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Habitat preferences of shrimp (*Penaeus monodon*) in Kelantan Delta, Malaysia

Suharmili Rosle and Sakri Ibrahim

Abstract
The abundance study of shrimp population, their life stages and habitat preferences were carried out in Tumpat Waterways at Kelantan Delta, Malaysia. Shrimp trawl was used to collect the samples. The specimens were preserved in 10% formalin for species identification. Total length (TL) and carapace length (CL) were measured to determine their life cycle stages. Among five species recorded, *Penaeus indicus* and *Penaeus monodon* were found highly abundant in brackish water which accounted for 76 and 70 total numbers respectively. The juvenile and adult life stages were found most prominent in this study with *Penaeus monodon* found abundantly at *Rhizophora* sp. and *Nypa fruticans*.

Keywords: Shrimp, *P. monodon*, distribution, mangrove, Kelantan Delta

1. Introduction
Mangroves are one of the habitats in estuaries and shallow coastal waters that form dominant estuarine habitat types in most tropical areas [1]. They dominate tropical shores and offer vital services for provisioning, regulating, supporting, and cultural services to human [2]. In addition, different mangrove types such as riverine, fringing and basin provide specific services and support coastal fisheries to a different extent [2, 3]. Mangroves also act as shelters from predation and provide habitat complexity for many species [4, 5]. The long residence time of water in mangroves physically retains immigrant larvae and juveniles and thus supports fisheries production [6, 7]. Recently, numerous studies have been conducted to assess the abundance of juveniles as well as adult shrimps in mangrove areas [8 -10]. In addition, the study of shrimp populations in mangroves with other habitats have been reported by Robertson and Duke (1987) [11] and Mohd-Suffian *et al*., 2004 [12]. Some areas of Kelantan Delta are important in providing a basis for scientific study and numerous studies have been conducted at this delta by many researchers [13-16]. *Penaeus monodon* is one of the most important shrimp species in estuarine and mangrove areas [17]. To date, there is no report on *Penaeus monodon* distribution in Kelantan River Delta by any researcher. Hence, the objective of this study is to observe the distribution of *Penaeus monodon* at different stages of life cycle in the mangrove ecosystem of Kelantan River Delta.

2. Methodology
2.1 Location of study
The study was conducted at the Kelantan Delta, Tumpat, Malaysia. The mangroves (Latitude, N: 6°11'.30" to 6° 13'.30" and longitude, E: 102°10'.00" to 102°13'.30") are located in the east coast of Peninsular Malaysia (Kelantan State) facing South China Sea and covers an area of approximately 12km^2. There were 5 sampling stations with varying salinity levels recorded. Station 1 was marine, station 2, 3 and 4 were brackish while station 5 was freshwater.

2.2 Sampling protocol
In the present study, sampling strategy for penaeid shrimp was done based on Vance *et al*., 2002 [8]. Each microhabitat was sampled using shrimp trawls. Two to three tows were conducted along a 30m to 50m path by a boat at each sampling station. The trawling was operated about half an hour operations using a speed boat with 85 horse power (HP) outboard engine.
Shrimps were preserved in 10% formalin for further identification. Bottom water temperature,

salinity, pH, DO, and water depth were recorded before each tow using Hydrolab-Quanta multi-probe meter (OTT Hydromet, Germany). Shrimp taxonomy was categorized using Joubert (1965) [18] and Kensley (1972) [19] methods. The carapace length (CL) was measured using a stereomicroscope for small specimens, while larger specimens were measured by vernier caliper and ruler.

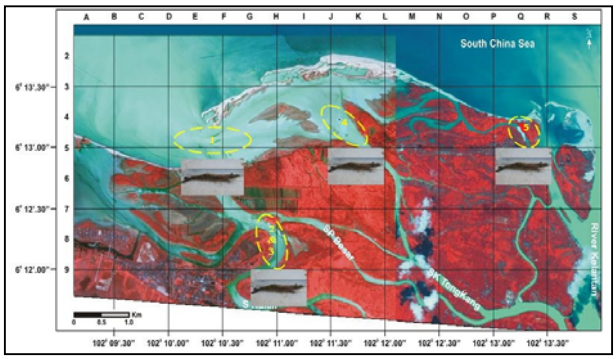

Fig 1: Location of sampling stations

2.3 Data analysis
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3. Results
There were 5 species of shrimp identified from all sampling stations comprising marine, brackish and freshwater environments. *Penaeus indicus* (76) and *Penaeus monodon* (70) were highly abundant followed by *Macrobrachium naso* (33) while both of *Sergestes sp*. and *Macrobrachium rosenbergii* presented only 1 individual (Table 1). In general, brackish water supported the highest number of species with 93 individuals. In this study, except for salinity, other water quality parameters were found to be almost similar. The number of *P. indicus* increased with the decreased of salinity while the number of *P. monodon* decreased as the salinity decreased.

Table 1: Number of species and water quality parameters at each sampling station.

	Station						
Species	**1 (marine)**	**2 (brackish)**	**3 (brackish)**	**4 (brackish)**	**5 (freshwater)**	**Total**	**%**
Penaeus monodon	34	18	14	3	1	70	38.67
Penaeus indicus	26	44	4	2	0	76	41.98
Macrobrachium naso	0	2	2	4	7	33	18.23
Sergestes sp	1	0	0	0	0	1	0.55
Macrobrachium rosenbergii	0	0	0	0	1	1	0.55
Total number of catch species	61	64	20	9	9		
Water quality parameters							
Temperature (°C)	28.35	27.70	27.50	27.55	27.70		
pH	7.68	7.60	7.50	7.50	7.05		
Dissolve oxygen (mg l^{-1})	5.10	5.80	5.05	6.05	5.85		
Salinity (mg l^{-1})	33.25	21.50	17.20	10.53	0.59		
Depth (m)	2.75	1.15	1.75	1.25	1.95		

Table 2 showed the life stages of *P. monodon* found in Kelantan Delta. Juveniles were mostly found in marine water while adults in brackish water. Table 3 showed the relations between shrimp abundance with types of vegetation in the delta.

Table 2: Number of juvenile (3 mm CL ≤ JV ≥ 50 mm CL) and adult (≥ 51 mm CL) *P. monodon* at different environmental areas. CL=carapace length, JV=Juvenile

	Marine		Brackish		Freshwater	
Species	**Juvenile**	**Adults**	**Juvenile**	**Adults**	**Juvenile**	**Adults**
P. monodon	33	1	21	14	0	1

Table 3: Shrimp abundance with vegetation type

Station	Stage of *P. monodon*		Types of vegetation
	Juvenile	Adults	
1 (Marine)	32	2	No dominant vegetation species
2 (Brackish)	7	11	*Rhizophora sp, Nypa fruticans*
3 (Brackish)	11	3	*Rhizophora sp., Nypa fruticans*
4 (Brackish)	1	0	No dominant vegetation species
5 (Freshwater)	2	1	*Hibiscus sp.* and *Acanthus sp*

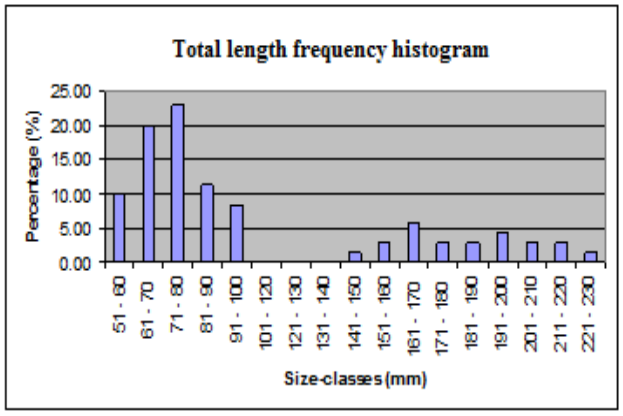

Fig 2: Total length frequency histogram of *P. monodon* in Kelantan Delta.

Figure 2 showed the total length distribution of *P. monodon*. This study found that the largest size of *P. monodon* ranged from 221 mm to 230 mm but the highest abundance of *P. monodon* was 71 mm to 80 mm.

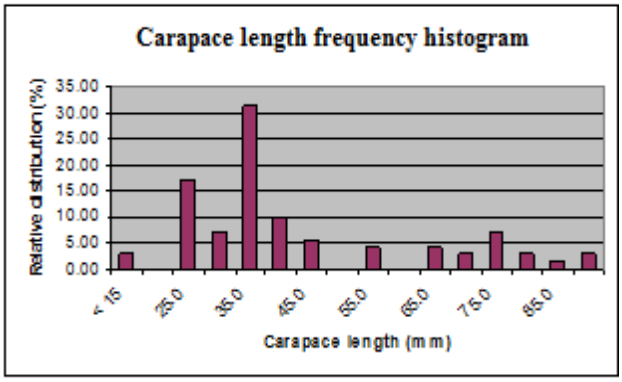

Fig 3: Carapace length frequency distribution of juvenile *P. monodon* caught during the study period at Kelantan Delta.

Figure 3 showed the carapace length frequency distribution of *P. monodon*. The highest value ranged between 35.0 mm to 40.0 mm while the second highest value was between 25.0 mm to 30.0 mm. The lowest value was observed at less than 15 mm.

4. Discussion

The present study showed that *P. indicus* and *P. monodon* were the most abundant species found in the Kelantan delta, accounted for 41.98 % and 38.67 %, respectively. On the other hands, *M. naso, M. rosenbergii* and *Sergestes sp.* accounted for 19.33 % of the total catch. This findings was in-agreement with earlier studies by Chong *et al*., 1990 [12] in *P. indicus*, and de Freitas (1986) [20] in *P. monodon*. The authors reported that Penaeid shrimp species have a preference for mangroves as nursery habitat in the Indo-Pacific region. In this study, *P. indicus* and *P. monodon* were highly abundant in brackish water compared to other areas. Dall *et al.* (1990) [21] reported that *Penaeus* and *Metapenaeus* spawn at sea and their post larvae shrimps moved to inshore and estuarine waters after a few months, while adults complete their life cycle in offshore. Other researchers have reported that the juveniles of banana prawns (*Penaeus merguiensis* and *P. indicus*), are found almost in mangrove-lined creeks and described as being highly mangrove-dependent [22- 24].

The shrimp population caught in the present study was dominated by juvenile and adult stages, which confirms the role of mangrove as nursery area for penaeid shrimps [25]. In this study, there were differences of area for juvenile and adult inhabitant. The juveniles were highly abundance in marine while the adults were in brackish environment. This findings found that different habitat preferences for a different stages of shrimp life cycle.

In general, the present study showed that brackish environments supported many shrimp species. *Penaeus monodon* was observed to adapt a wide range of salinity levels. Different ranges of salinity have been reported to support the survival and better growth performance of *P. monodon* [26-30].

Juveniles of *Penaus monodon* were found in highly abundant at marine and brackish water station compared to adult stage. This study was in agreement with the findings of Loneragan *et al*., 1998; Ronnback *et al*., 2004; Vance *et al*., 2002 [31, 23, 24]. The authors stated that smaller shrimps are normally to be less active swimmers compared to bigger shrimps, therefore their tendency to be transported to the mangrove edges and mud flats are high.

P. monodon were found to be abundance at areas was dominated by *Nypa fruticans* Wurmb and *Rhizophora* sp. *Nypa* palms is a mangrove palm that grows well in calm estuaries and coastal zones [32]. Mohd Nasir and Safiah Yusmah (2007) found that this fruit could be used as a potential source of natural antioxidant. *Rhizophora* sp are widely distributed throughout mangrove forest area in Peninsular Malaysia and are of economics importance in forestry and fishery industries [34]. The extensive root systems of mangroves create habitat heterogeneity and complexity, offering suitable foraging sites for juvenile fishes and protecting them from predators by reducing their visibility [35, 36].

5. Conclusion

The highest diversity of shrimp was found to be at brackish water environments. The shrimp distribution was highly influenced by the area, salinity and vegetation. The present study showed that the proportions of smaller shrimps are greater closer brackish water areas than freshwater. Adult shrimps occur in the subtidal areas, which probably act as a transition area during migration periods. *Penaeus monodon* distribution was influenced by salinity and are found abundantly at *Rhizophora* sp. and *Nypa fruticans* areas rather than other species of mangrove vegetation.

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