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Preliminary study of some decapod larvae in the Mae Klong Estuary, Samut Songkram Province

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Abstract

Decapod larvae are the major meroplankton in many coastal ecosystems, such as mangrove forests, seagrass beds, and estuaries. However, there is still a lack of decapod larvae diversity in Thailand. From March to April 2023, a study of some decapod larvae diversity in the Mae Klong Estuary, Samut Songkram, was investigated using a plankton net in 14 stations. Eight families were found. All crabs were zstage 1. The crab larvae were dominant at station 8, in which Grapsidae, Anomuna, and Ocypodidae were the dominant groups. The illustration and description of crab larvae in this area are provided.

Keywords
crab larva, *Brachyura*, plankton, Mae Klong Estuary, Samut Songkram

Introduction

Zooplankton are planktonic animals that cannot swim against water currents. They range from single-celled heterotrophic flagellates to complex metazoans. This can be classified as the ontogenetic classification. The zooplankton that live as planktonic organisms throughout their life are holoplankton, while those planktonic only some period of their lives are meroplankton (Williams, 1986).The meroplankton, including those that develop into nektons, such as fish or squid larvae, or those that transition into the sessile form, such as barnacles, corals, tunicates, or change into the benthic form, such as shrimp, crabs, and sea cucumber (Benfield, 2012). Due to the salinity fluctuation in the estuary, many decapods spawn outside of estuaries, such as freshwater shrimp *Macrobrachium* that spawn in the upper river. On the other hand, the shore crabs *Portunus pelagicus* migrate to offshore coastal areas to release their eggs into the water column, and the crab larvae migrate back to the estuaries and shallow-water areas (Onsri *et al*., 2024).

The Mae Klong River, situated in the western-central region of Thailand, flows through Kanchanaburi, Ratchaburi, and Samut Songkhram before it ultimately flows into the inner Gulf of Thailand. Along the river mouth in the Mae Klong Estuary. There are mangrove

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forests that provide the habitat and nursery ground for aquatic animals (Chaisanguansuk *et al*., 2023). This region features urban areas and zones dedicated to aquaculture, making it a significant hub for fishing and aquaculture activities (Chaisanguansuk *et al*., 2023). The study of meroplankton in this area is important not only for observation of the zooplankton diversity and distribution, but also because most of the meroplankton are economic species, including the crab larvae (Epifanio and Dittel, 1984). This study aims to investigate the diversity and abundance of crab larvae in Mae Klong Estuary, Samut Songkram Province.

Materials and methods

Study area

The sampling sites were in the Mae Klong River mouth, Samut Songkram Province. The sampling was carried out in April of 2023. The spatial sampling was performed in 14 stations, from upstream in Bang Khonthi District to the river mouth at Don Hoi Lot (Figure 1). A global position system (GPS) was used to determine the coordinates of the sampling sites. The physio-chemical environment, including temperature (°C), salinity, conductivity (µS/m), dissolved oxygen (mg/l), and pH, were measured in situ with a multi-parameter probe (EXO). The zooplankton was collected by horizontal tows using a plankton net with a mesh size of 330 µm at the same depth of the water sampling, at an average tow speed of 1 knot. A calibrated flow meter was used to estimate the volume filtered by each haul. The collected samples were immediately preserved, in situ, in a 70% ethanol solution for further analysis. In the laboratory, the organisms were identified to the lowest level taxa possible and counted under a stereoscopic microscope using appropriate identification keys (Chuaypanang, 1998 and Suwansanit, 2007). Abundances were expressed as ind./10 m^3 for all identified taxa.

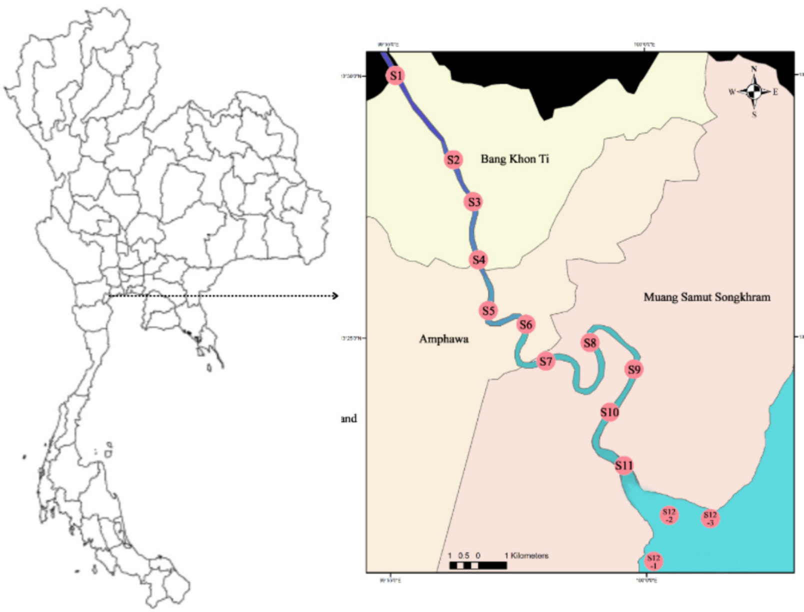


Figure 1. The sampling sites in Mae Klong Estuary, Samut Songkram.

Crab Identification

Crab identification was made by investigating the appendages without dissection. The characteristics used for identification included antennule, antenna, maxilla, maxillue, shape of carapace, spines on carapace, maxilliped and telson (Figure 2).

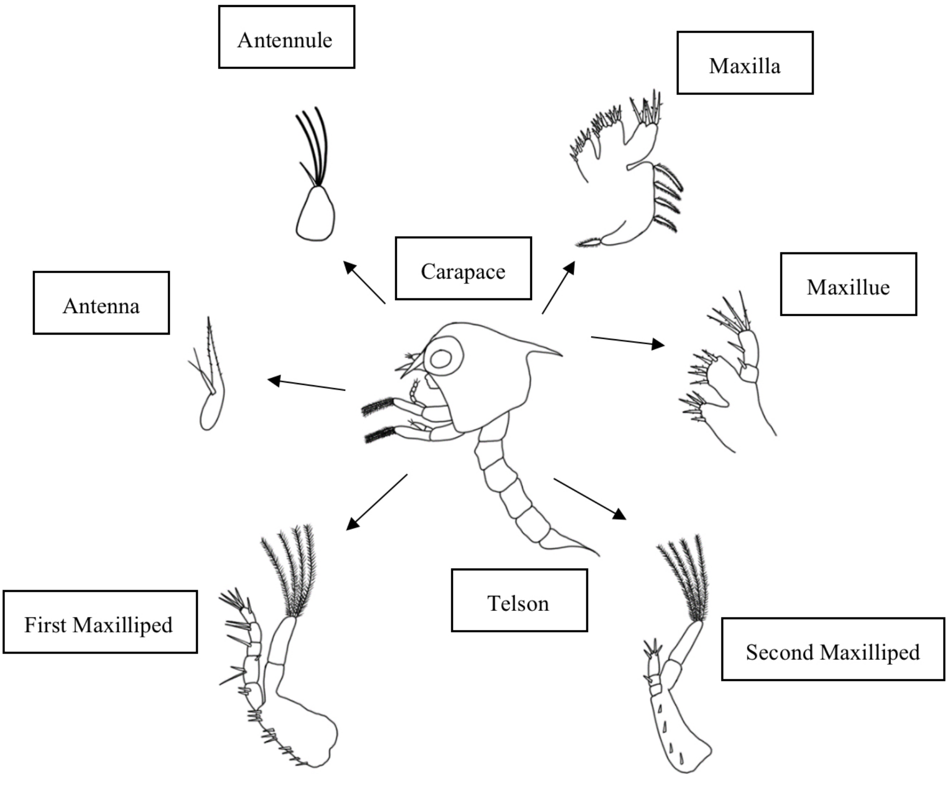


Figure 2. Crab zoea general characteristics used for identification (modified from Suwansanit, 2007).

Crab larval stage identification

Even the external morphology of crabs is different in each species, but the zoea stage of crab share similar characteristics. Larval identification of the stages was as follows, zoea 1–8 and megalopa. The appendages using for laval stage identification are included: antenna: the setae and development of endopod, exopod and protopod on antenna; maxillue: the setae on the basin and coxa of maxillae; maxilla: the scaphognathite setae on basin of maxilla; maxilliped: the number of natatory setae on the exopod of maxilliped (Table 1).

Table 1. Crab zoea stages identification (modified from Chuypanang, 1998).

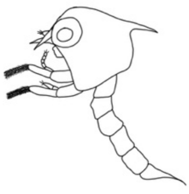
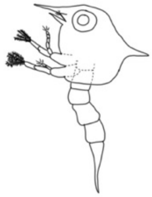
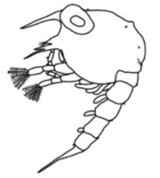
Zoea stage	Stage 1	Stage 2	Stage 3	Stage 4
Body				
Antennule				
Antenna				
Maxillue				
Maxilla				

Table 1. Crab zoea stages identification (modified from Chuypanang, 1998) (continue).

Zoea stage	Stage 1	Stage 2	Stage 3	Stage 4
First Maxilliped				
Second Maxilliped				

Result and discussion

Crab zoea diversity

A total of seven crab families were found. The dominant was Grapsidae, followed by anomuran larvae, and Ocypodidiae (Figure 3). All the crab larvae found in this work were zoea 1.

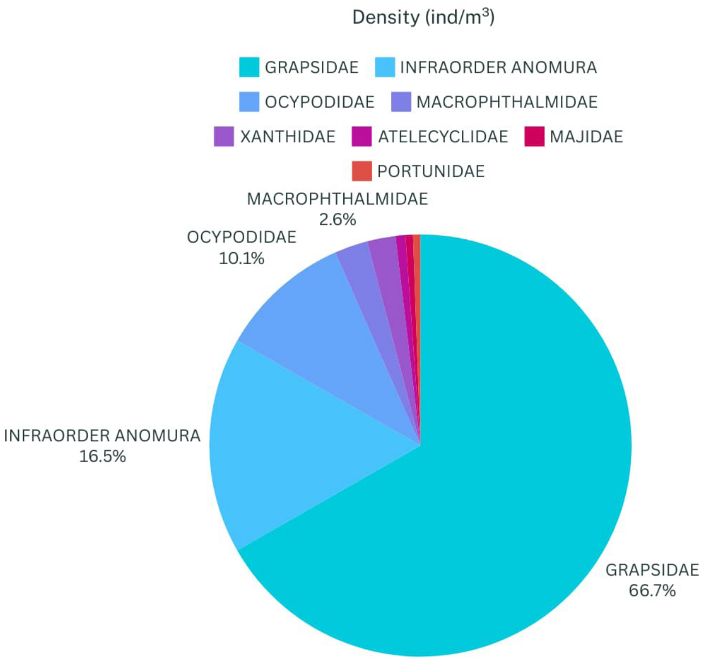


Figure 3. Some decapod larvae proportion in Mae Klong Estuary.

Infraorder Brabchyura

Family Atelecyclidae
(Figure 4)

Carapace markedly globular, with dorsal spine and rostral spine; both spines longer than carapace length; Antennal length equal to ¾, or more, of rostrum length, exopod shorter than protopod, with terminal setae and spines; swimming setae restrict to exopodite of first and second maxillipeds.

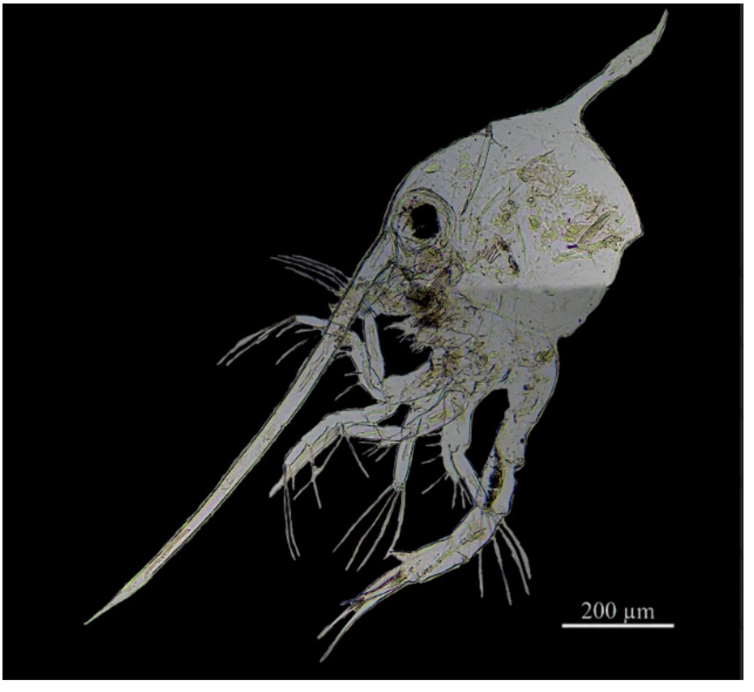


Figure 4. Zoea stage of family Atelecyclidae.

Abdomen thin and relatively short; abdominal segment 3 to 5 with lateral-posterior spines, whose lengths are notoriously more than half of the somite length. Telson furcated, armed with dorsal and lateral spines; pleonites 2 to 4 posterolateral process present.

Ecology. The atelecyclid crab larvae are mostly benthic and demersal species, with depth ranges from 0 to 1200 meters.

Family Grapsidae
(Figure 5)

Carapace markedly triangular, with dorsal spine and rostral spine; both of spines shorter than carapace length; antenna length equal ½, or less, of rostrum length, exopod shorter than protopod, with terminal setae and spines; maxilla endopod with 2+2 setae.

Figure 5. Zoea stage of family Grapsidae.

Abdomen thin and relatively short; abdomen segment 3 to 5 with short lateral posterior spinous processes or spines. Telson fork short, without accessory lateral spines, inner margin with three pairs of setae.

Ecology. The grapsid crab larvae are substrate-associated and commonly found at depths of 0–6 meters.

Family Majidae
(Figure 6)

Carapace mostly round or oval, anterior setae on inner lateral margin of carapace, with dorsal spine, rostral spine, and lateral spine; dorsal spine length double of carapace length; antenna length equal rostral spine, exopod length equal spinous process.

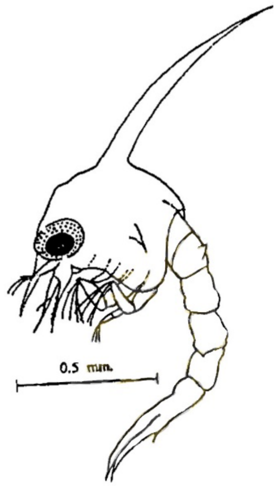


Figure 6. The zoea stage of family Majidae (modified from Chuaypanang, 1998).

Abdomen relatively long; abdomen segment 2 with large dorsal-lateral process; telson furcated and long, inner margin with 3 pairs of setae, posterior bend with triangular form.

Ecology. The marjid adult crab occupies various habitats, including benthic, demersal, and substrate associated.

Family Ocypodidae
(Figure 7)

Carapace markedly oval, with dorsal spine, rostral spine and lateral spine, curved posteriorly; both of spines length equal to ½, or more, of carapace length; antenna length shorter than rostral spine, biramous, exopod with two terminal simple setae.

Figure 7. Zoea stage of crab family Ocypodidae.

Abdomen relatively short; abdomen segments 2 to 3 with dorsal-lateral process, segments 3 to 5 with lateral spine; telson furcated, inner margin with 3 pairs of setae.

Ecology. The fiddler crab larvae are semi-terrestrial and can be found in mangrove forests, salt marshes and sandy or muddy sandy, mostly intertidal zone.

Family Portunidae
(Figure 8)

Carapace markedly rectangular, with dorsal spine, rostral spine and lateral spine; dorsal spine length equal carapace length, curved distally, rostral spine generally straight, lateral spine straight and short; basin of first maxilliped with 10 setae and maxilla endopod bilobed with 2+4 setae.

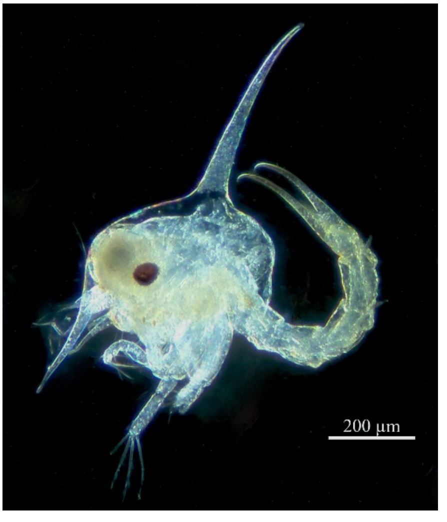


Figure 8. Zoea stage of crab family Portunidae.

Abdomen thick and long; abdomen segments 2 to 3 with dorsal-lateral process, segments 3 to 5 with large lateral spine; telson with dorsal and lateral spines on furcal rami, typically bifurcated into 2 long process, inner margin with 3 pairs of setae.

Ecology. The portunid crab larvae live on sandy or muddy substrates, as well as rocky shores for shelter. They are mostly found in the intertidal zone, within the depth ranges of 0 to 70 meters (although some species have been found at depths of 400m).

Family Xanthidae
(Figure 9)

Carapace mostly oval, with dorsal spine, rostral spine and lateral spine, dorsal spine and rostal spine longer than carapace length; Basin of first maxilliped with 10 setae and maxilla endopod bilobed with 3+5 setae.

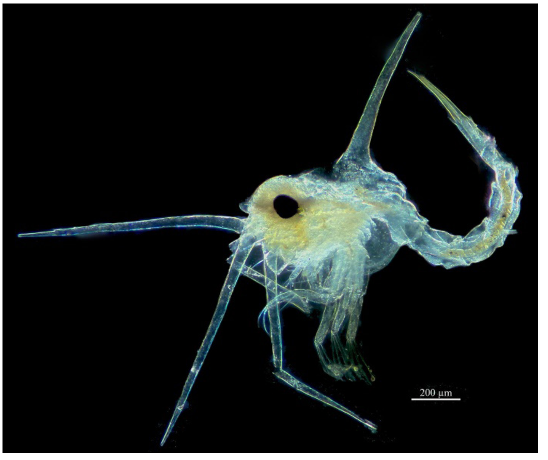


Figure 9. Zoea stage of crab family Xanthidae.

Abdomen long and slim; abdomen segments 3 to 5 with long lateral-posterior processes or spines; telson fork short, with dorsal and lateral spines on furcal rami.

Ecology The xanthid crab lavae are substrate-associated species. Most of them living in intertidal area at the depth of 0 to 10 meters range. Some species can be found at a depth of 50 meters.

Family Macrophthalmidae
(Figure 10)

Carapace markedly subquadrate, almost circular, with dorsal spine, rostral spine; antennal exopod well develop, narrow, similar in size, or longer than protopod, pleonal expansions on pleonite.

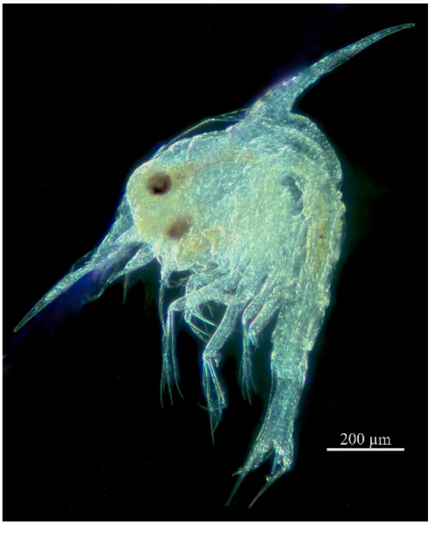


Figure 10. Zoea stage of crab family Macrophthalmidae.

Abdomen relatively short; furcated unarmed telson.

Ecology. The macropthalmid is a benthic crab that can be found at depths of 0 to 5 meters. The crab larvae are euryhaline, preferring brackish habitats.

Crab larvae distribution along Mae Klong Estuary

The crab family Grapsidae was the most dominant group, while the anomuran larvae were the common group in every station. The crab larvae were diverse outermost in the estuary (stations 8, 12.1, 12.2, and 12.3). The present work was like the work of Suwansanit (2007) and Chuaypanang (1998), in which the dominant group was the family Grapsidae. The average density in this work was also similar to Suwansanit (2007) (408-82680 ind/m^3) and Chuaypanang (1998) (543-27906 ind/m^3) (Table 2).

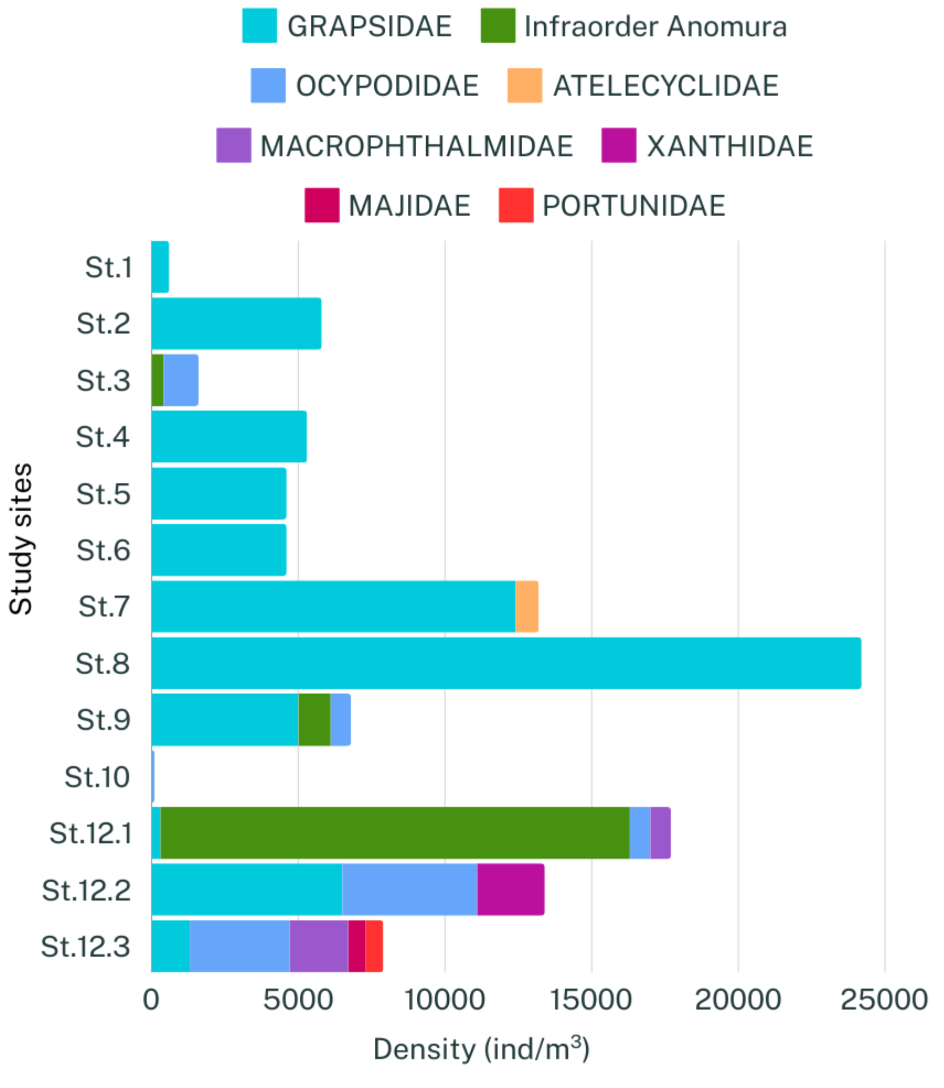


Figure 11. Some decapod larvae distribution along Maeklong Estuary.

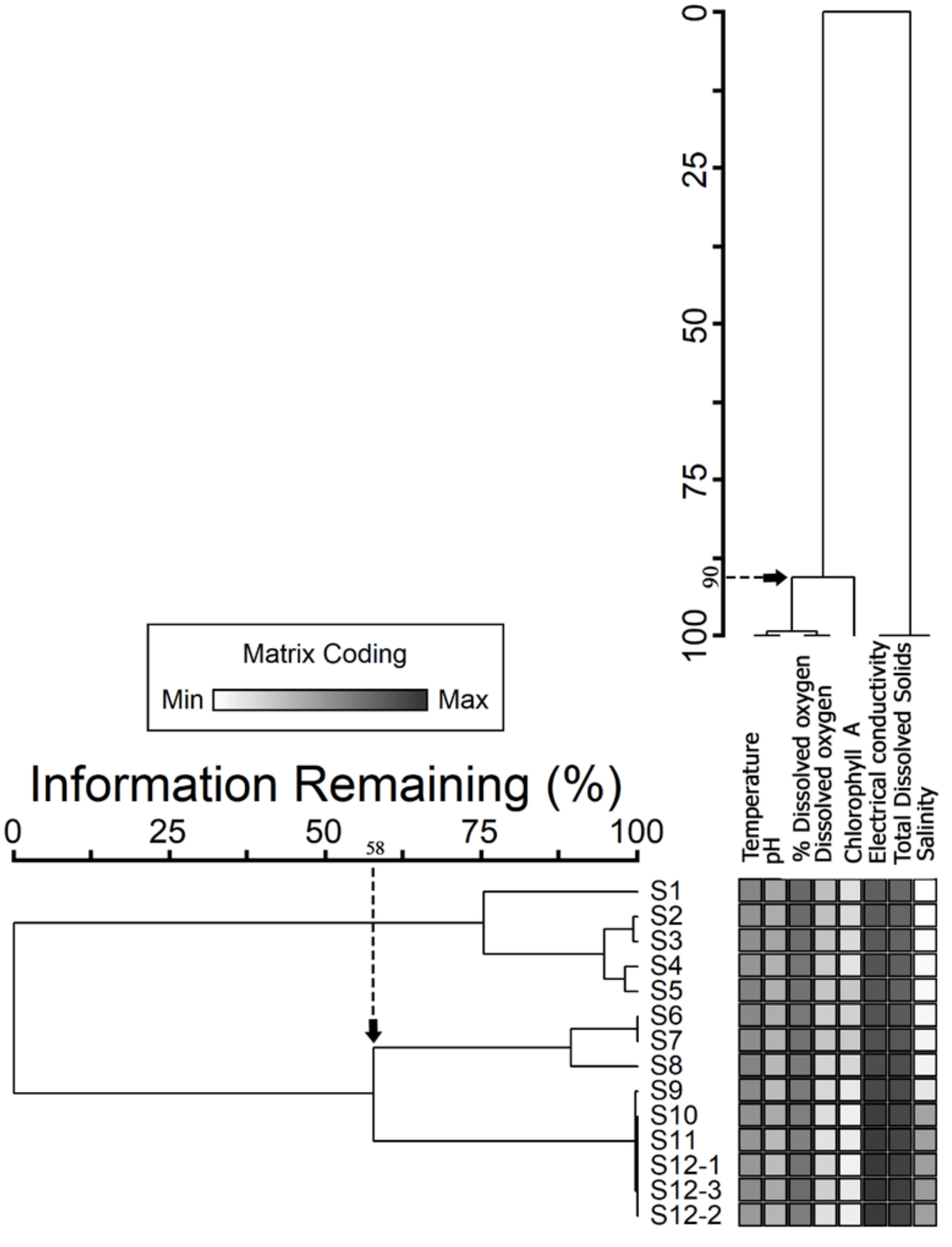


Figure 12. The Two-way Clustering analysis of environmental parameters in Mae Klong Estuary.

Table 2. Comparison of diversity and abundance of crab with other studies.

Study site	**Total of crab families**	**Families**	**Average density (ind/m^3)**	**Reference**
Mae Klong Estuary, Samut Songkram Province	7	Grapsidae, Ocypodidae, Atelecyclidae, Macrophthalmidae, Majidae, Xanthidae, Portunidae, Anomura	600–70600	Present study
Mangrove Forest, Pak Phanang District	3	Grapsidae, Ocypodidae, Portunidae	408–82680	Suwansanit (2007)
Mangrove Forest, Sikao District	12	Grapsidae, Ocypodidae, Xanthidae, Portunidae, Atelecyclidae, Pinnotheridae, Calappidae, Majidae, Leucoslidae, Dorippidae, Hymenosomatidae, Corystidae	543–27906	Chuaypanang (1998)

Crab larvae normally engage in vertical migration like other zooplankton to avoid predation (Hsieh *et al*., 2010). The salinity variation in an estuary has the major effect on crab larvae development. Crab larvae of each species sense the salinity from the cilia on the maxilliped and show different responses to different salinity levels (Warner, 1977). In the estuary, the younger crab or the newly hatched tolerates the salinity range of 2-20 psu while the older stage, like megalopa, prefers the salinity range of 20-40 psu (Foskett, 1976). Some true estuarine crabs, such as fiddler crabs, can tolerate the salinity range of 5–55 psu (Cuesta *et al.*, 1999), which might be the key to succession in mangrove forests (Suwansanit, 2007). Previous research mentions that pressure and gravity are the factors that affect crab larvae migration, but not for zoea 1, which mainly lives near the surface water for tidal migration (Queiroga *et al*., 2004). Most of the crab larvae in the zoea and megalopa stage movement up or down in the water column utilizes the vertical shear of ambient currents, resulting in horizontal transport. After the next stage of development, the crab larvae will respond more to the pressure and gradually change from negative to positive (Epifanio and Cohen, 2016).

Only zoea 1 was found in this work due to the sampling in the dry season in February, in which the salinity ranges from 0.1 –18.5 psu (Fig 2). The previous research of Suwansanit (2007) found that zoea 1 was high in high salinity, except for the Grapsidae, which are euryhaline species. The grapsid zoea 1 can survive in 15-30 psu (Duangngen and Chiampreecha, 2004; Sudtongkong, 1996; Islam and Uehara, 2005), while the adult can survive in 5–55 psu (Cuesta *et al*., 1999).

In this work, the outer estuary at stations 12.1–12.3 contained a high diversity crab larvae species, which were marine and brackish water species. The gravid female swims seaward to high-salinity areas, stimulating the hatchling. In the rainy season, other crab larvae stages could exist. (Suwansanit, 2007; José Paula, 2018; Kannika, 2005).

Summary

In Mae Klong Estuary, crabs were found in seven families: Grabsidae, Ocypodidae, Atelecyclidae, Majidae, Xanthidae, Macrophthalmidae, and Portunidae. Only zoea stage 1 was found. Salinity and osmolality are the main environmental factors affecting the abundance and diversity of crab larvae. The most abundant crab is the family Grapsidae, found in almost all study sites. The most diverse study sites were stations 12.1-12.3.

Acknowledgments

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References

Benfield, M. C. 2012. Estuarine Zooplankton. **Estuarine Ecology**. 285–302.

Chaisanguansuk, P., S. Ploenbuppa, T. Assawincharoenkij, S. Phantuwongraj, and A. Jiraphinyakul. 2023. Microplastic Contamination in the Coastal Environment: A Case Study from the Mae Klong River, Samut Songkhram. **Applied Environmental Research** 45(2): 1–12.

Chuaypanang, S. 1998. **Zooplankton in Mangrove Forest at Sikao District, Trang Province with Emphasis on Shimp and Crab larvae**. M.S. Thesis, Chulalongkorn University. (In Thai)

Cuesta, J. A., M. Schuh, R. Diesel, and C.D. Schubart. 1998. Abbreviated Development of Armases Miersii (Grapsidae: Sesarminae), a Crab That Breeds in Supralittoral Rock Pools. **Journal of Crustacean Biology** 19(1): 26-41.

Duangngen, T and B. Chiampreecha. 2004. **Breeding and larval rearing of mangrove crab, (*Episesarma mederi* H. Milne Edward, 1854) in different salinities**. Academic Document No. 65/2004 Marine Shrimp Culture Research and Development Center Samut Songkhram Province. Department of Fisheries. (In Thai)

Epifanio, C. E., and A.I. Dittel. 1984. Seasonal Abundance of Brachyuran Crab Larvae in a Tropical Estuary: Gulf of Nicoya, Costa Rica, Central America. **Estuaries** 7(4): 501–505.

Epifanio, C. E. and J.H. Cohen. 2016. Behavioral adaptations in larvae of brachyuran crabs: A review. **Journal of Experimental Marine Biology and Ecology** 482: 85-105.

Hsieh, H., L. Fan, C. Chen, J. Wu, and W. Liu. 2010. Effects of semidiurnal tidal circulation on the distribution of holo- and meroplankton in a subtropical estuary. **Journal of Plankton Research** 32(6), 829-841.

Islam, Md. And Uehara, T. 2005. Larval settlement of the sesarmid crab *Neopeisesarna Iafondi* (Jaquinot and Lucas, 1853) In The Mangrove Estuaries of the Ryukyu Islands, Japan. **In Evvironmental Physiology Conference** (abstract only).

Onsri, N., I. Sivaipram, P. Boonsanit, K. Sagulsawasdipan and S. Saramul. 2024. Larval Dispersal Modelling of the Blue Swimming Crab *Portunus pelagicus* (Linnaeus, 1758) from the Crab Banks along the Coast of Trang Province, Southern Thailand. **Water** 16, no. 2: 349.

Queiroga, H. and J. Blanton. 2004. Interactions Between Behaviour and Physical Forcing in the Control of Horizontal Transport of Decapod Crustacean Larvae. **Advances in Marine Biology** 107–214.

Paula, J. 2018. Keys and bibliography for the identification of zoeal stages of brachyuran crabs from the Western Indian Ocean. **Western Indian Ocean Journal of Marine Science** 17(1): 13-51.

Queiroga, H and Blanton, J. 2005. Interactions Between Behavior and Physical Forcing in the Control of Horizontal Transport of Decapod Crustacean Larvae. **Advances in Marine Biology. Vol 47**, pp. 109-214.

Sudtongkong C. 1996. **Habitat Selection, Food Preference and Fishery Biology of Mud Crab Scylla Serrata (Forskai, 1775)** in KlognNgao Mangrove Forest, Ranong Province. M.S. Thesis, Chulalongkorn University. (In Thai)

Suwansanit T. 2007. **Development and Recruitment of Grapsidae Crabs Neoepisesarma mederi (H. Milne Edward, 1853) in Pak Phanang Mangrove Forests, Nakhon Si Thammarat Province**. M.S. Thesis, Chulalongkorn University. (In Thai)

Warner, G.F. 1977. **The Biology of Crabs**. Paul Elek (Scientific Books). London. 202 pp.

Williams, R., Collins, N.R. Seasonal composition of meroplankton and holoplankton in the Bristol Channel. Marine Biology 92, 93–101 (1986).