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Research Article

Occurrence of Pedunculate Barnacle, *Octolasmis* spp. in Blue Swimming Crab, *Portunus pelagicus*

Tingkat Kejadian Pedunculate Barnacle, *Octolasmis* spp. pada Rajungan, *Portunus pelagicus*

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Abstract

Barnacles are symbiont and harm to the crabs when they are in large numbers. They will affect the respiration, normal activity and growth of the crabs. The prevalence, mean intensity and identification of pedunculate barnacle, *Octolasmis* spp. on blue swimming crab, *Portunus pelagicus* from coastal area of Kuala Terengganu were studied. The site specificity of the different species of *Octolasmis* attached was examined. The crabs were measured and weight. The crabs were euthanized by put in ice until no movement. The *Octolasmis* were observed from the surfaces and gills or brachial chamber. The *Octolasmis* were observed from each gill. The prevalence and mean intensity were calculated. The *Octolasmis* were preserved in 70% alcohol and mounting using glycerine jelly to make permanent slide. A total of all 13 crabs were infested by four species of *Octolasmis* which is 218 *Octolasmis angulata*, 191 *Octolasmis warwickii*, 16 *Octolasmis tridens* and 218 *Octolasmis lowei*. *Octolasmis angulate* showed highest prevalence (84.62%) and lowest prevalence was *O. lowei* (23.08%) *and O. warwickii* (23.08%). The barnacles were attached to the gill, carapace, abdomen and also walking legs. Barnacle occurred most frequently on the gill part by having 371 (57.70%) barnacles compared to other areas, 272 (42.30%) barnacles. The distributions of barnacle in this study suggest distal areas are more susceptible in infestation by *Octolasmis* spp. However, they did not show site specificity on the gill areas because it depends on the water current.

Abstrak

Barnacle (teritip) adalah simbion yang dalam jumlah besar akan membahayakan kepiting. Teritip tersebut berpengaruh pada pernapasan, aktivitas normal dan pertumbuhan kepiting. Prevalensi, intensitas rata-rata dan identifikasi pedunculate barnacle, *Octolasmis* spp. pada rajungan, *Portunus pelagicus* dari daerah pesisir Kuala Terengganu telah diteliti. Kekhasan lokasi dari berbagai spesies *Octolasmis* telah diperiksa. Kepiting telah diukur dan ditimbang. Kepiting dieuthanasi dengan cara dimasukkan kedalam es sampai tidak bergerak. *Octolasmis* diamati dari permukaan tubuh dan insang (*branchial chamber*). *Octolasmis* diamati pada tiap insang. Prevalensi dan intensitas rata-rata dihitung. *Octolasmis* diawetkan dalam alcohol 70 % dan *mounting* menggunakan Jeli gliserin untuk membuat slide permanen. Semua kepiting 13 ekor telah terinfestasi oleh empat spesies *Octolasmis*, yaitu 218 *Octolasmis angulata*, 191 *Octolasmis warwickii*, 16 *Octolasmis tridens* dan 218 *Octolasmis lowei*. *Octolasmis angulate* menunjukkan prevalensi paling tinggi (84,62%) dan prevalensi paling rendah adalah *O. lowei* (23,08%) dan *O. warwickii*(23,08%). Teritip menyerang insang, karapas, abdomen dan juga kaki jalan.Teritip paling sering ditemukan pada bagian insang 371 ekor (57,70%) dibandingkan pada bagian lain, 272 ekor (42,30%). Distribusi teritip pada penelitian ini menunjukkan bahwa bagian *distal* lebih rentan mengalami infestasi *Octolasmis* spp. Namun, teritip tidak menunjukkan kekhasan lokasi pada daerah insang bergantung pada arus air.

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1. Introduction

Crustaceans become a significant species led to a growing interest in the aquaculture. In Malaysia marine fishery, the total landings of crabs are 3,745 tonnes in 2010 and increased to 5,579 tonnes in 2013. Johor has been the major areas for crabs in Malaysia and contributing about 2,929 tonnes of the total production 18,072 tonnes in period 2010 until 2013 (DOF, 2014). Most of the edible crabs caught in the marine water regions belong to the family Portunidae. Because of the increasing demands from all over the world, crustacean fisheries productions are undergoing a significant global expansion. The high nutritive value and good in market price, many countries in Asia like China (Lai *et al*., 2010), India (Soundarapandian *et al*., 2007; Bhat *et al*., 2011), Japan (Hamasaki *et al*., 2011), Thailand (Nitiratsuwan *et al*., 2010), Indonesia (Rejeki, 2007) and Malaysia (Ikhwanuddin *et al*., 2012) are actively involved in *P. pelagicus* fisheries commodity.

Portunus pelagicus commonly live in a wide range of inshore and continental shelf areas, including sandy, muddy and seagrass habitat. Unfortunately, the disease factor became one of the most common problems that can immobilize the crustacean aquaculture sector. Thus, it was affect the crustacean production. Themost study, diseases problem are related to the presence of pathogenic organisms. But in some cases, the present of barnacle from *Octolasmis* spp. usually found on crabs and cause significant damage to the host. The calcified carapaces of the crabs appear one of the suitable mobile habitats for attachment of this barnacle. They will become pathogenic and cause harm to their host when it present in large numbers on the crabs (Rohde, 1991). As reported, the barnacles's attachment in crabs does not kill the crab but it may affect the crab respiration, normal activity and normal growth of the crabs (Sinduja *et al*., 2013). Thus, this study was observed the prevalence and mean intensity of the *Octolasmis* spp. found on the crabs, and identify of the *Octolasmis* spp. found. The site specificity of the different species of *Octolasmis* attached was examined in order to know whether there are differences of distribution between the species.

2. Materials and Methods

2.1 Portunus pelagicus samples

Portunus pelagicus were collected from Kuala Terengganu coastal area and brought to Parasitology Laboratory, Institute of Tropical Aquaculture for examination. A total of thirteen crabs were examined because of difficulty to catch the crabs during the raining season. The weights of the crabs were measured to the nearest gram (g) by using a digital electronic balance of 0.1g sensitivity. The carapace width of crabs were measured from the tip of the left dorsal spine to the tip of the right dorsal spine (Bastami *et al*., 2012). Carapace lengths of crabs were measured to the nearest centimeter (cm) from the edge of the frontal region to the tip of the carapace back wall using a vernier caliper (Bastami *et al*., 2012). The crabs were pitched by put in ice for a few minutes or until no movement observed.

2.2 Octolasmis spp site specificity

Dorsal and ventral external surfaces of the carapace and appendages of each crab sample were examined and observed for the barnacles. The site of barnacle attachment and number of individual barnacle on each crab found on the external area were recorded. The barnacles were fixed and preserved in 70% alcohol (Ihwan *et al*., 2014). The barnacles were mounting using glycerine jelly to make a permanent slide.

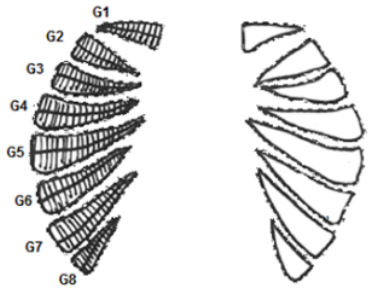

Figure 1. Gill division of *P. pelagicus* (Ihwan *et al*., 2014)

The carapace was removed gently by using forceps for allowing the inspection of barnacle on the internal area (Kumaravel *et al*., 2009). The gills were divided to left and right by followed method by Ihwan *et al*., (2014). It was labeled as G1 until G8 (Figure 1). Each gill was divided into three parts; distal, medial, and proximal. The gills were observed under a dissecting microscope for the numbers of barnacle attachments. The barnacles were removed by using forceps and preserved in 70% alcohol and mounting by using glycerine jelly for permanent slide.

2.3 Identification of Octolasmis spp.

The capitulum length, peduncle of the barnacle and calcareous plates including branched scutum, carina

and the presence of tergum were observed. The length and shape of calcareous plates were recorded. Barnacles have identified the species based on the description of the morphological characteristics by Ihwan *et al*., (2013, 2014) and Jeffries *et al.,* (2005). The good conditions of *Octolasmis* spp. specimens were selected for the drawing process. All drawings were made by using a compound microscope attached with Lucida camera. The drawing measurements were in the nearest micrometers (µm). The photo of *Octolasmis* spp. were taken by using research compound microscope (Nikon Eclipse 80i) with NIS-D Element programme.

2.4 Prevalence (P) and intensity (I) of Octolasmis spp.

The entire barnacles that have been collected were analyzed for the prevalence and intensity for each crab. The prevalence and intensity for barnacle found from each gill crab according to their species. The calculation of prevalence (P) and mean intensity (I) were calculated according to the formula of Margolis *et al*., (1982).

3. Results and Discussion

3.1 Morphological identification of Octolasmis spp. *found on P. pelagicus*

There are four species of barnacle in the genus *Octolasmis* spp. have been identified by comparing their calcareous plates which including scutum and carina; they are *Octolasmis angulata* (Figure 2), *Octolasmis warwickii* (Figure 3), *Octolasmis tridens* (Figure 4), and *Octolasmis lowei* (Figure 5). The prevalence and intensity of the barnacle infection are 92.3% and 49.46% respectively, which are 443 barnacles infect male and 200 barnacles infect female crabs. However, the distributions of *Octolasmis* spp. on crabs were different. *Octolasmis angulata* showed the highest prevalence (84.62%) followed by *O. lowei* (23.08%), *O. tridens* (30.77%), and *O. warwickii* (23.08%). The different species showed the different value of mean intensity, *O. angulata* (16.8) and *O. lowei* (16.8) showed the highest intensity (16.8) followed by *O. warwickii* (14.7) and *O. tridens* (1.2).

This study examined the barnacle as an ectosymbionts on blue swimming crab, *Portunus pelagicus* from coastal area of Kuala Terengganu. From all barnacles that have been observed, four species of pedunculate barnacle genus *Octolasmis* were found and have been identified by comparing their different shape of scutum and carina. Usually, the morphology identification depends on the shape of calcareous plates (Jeffries and Voris, 1996).

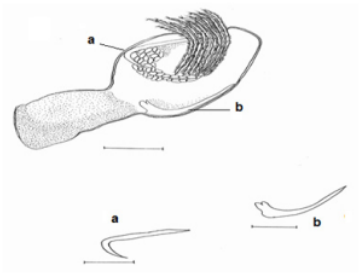

Figure 2. *Octolasmis angulate*: whole body, (a) Scutum and (b) Carina (scale bar = 50µm)

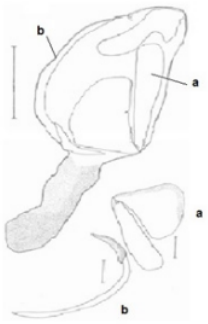

Figure 3. *Octolasmis warwickii*: whole body, (a) Scutum and (b) Carina (scale bar = 50µm)

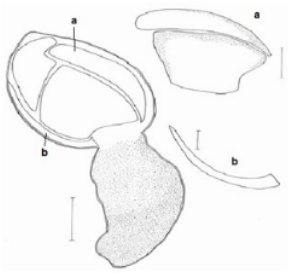

Figure 4. *Octolasmis tridens:* whole body, (a) Scutum and (b) Carina (scale bar = 50µm)

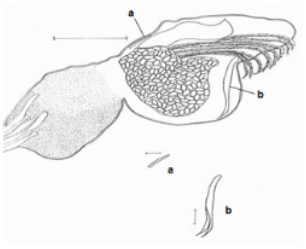

Figure 5. *Octolasmis lowei:* whole body, (a) Scutum and (b) Carina (scale bar = 50µm)

Octolasmis angulata has different shape of calcareous plates with long shape. It has capitulum oval shape and partially calcified with 3 plate (Ihwan *et al*., 2014). *Octolasmis warwickii* by having 5 capitular plates, 2 scuta, 2 terga and a carina (Voris and Jeffries, 1997). From the previous study, there were five *Octolasmis* species recorded from portunid crabs in the Northern Gulf of Thailand (Jeffries *et al*., 2005). The following species are *Octolasmis angulata*, *Octolasmis cor*, *Octolasmis lowei*, *Octolasmis neptuni*, *Octolasmis tridens,* and *Octolasmis warwickii*. It were reported that *Octolasmis angulata* was found on the gill chambers of species of the families Calappidae, Palinuridae and Portunidae from the Bay of Bengal, Arabian Sea, Malay Archipelago and off Madras. According to Jeffries *et al*., (2005), 10 species of genus *Octolasmis* have been recorded in South East Asia which attached on a living organism, *Octolasmis angulata*, *Octolasmis bullata*, *Octolasmis cor*, *Octolasmis lowei*, *Octolasmis neptuni*, *Octolasmis tridens*, *Octolasmis warwickii* and three unidentified species.

3.2 Site specificity of Octolasmis spp on P. pelagicus

The higher infestation rate of *Octolasmis* species was recorded by *O. angulata and O. lowei,* both are 33.9%. The *O. warwickii* is 29.7% and *O. tridens* is 2.5%. *Octolasmis angulata* showed the highest number of infestation on other areas such as carapace, legs, and abdomen are 70 *Octolasmis*. For the gills area preference, gill number 4 (G4) showed the highest number of *Octolasmis angulata* attached (n= 33). The *Octolasmis angulata* are commonly attached in the range gill number 3 to 8 (G3, G4, G5, G6, G7, and G8). It majorly distributed on the distal part for both gills (Table 1; Figure 6).

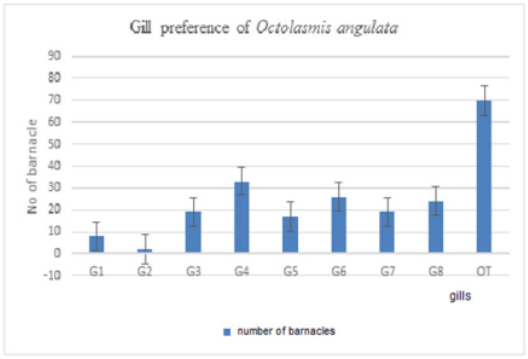

Figure 6. Gill preferences of *Octolasmis angulata*

The total number of *Octolasmis angulata* infested on the gills were 149. For *O. warwickii*, other areas such as carapace, leg, and abdomen also showed the highest number of barnacle infestation, 188 barnacles. For gill area, gill number 2 (G2) was the only gill that infected by barnacles which is 3. It distributed on the distal, proximal and medial part for both gills (Table 2; Figure 7).

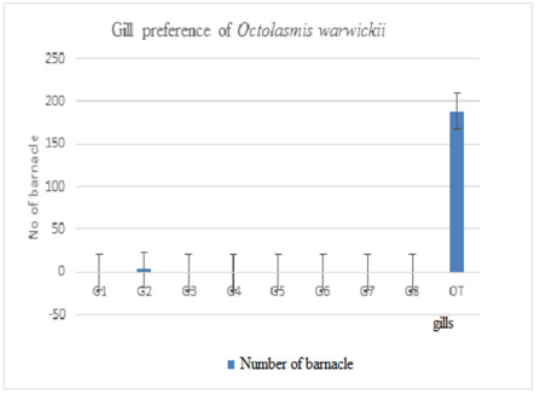

Figure 7. Gill preference of *Octolasmis warwickii*

For *O. tridens,* other areas such as carapace, leg, and abdomen showed the highest number of barnacle which is 9 infested on it. For gill area, gill number 4 (G4) showed the highest number of *O. tridens* attachment, 4 barnacles. These barnacle species are commonly attached in the gill number 2, 3, 4 and 7 (G2, G3, G4, and G7). It majorly distributed on the distal part for both gill (Table 3; Figure 8).

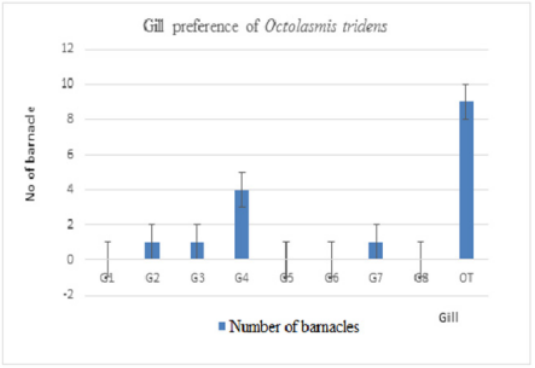

Figure 8. Gill preference of *Octolasmis tridens*

For *O. lowei*, gill number 6 (G6) showed the highest number of infestation, 42 barnacles. For gill area, these barnacle species are commonly attached in the range gill number 1 to 8 (G1, G2, G3, G4, G5, G6, G7 and G8). These species are majorly distributed on the distal part for both gills (Table 4; Figure 9).

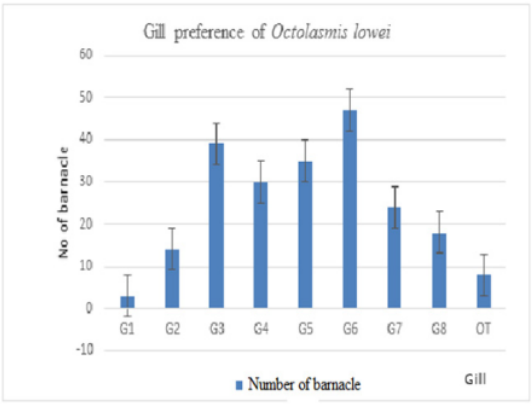

Figure 9. Gill preference of *Octolasmis lowei*

horseshoe crabs, coral, mollusks, sea snakes and fish (Jeffries and Voris, 1996; Amber *et al*., 2014; Tan *et al*., 2011). However, six barnacle species of the genus Octolasmis which are *Octolasmis angulata*, *Octolasmis cor*, *Octolasmis lowei*, *Octolasmis neptuni*, *Octolasmis tridens*, *Octolasmis warwickii* were reported in crabs and lobsters (Jeffries *et al*., 2005). There was more barnacle on the gill of crabs. It could be more fouled because gill was a better available to the settling of barnacle from larval stages (Bastami *et al*., 2012). Our results showed the distribution of the *O. angulata, O. warwickii, O. tridens* and *O. lowei* are randomly among the gill area. For gill as site specificity study, the highest abundance of barnacle was recorded in gill number 3 (G3) to gill number 6 (G6). There were observed that only *O. angulata* and *O. lowei* were found at proximal, distal and medial part.

Table 1. The distribution of *Octolasmis angulata* attached on the gill area of *Portunus pelagicus*.

Gill number	Proximal	Medial	Distal	Total
G1	-	-	-	-
G2		1	-	1
G3	1	-	-	1
G4	-	-	4	4
G5	-	-	-	-
G6	-	-	-	-
G7	-	-	1	1
G8	-	-	-	-
TOTAL	1	1	5	7

Most species within the genus *Octolasmis* colonize on host species usually decapods. For mean intensity, both *O. angulata* and *O. lowei* showed the highest mean intensity (16.8). The infestation occur entire body of the *P. pelagicus* such as gill, abdomen and the carapace area. Earlier study reported that the *O. angulata* has minimum value of intensity (11.0) in *P. pelagicus* and *O. warwickii* has 14.3 % value of intensity (Kumaravel *et al*., 2009). The observation suggest that infestation rate of *Octolasmis* differ between species and location.

Most barnacle species are typically very selective as to the site of attachment on the body of the host (Voris *et al*., 1994). Sinduja *et al*., (2013) was mentioned the stalked barnacles attach in various species and various region. The *Octolasmis* was reported attached to many decapods and isopod crustaceans, *Octolasmis tridens* preferred the proximal and distal part of gill only. The patterns of the distribution of barnacle for this study are more to left and right part of the gill area or proximal and distal part. In this study, it showed certain *Octolasmis* spp. only specified to certain part of the gill. Shazia and Javed (2017) was observed that the *Octolasmis* was concentrated on the proximal and medial parts of the gills rather than distal. The attachments of barnacle influenced by certain factor, for example the current or water flow through gill (Voris *et al*., 1994). In crabs, most of the water enters through the openings at the bases of the chelipedes and through pores situated in between walking legs. Then, water enter the crab hypobranchial chamber through opening at the bases of thoracic appendages, this occurs as results of pressure created (Shazia and Javed, 2017). The water flows was influenced the site selection of *Octolasmis* spp. attachment. Mostly the *Octolasmis* was distributed

Table 2. The distribution of *Octolasmis warwickii* attached on the gill area of *Portunus pelagicus*.

Gill number	Proximal	Medial	Distal	Total
G1	-	-	-	-
G2	1	1	1	3
G3	-	-	-	-
G4	-	-	-	-
G5	-	-	-	-
G6	-	-	-	-
G7	-	-	-	-
G8	-	-	-	-
TOTAL	**1**	**1**	**1**	**3**

Table 3. The distribution of *Octoclasmis tridens* attached on the gill area of *Portunus pelagicus.*

Gill number	Proximal	Medial	Distal	Total
G1	-	-	-	-
G2		1	-	1
G3	1	-	-	1
G4	-	-	4	4
G5	-	-	-	-
G6	-	-	-	-
G7	-	-	1	1
G8	-	-	-	-
TOTAL	**1**	**1**	**5**	**7**

Table 4. The distribution of *Octoclasmis lowei* attached on the gill area of *Portunus pelagicus*

Gill number	Proximal	Medial	Distal	Total
G1	-	-	3	3
G2	7	4	3	14
G3	16	3	23	42
G4	9	3	17	29
G5	15	3	22	40
G6	9	4	29	42
G7	6	-	17	23
G8	-	-	19	19
TOTAL	**62**	**17**	**133**	**212**

within branchial chambers of crabs because of the water flows into the branchial chamber. However, the attachment of Octolasmis on crabs also depend on the behaviour. Walker (2001) was found that O. angulata principally attached to the cuticle of the anterior chamber wall in the epibranchial space compared to the gills of *Charybdis callianasa. Charybdis callianasa* behaviour is frequently buries itself into soft bottom in nature. Thus, the buried position make the respiration current is likely to be reversed with water entering through the epibranchial space and leaving through the openings at the bases of chela and legs.

4. Conclusion

In conclusion, four different species of *Octolasmis* spp. have been identified and described by comparing to the previous study. All samples that have been identified up to species are *O. angulate, O. warwickii, O. tridens,* and *O. lowei*. Basically, the distribution of *Octolasmis* spp. did not show their specific gill attachment but the previous study showed the specific gill attachment. Generally, site specificity for the *Octolasmis* spp. mostly depend on the water current and their abundance according to the species which attach earlier. Besides, their natural surrounding will affect the infestation rate.

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References

Amber, K.G., Flint, M., & Paul, C. M. (2014). An antemortem guide for the assessment of stranded Australian sea snakes (hydrophiinae). *Journal of Zoo and Wildlife Medicine*, 45(4): 755-765

Bastami, A., Najafian, M., & Hosseini (2012). The distribution of the barnacle Epizoite, Chelonibitapatula (Ranzani) on blue swimmer crab, Portunuspelagicus. *World Applied Science Journal,* 20: 236-240.

Bhat, B. A., Ravichandran, S., & Allayie, S. A. (2011). Influence of the eyestalk hormones on the metabolism and ionic regulation of the Crab *Portunus pelagicus* (Lineaus, 1857). *Journal of Biological Sciences,* 11: 203-209

DOF: Department of Fisheries. Fisheries Statistics of Malaysia (2014). Fisheries Statistics of Malaysia, Fishery Economic Division, Malaysia.

Hamasaki, K., Obata, Y., & Kitada, S. (2011). A review of seed production and stock Enhancement for commercially important portunid crabs in Japan. *Aquaculture International,* 19: 217-235.

Ihwan, M. Z., Ikhwanuddin, M., & Marina, H. (2014). Morphological distribution of Pedunculate Barnacle *Octolasmis angulata* (Aurivillius, 1894) on Wild Mud Crab Genus *Scylla* from Setiu Wetland, Terengganu Coastal Water, Malaysia. *Journal of Fisheries and Aquatic Sciences*, 9: 366-371

Ihwan, M. Z., Ikhwanuddin, M., & Marina, H. (2013). Morphological characteristic of pedunculate barnacle attached on the gill of wild mud crab, *Scylla olivacea* from Setiu Wetland Terengganu, Malaysia. In: The 22st Scientific Conference of the Microscopy Society of Malaysia, Terengganu, Malaysia.

Ikhwanuddin, M., Azra, M. N., Talpur, M. A. D., Abol-Munafi, A. M., & Shabdin, M. L. (2012). Optimal Water temperature and salinity for production of blue swimming crab, *Portunus pelagicus* 1st day juvenile crab. *Aquaculture, Aquarium, Conservation & Legislation.* 5: 4-8.

Jeffries, W. B. & Voris, H. K. (1996). A subject indexed bibliography of the symbiotic barnacles of thegenus *Octolasmis Gray*, 1825 (Crustacea: Cirripedia: Poecilasmatidae). *The Raffles Bulletin of Zoology*, 44: 575–592.

Jeffries, W. B., Voris, H. K., Naiyanetrand, P., & Panha, P. (2005). Pedunculate barnacle of the Symbiotic genus *Octolasmis* (Cirripedia: Thoracica: Poecilasmatidae) from the Northern Gulf of Thailand. *The Natural History Journal of Chulalongkorn University,* 5: 9-13.

Kumaravel, K., Ravichandran, S., & Rameshkumar, G. (2009). Distribution of barnacle *Octolasmis* on the gill region of some edible crabs. *Academic Journal of Entomology,* 2: 36-39.

Lai, J. C. Y., Ng, P. K. L., & Davie, P. J. F. (2010). A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (Crustacea: Brachyura: Portunidae), with the recognition of four species. *The Raffles Bulletin of Zoology*, 58: 199-237.

Margolis, L., Holmes, J. C., Kuris, A. M., & Shad, G. A. (1982). The use of ecological term in parasitology. *Journal of parasitology,* 68: 131-133.

Nitiratsuwan, T., Nitithamyong, C., Chiayvareesajja, S., & Somboonsuke. (2010). Distribution of blue swimming crab (*Portunus pelagicus*Linnaeus, 1758) in Trang province. *Songklanakarin Jour-*

nal of Sciences and Technology, 32: 207-212.

Rejeki, S. (2007). The effects of different water flow rates on the survival rate of blue crab (*Portunus-pelagicus*) zoea IV-megalopa stages. *Journal of Coastal Development*, 10: 197-203.

Rohde, K. (1991). Ecology of Marine Parasite. University of Queensland Press, Queensland, Australia.

Shazia, R. & Javed, M. (2017). Pedunculate barnacle *Octolasmis* (Cirripedia, Thoracica) on the gills of two species of Portunid Crabs. International *Journal of Marine Science*, 7(45): 432-438.

Sinduja, K., Raja, K., Saravanakumar, A., & Vijayakumar, R. (2013). Occurrence of goose barnacle *Octolasmis* spp. infestation on commercial important crabs from parangipettai, Tamilnadu, Southeast Coast of India. *Wayamba Journal of Animal Science*, 578: 768-772.

Soundarapandian, P., Thamizhazhagan, E., & Samuel, M. J. (2007). Seed production of commercially important blue swimming crab *Portunus pelagicus* (Linnaeus). *Journal of Fisheries and Aquatic Sciences*, 2: 302-309.

Tan, A. N., Christianus, A., & Abdul-Satar, M. K. (2011). Epibiont infestation on horseshoe crab *Tachypleus gigas* (Muller) at Pantai Balok in Peninsular Malaysia. *Our Nature*, 9: 9-15.

Voris, H. K., Jeffries, W. B., & Poovachiranon, S. (1994). Patterns of distribution of two barnacle species on the mangrove crab, *Scylla serrata*. *The Biological Bulletin,* 187: 346-354.

Voris, H. K. & Jeffries, W. B. (1997). Size distribution, and significance of capitular plates in *Octolasmis* (Cirripedia: Poecilasmatidae). *Journal of Crustacean Biology*, 17: 217 – 226.

Walker, G. (2001). Some observations on the epizoic barnacle *Octolasmis angulate* within the branchial chambers of an Australian swimming crab. *Journal of Crustacean Biology*, 21 (2): 450-455.

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