7 mm CW. Adult crabs of *E. japonica* migrate downstream from the freshwater area to the tidal river and sea area for mating and oviposition (Kobayashi & Matsuura 1995b). According to Ishida (1976), survival of zoea larvae declines with decreasing salinity during earlier stages (1st - 4th zoea stages). However, the trend is reversed in the later larval stages (5th zoea and megalopa stages) and the 1st instar crab can live in freshwater. The present study also indicates that the megalopa larvae and 1st instar crabs are tolerant of very low salinity. As with older crabs, megalopa larvae and young crabs were found hiding under the rocks or buried in the substrate. They are exposed to low salinity during the ebb tide (less than 0.5‰ in interstitial water, and 0‰ in river water).

In the Chinese mitten crab *E. sinensis* which is similar to the present species in terms of catadromous habit, settlement of megalopa larvae and their metamorphosis to the crab stage in the estuary, and their upstream migration to the freshwater area have been deduced from the results of rearing experiments (Anger 1991). However, the precise location and timing of settlement and migration have not been known.

Two peaks of larval settlement observed for *E. japonica* coincided with the periods of reproduction seen in the coastal zone. Kobayashi & Matsuura (1995b) reported that there were two groups of *E. japonica* differing in the timing of oviposition on the Tsuyazaki Beach, c. 3 km away from the Saigo River. Ovigerous crabs occurred from September to June in this area. It was estimated that a small number of

crabs oviposited mainly from September to December (the early-reproducing group), and a large number of crabs oviposited after December (the late-reproducing group). Both groups oviposited three times and the volume of egg mass decreased in later clutches. Crabs were physically exhausted and died during reproduction, and the number of ovigerous females decreased with time. Thus, temporal variation in the number of ovigerous females showed two peaks, a small one in September and a large one in December - January. Duration of embryonic development varied with water temperature, from nearly two weeks (oviposition in early September and mid June - early July) to three months (oviposition in January) (Kobayashi & Matsuura 1995a). Duration of larval development also varied with water temperature, from nearly two weeks (hatching in October) to more than three months (hatching in December) (Kobayashi, unpublished). Therefore, the first brood from the early-reproducing group (oviposition in September and hatching in September - October) coincided with the first peak of settlement in October. The second and third broods of the early-reproducing group (oviposition in October and hatching in October - November in the second brood, and oviposition in October - November and hatching in November - December in the third brood) coincided with settlement in late November and early January - early February, respectively. Settlement of the larvae of the first to the third brood of the late-reproducing group (oviposition in December - May and hatching in February - June) constituted the second peak of settlement in May to June.

Growth and upstream migration in the tidal area suggest that larvae and young crabs are sensitive to low water temperatures. They cannot grow and migrate upstream in winter when temperature is below 10°C. Thus, settlement in winter may be ineffective. Young crabs which settled in autumn must wait for an increase in water temperature in spring without growth in the upper tidal area. The growth rate of crabs also varied widely depending on water temperature.

Eriocheir japonica has a wide longitudinal distribution, from the lower to the upper reaches of a river (Kobayashi & Matsuura 1991, Kobayashi et al. 1997).

In view of this, upstream migration of young crabs constitutes an important process of their distribution along a river. Mass upstream migration of young crabs has been observed in several regions in Japan (Nonaka 1994, Kobayashi et al. 1997). As in the case of diadromous fishes, the construction of large weirs or dams may hinder the upstream migration of this crab (Miya & Hamano 1988). Recently, thick ropes have been installed by the side of some fishways to help the crab migrate through newly built weirs in some Japanese rivers (Nonaka 1994). The smooth surface of a fishway made of concrete presents much difficulty to benthic animals (e.g., shrimps) when they crawl against water flow (Hamano et al. 1995). Thus, hanging of ropes and an improvement in the substrate (i.e., increased roughness of its surface) may help crab migration. The present study indicated that young crabs (> 5.6 mm CW collected at Station 7) could pass through the weir of 1 m high without a fishway on the upper border of Station 6. In order to construct an effective fishway, it is necessary to know the relationships between crab size and mobility, and between size of crabs migrating in each area and size at the end of migration. Determining the timing of upstream migration is also necessary for the conservation of young crabs. Engineering works (e.g., control of salinity by opening and closing a floodgate, construction of a weir, digging of a river bed and removal of sediments) in the upper tidal (brackish water) area of a river may directly influence larval settlement and survival of young crabs. Because the 1st - 2nd instar crabs and young crabs occurring in winter season have limited mobility, they are vulnerable to disturbance in a local area. It is therefore desirable to consider counter-measures before engineering works are undertaken at the time when young crabs accumulate in tidal areas, in order to conserve *E. japonica* populations.

Release of young crabs has been carried out in several rivers of Japan for restocking *E. japonica* (Kobayashi et al. 1997). The present study suggests several conditions which are necessary for a successful release. First, the conditions of release (life stage, season and location) should closely follow those seen in natural migratory processes in order to increase their survival rate and to avoid the decimation of

natural populations. Second, crabs for releasing should be chosen from cultured crabs which have attained the minimum size of 5 mm CW with sufficient mobility. Third, the ideal releasing season is May to June when a large number of young crabs migrate upstream and their growth rate is high. Because the time of reproduction and migration in *E. japonica* does not vary greatly among rivers in Japan (Kobayashi et al. 1997), this may also be applicable in other localities. Last, the freshwater area of lower reaches is desirable as a release site. Young crabs disperse upstream from the lower reaches of a river and it has been estimated that population density decreases upstream (Kobayashi & Matsuura 1995c). It is desirable that crabs are released in areas where their population density is high and a large area remains to be colonized in the upper reaches.

There is a small number of reports on upstream migration of diadromous crustaceans including brachyuran crabs. For a grapsid crab *Varuna litterata*, mass upstream migration of megalopa larvae has been reported (Ryan & Choy 1990). The megalopa larvae of this crab swam upstream in the lower region of a river. Larvae of this species were also collected in the upper tidal area (Station 4) with the larvae and young crabs of *E. japonica* in the present study. This species may settle in the upper tidal area just as *E. japonica* does. Mass upstream migration of diadromous shrimps has also been observed in rivers (e.g., *Macrobrachium australiense* in Lee & Fielder 1979, *Caridina japonica*, *Paratya compressa compressa* and *Macrobrachium japonicum* in Hamano & Hayashi 1992 and Hamano et al. 1995). These shrimps belonging to Atyidae and Palaemonidae are anadromous species (Suzuki & Sato 1994). Oviposition and hatching occur in freshwater areas, and planktonic larvae flow downstream to tidal river and sea areas. Larvae grow in the sea and migrate back to the freshwater areas. We must also investigate the precise location of settlement, especially in relation to salinity levels, and the process of migration of these diadromous crustaceans for the effective maintenance of river ecosystems.

Acknowledgements

I wish to thank members of the Marine Biological Laboratory, Kyushu University, for their kind assistance. I also wish to thank Dr. Y. Takemon, University of Osaka Prefecture, for the comments that improved this paper.

摘 要

通し回遊種モクズガニ *Eriocheir japonica* (de Haan) の稚ガニ期の着底と遡上の過程を明らかにするため、福岡県宗像郡福岡町の西郷川下流域と隣接する海域(淡水域3定点, 河川感潮域3定点, 海域1定点)で1997年7月~1998年9月に月2回の割合で素手と手網による採集を行った。メガラバ幼生は河川感潮域の上部に着底しそこでカニに変態していた。1齢稚ガニは甲幅2mm程度であり, 甲幅3.6mm以上に成長したのちに淡水域への遡上を開始された。メガラバ幼生の着底時期は, 秋(10月)と晩春(5~6月)に2回のピークがみられたが, 11月や1~2月にも少数確認された。秋から初冬に着底した個体は冬の間は成長せず感潮域に留まっていた。水温が10℃以下に下がる冬に着底した幼生は, 変態できず生残できないことも明らかとなった。冬期感潮域に留まっていた稚ガニは, 淡水域への遡上を3月に開始し6月には終えた。また3月に水温が上昇すると成長を再開し, 6月にはほぼ甲幅10mmに達した(着底後8~9ヶ月後)。一方, 5~6月に着底した個体は淡水域への遡上を7月に開始して8月には終えており, 成長も速く9月には甲幅10mmに達した(約4ヶ月後)。このようにモクズガニの成長と遡上は河川感潮域の水温に強く影響されることが推察された。福岡では海域で繁殖に参加するモクズガニに産卵時期の異なる2群があり, これを幼生の着底時期と比較すると, 秋から冬に繁殖するグループの産んだ幼生が秋から冬にメガラバとして着底し, 一方冬から春に繁殖するグループからの幼生が, 初夏に着底していると推定された。河川感潮域での改修工事や堰の建設および稚ガニの放流事業は, 以上のようなモクズガニの着底と遡上のプロセスを考慮に入れて行うことが望まれる。他の回遊性甲殻類についても同様に, 回遊のプロセスを明らかにし保護事業に活かす必要があるだろう。

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