Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 29(6): 1317 – 1331 (2025)
www.ejabf.journals.ekb.eg

Dimension, Prevalence, Intensity and Histopathology of *Octolasmis* sp. on Blue Swimming Crab from Bulusan Beach, Banyuwangi Regency, Indonesia

Maria Agustina Pardede[1, 2*], Dewi Ambarwati[1], Elmira Kurnia Agesti[1], Putri Puspita Sari[1], In'amul Aufa[1], Muhammad Abdul Aziz[1], Nesya Sahada Rahma[1], Shovia Finny Anggreani[1], Mohammad Faizal Ulkhaq[1, 2], April Hari Wardhana[3], Farah Haziqah Meor Termizi[4], Jiun-Yan Loh[5]

[1]Study Program of Aquaculture, Department of Health and Life Sciences, Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga
[2]Sustainability Aquaculture and Environment Research Group, Universitas Airlangga, Banyuwangi, Indonesia
[3]Pusat Riset Veteriner, Organisasi Riset Kesehatan, Badan Riset Inovasi Nasional
[4]School of Biological Sciences, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia
[5]Tropical Futures Institute, James Cook University Singapore, 149 Sims Drive, 387380, Singapore
[*]Corresponding Author: mariapardede@sikia.unair.ac.id

ARTICLE INFO

Article History:
Received: Aug. 20, 2025
Accepted: Nov. 2, 2025
Online: Nov. 28, 2025

Keywords:
Blue swimming crab, *Portunus pelagicus*, *Octolasmis angulate*, Sustainable Fisheries, Ectoparasites

ABSTRACT

The blue swimming crab *Portunus pelagicus* is an economically important species in tropical waters, particularly in Indonesia. This study aimed to investigate the prevalence, intensity, and pathological effects of the ectoparasite *Octolasmis angulata* on *P. pelagicus* at Bulusan Beach, East Java, during October to November 2024. Morphological identification and histopathological analyses of 12 specimens revealed that *O. angulata* attachment caused severe respiratory impairments, as evidenced by disrupted gill lamellae and hemocytic responses. A strong positive correlation was observed between crab size and infestation level, suggesting that larger crabs were more susceptible to heavier *O. angulata* colonization. Infestation analysis showed that *O. angulata* exhibited a marked preference for the gills, with 2,081 individuals recorded, compared to 205 on the carapace and 43 on the pereiopods. Histopathological examination of the gills revealed extensive structural damage, including lamellar fusion, vacuolization, and hemocyte aggregation, emphasizing the detrimental effects of *O. angulata* on host respiratory function. These findings provide new insights into the infestation dynamics and pathological implications of *O. angulata* in *P. pelagicus*, contributing to a better understanding of host–epibiont interactions in tropical marine ecosystems.

INTRODUCTION

The blue swimming crab, *Portunus pelagicus*, is a high value economic commodity that is widely distributed in tropical waters including Indonesia **(Chande & Mgaya, 2004)**. This species is important in supporting the economy of coastal communities

through fishing and international trade. According to the **FAO (2024)**, the production of *P. pelagicus* reached 243,000 tons in 2022, thus showing its high value. Besides the contribution to the fisheries sector, this species has a great potential for sustainable economic development, especially with the management strategies that focus on resource and ecosystem sustainability. *P. pelagicus* represents a strategic marine resource in the development of tropical fisheries. The blue swimming crab *P. pelagicus* is abundant in Indo-Pacific waters and is an important recreational and commercial fishery **(Alsaqabi & Eshky, 2012)**.

However, the production of blue swimming crabs faces challenges, notably the prevalence of diseases affecting the species. The most common is the infestation of ectoparasite that can cause serious damage to the body and organs of the crab. Examples of ectoparasites that pose apprehension include *Octolasmis*, *Zoothamnium*, and *Epistylis* since they have potential impacts on host health, behavior, and survival **(Purna *et al.*, 2021)**. Ectoparasites commonly attach to all body parts of the crab, including gills and carapace, and may cause impairment in respiration, locomotion, and overall activity fitness. The damage caused by these parasites can lead to secondary infections, disrupting the growth and immune systems of the host, making them susceptible to bacterial and viral infections, and ultimately causing mortality. The swimming crab *P. sanguinolentus*, another commercially and ecologically important species, is notably found in Asia. Studies have identified two epibiont barnacle species, *O. bullata* and *O. warwickii* that were commonly infesting *P. sanguinolentus* **(Yang *et al.*, 2015)**.

Bulusan Beach, located in Banyuwangi, East Java, Indonesia, is a coastal region rich in biodiversity and serves as a habitat for various marine species, including the genus *Portunus*. Despite its high ecological value, research on epibiosis in this area remains limited, particularly concerning the prevalence and impacts of *Octolasmis* on local crab populations. Understanding these interactions is essential for developing sustainable management strategies, considering the ecological and economic importance of *Portunus* species in local fisheries. This study aims to explore the dimensions, morphological characteristics, prevalence, intensity, and pathological effects of *Octolasmis* on *Portunus* crabs in Bulusan Beach. By analyzing these parameters, this research seeks to contribute to a broader understanding of epibiosis interactions and their implications for host health and the coastal marine ecosystem.

MATERIALS AND METHODS

1. Study area and sampling period

This study was conducted from October to November 2024 at Bulusan Beach, Banyuwangi Regency, East Java, Indonesia. Morphological identification and ectoparasite analysis were performed at the Integrated Laboratory of the Faculty of Health Sciences, Medicine, and Natural Sciences, Airlangga University, Banyuwangi.

The sampling was performed during two distinct periods within the overall timeframe of the study from October to November 2024.

2. Sample collection and preparation

A total of 12 specimens of *Portunus* sp. were collected through random sampling from the catch of local fishermen at Bulusan Beach. The samples were preserved in absolute ethanol and transported to the laboratory for further analysis. Morphological identification was conducted to confirm the species, and ectoparasites were examined under a stereo microscope to identify and quantify their presence. The dimensions measured from the crabs are the length, width, and depth of the carapace, pereiopod length, and propodus length. The dimension of *Portunus* sp. and ectoparasites are measured using a digital caliper with an accuracy 0.01mm. They were sexed and measured for their carapace width (CW) by means of a vernier caliper with an accuracy of 0.01mm then were divided into three size-based categories, small (27– 33mm), medium (48– 54mm) and large (106– 151mm). Twelve individuals representing each size class were selected for examination. For those, the carapace was lifted and gills were visually inspected for the presence of the ectocommensal barnacle according to **Martin *et al.* (2014)**.

3. Ectoparasite identification, intensity and prevalence

Ectoparasites were isolated and examined under a stereo microscope. Detailed morphological analysis was conducted using brightfield and differential interference microscopes (Nikon DM 6000). Specimens were dissected in lactic acid, and appendages were examined for morphological variations. Drawings were created using a camera lucida attached to the microscope and calibrated with an ocular micrometer. The number of *Octolasmis in* each infested crab (intensity) and total number per sample/total number of infested crabs (mean intensity) were calculated. Finally, the prevalence of *Octolasmis* was calculated by dividing the number of infested hosts on the total number of examined individuals and expressed as a percentage **(Hassan *et al.*, 2019; Pardede *et al.*, 2020)**.

4. Histophatology examination

The gills of blue swimming crab were observed using a histological method **(Bell *&* Lightner, 1988; Pardede *et al.*, 2024a, b)**. Observations were made to identify the clinical signs of crab. This was analyzed using software.

5. Data analysis

The intensity of infestation (the number of ectoparasites individuals per infested crab) and mean intensity (the total number of ectoparasites divided by the total number of infested crabs) were calculated. Prevalence was determined as the percentage of infested hosts relative to the total number of examined crabs **(Purna *et al.*, 2021)**. Statistical analyses were performed assuming normal distribution of the population data for ectoparasites. Parametric analysis was used in this study on the assumption that the

population data of ectoparasites were normally distributed **(Campbell & Swinscow, 1976)**. The correlation between crab weight and width with total parasit were appraised using correlation test. The significance criterion in all tests was set at $P< 0.05$. The homogeneity of the slope of the linear regression between crab weight and total of *Octolasmis* was tested with an ANOVA **(Oliva, 2014)**.

RESULTS

1. Dimension of *Portunus pelagicus*

The carapace length of the crabs exhibited an average of 41.30mm, with a range of 11.00– 84.00mm. The carapace width had a mean of 69.68mm, ranging from 31.00 to 151.00mm, while the carapace depth showed an average of 12.77mm with a range of 5.00– 24.27mm. The pereopod length had a mean of 65.38mm, with values spanning 25.00– 125.33mm, and the propodus length averaged 33.02mm, ranging between 15.50 and 69.25mm. The weight of the specimens ranged from 68.64 g to 285.55g, with an average of 138.29g (Table 1). Among the measured parameters, carapace width and length displayed the highest variability, reflecting significant size differences between specimens. The largest specimen recorded a carapace width of 151.00mm, nearly five times greater than the smallest width of 31.00mm.

Table 1. Dimension of *Portunus pelagicus*

Crab Number	Carapace Length (mm)	Carapace Width (mm)	Carapace Depth (mm)	Pereipod Length (mm)	Propodus Length (mm)	Weight (g)	Number of *Octolasmis*
1	84	151	24,27	123.45	69.25	284.55	926
2	71	113	31	106.47	54.45	226.6	390
3	79	139	23.3	125.33	72	260.515	712
4	12.68	31	6.82	28.2	15.1	72.68	5
5	12.35	31.06	6.5	30.1	16	74	0
6	31.88	48.07	9.35	43.25	18.9	93.33	20
7	35.1	50	9.54	54.3	23	98.4	33
8	70	106	20.27	100.2	50.4	203.1	151
9	35.53	52.48	9.92	56.9	23.55	98.75	39
10	39.7	54.05	11	59	20.5	100.75	45
11	11	27.5	5	25	15.5	68.64	0
12	13.41	33	7.78	32.3	17.6	78.15	8
Avg	41.30416667	69.68	12.77090909	65.375	33.02083333	138.28875	194,0833333
Min	11	31	5	25	15.5	68.64	0
Max	84	151	24,27	125,33	69.2	285.55	926

Pereopod length demonstrated a wide range (25.00– 125.33mm), which suggests functional variability likely influenced by environmental or developmental factors. Weight was positively correlated with overall carapace dimensions and pereopod length, consistent with growth patterns observed in crustaceans. In contrast, carapace depth exhibited the least variability, indicating a consistent proportional relationship with carapace width and length. These findings provide insights into the morphological and weight characteristics of the crab specimens, contributing valuable data to the study of their ecological and physiological adaptations.

2. *Portunus pelagicus* with *Octolasmis* sp. infestation

The study examined the predilection sites of barnacle attachment on different body parts of *Portunus pelagicus* crabs, including the carapace, gills, and pereiopods (Fig. 1). The study identified the predilection sites of *Octolasmis* sp. infestation on various body parts of *Portunus pelagicus*. Barnacle attachments were observed predominantly on the carapace, gills, and pereiopods, indicating a preference for these anatomical regions. Among these, the gills exhibited the highest infestation rate, suggesting that this area provides an optimal environment for barnacle attachment due to its surface area and accessibility. Attachments on the carapace and pereiopods were comparatively less frequent, highlighting differences in the suitability of these sites for colonization (Fig. 1).

Fig. 1. Infestation of *Octolasmis* on crab *Portunus pelagicus*

A total of 12 crabs were analyzed, revealing significant variation in barnacle attachment across these sites. The gills showed the highest frequency of barnacle attachment, with a total of 2,081 barnacles recorded, accounting for the predominant site of infestation. The carapace followed with 205 barnacles, while the pereiopods had the lowest number, with only 43 barnacles observed. Among individual crabs, the highest number of barnacles on the gills was observed in Crab 1 (889 barnacles), followed by Crab 3 (701 barnacles). On the carapace, the highest attachment was in Crab 8 (77 barnacles), while the pereiopods showed the greatest number of barnacles in Crab 8 as well (13 barnacles). Some crabs, such as crabs 5 and 11, showed no barnacle attachment across all body parts (Table 2).

Table 2. Predilection of *Octolasmis* on crab *Portunus pelagicus*

Crab Number	Predilection		
	Carapace	Gills	Pereiopod
1	35	889	2
2	20	359	11
3	7	701	4
4	4	1	0
5	0	0	0
6	3	16	1
7	7	26	0
8	77	61	13
9	26	6	7
10	22	19	4
11	0	0	0
12	4	3	1
Total	205	2081	43

These findings indicate a strong preference for gills as the primary attachment site, which could be attributed to their suitability for barnacle anchorage and proximity to a nutrient-rich environment. The analysis of infection parameters revealed notable variations in intensity and prevalence among the sampled individuals. The total number of samples examined was 12, with 10 of them showing signs of infestation, resulting in a prevalence rate of 83.33%, which is categorized as usually. The intensity of infestation was measured at 232.9, with a total of 2,329 individual barnacles recorded across the infected samples, falling under the awfully category (Table 3). These findings indicate a high rate of infestation among the sampled individuals, suggesting a strong association between host susceptibility and epibiont colonization.

Table 3. Intensity and prevalence of crab *Portunus pelagicus*

Parameter	Total Sampels	Total Infected Samples	Category
Intensity	12	2329	232,9 (awfully)
Prevalance	12	10	83,33% (usually)

3. Morphology and dimension of *Octolasmis angulata*

The results are presented in terms of various measurements related to the barnacle's anatomical features. CL refers to the carina length, which quantifies the length of the carina, a structure vital for barnacle attachment. CW indicates the carina weight, reflecting the weight of the carina. SL stands for scutum length, measuring the length of the scutum, another key structure involved in attachment. PW represents penduncle weight, which gauges the weight of the penduncle, a stalk-like structure that anchors the barnacle to the surface. Finally, PL denotes penduncle length, quantifying the length of the penduncle. These measurements provide insights into the physical attributes of the barnacle's attachment structures (Fig. 2).

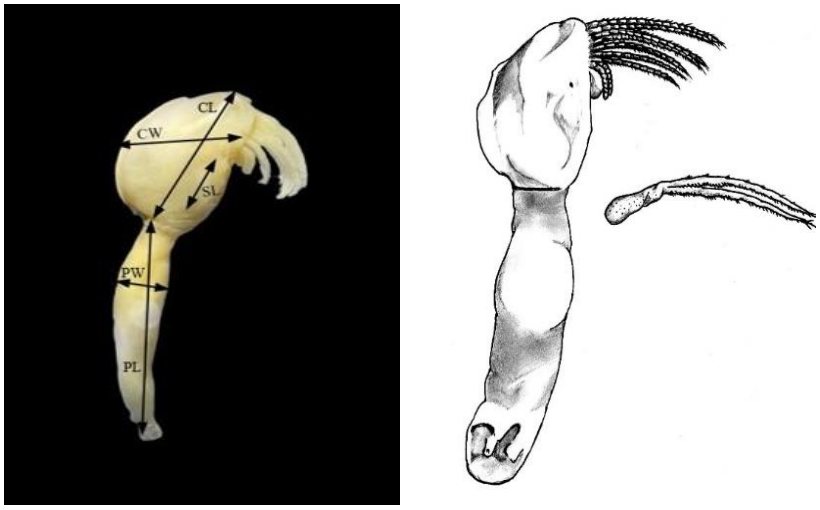

Fig. 2. Morphology of *Octolasmis* on crab *Portunus pelagicus*

Note: (CL; Carina lenght, CW: Carina weight, SL: Scutum length, PW: Penduncle weight, PL: Penduncle length)

The dimensions of *Octolasmis angulata* were examined, focusing on carina width, carina length, peduncle width, peduncle length, scutum length, and total cirri length. A

total of 20 specimens were measured for the capitulum, peduncle, scutum, and carina lengths. Detailed measurements are provided in Table (4). The carina width exhibited an average of 5.19mm, with a range of 2.4– 10.4mm, while the carina length averaged 7.48mm, ranging from 5.0– 9.6mm. The peduncle width averaged 2.27mm (range 1.1– 4.0mm), and the peduncle length averaged 7.29mm, spanning 4.4– 11.88mm. The scutum length had a mean of 3.7mm, with a range of 2.22– 4.93mm. Lastly, the total cirri length showed an average of 14.7mm, ranging from 10.0– 18.0mm (Table 4).

Table 4. Dimension of parasite *Octolasmis angulata*

Number of Parasite	Carina Width (mm)	Carina Length (mm)	Peduncle Width (mm)	Peduncle Length (mm)	Scutum Length (mm)	Total of Cirri
1	5.5	7.3	3	8	3.88	14
2	6.1	9.3	3	11.11	4.55	11
3	3.5	5.4	2	8	3.3	16
4	2.4	5	2	6	2.49	16
5	6.4	8.9	3.28	8.91	3.1	17
6	3.8	6.3	2.99	6.92	3.74	12
7	5.5	7.9	2.56	10.56	3.28	10
8	10.4	7	3.33	11.88	4.93	18
9	4.6	6.9	2.44	7.36	3.4	18
10	6.2	7.5	2.38	7.25	2.22	16
11	5.3	7.8	3.9	5.5	4.4	14
12	2.5	7.2	1.2	4.4	3.8	11
13	4.7	7	1.3	6.2	4.89	16
14	4.4	7.9	1.9	6.7	3.46	11
15	5.5	9.1	2.1	5.5	3.21	13
16	5.4	7.1	1.5	4.9	3.19	12
17	6.3	9.5	1.8	7.3	4.5	18
18	5.1	6.9	1.9	6.8	3.9	16
19	4.1	6.1	1.1	6.9	4.92	17
20	6.2	9.6	1.9	5.7	2.84	18
Avg	5.19	7.48	2.27	7.29	3.70	14.70
S.E.M	0.37	0.28	0.16	0.43	0.17	0.60
Min	2.4	9.6	1.1	4.4	2.22	10
Max	10.4	5	4	11.88	4.93	18

Among these parameters, the carina width demonstrated the greatest variability, with measurements ranging from 2.4– 10.4mm, suggesting significant morphological diversity within the sampled population. The total cirri length also exhibited a broad range (10.0– 18.0mm), which may indicate differences in developmental stages or environmental adaptations. In contrast, the scutum length was the most consistent parameter, characterized by a relatively narrow range and lower SEM, reflecting less variability

among specimens. Peduncle dimensions (width and length) displayed moderate variation, which may relate to their roles in attachment or feeding mechanisms. The correlation between carapace width and the total number of *Octolasmis* individuals was analyzed to determine the relationship between host size and epibiotic infestation. A positive linear correlation was observed, as shown in Fig. (3).

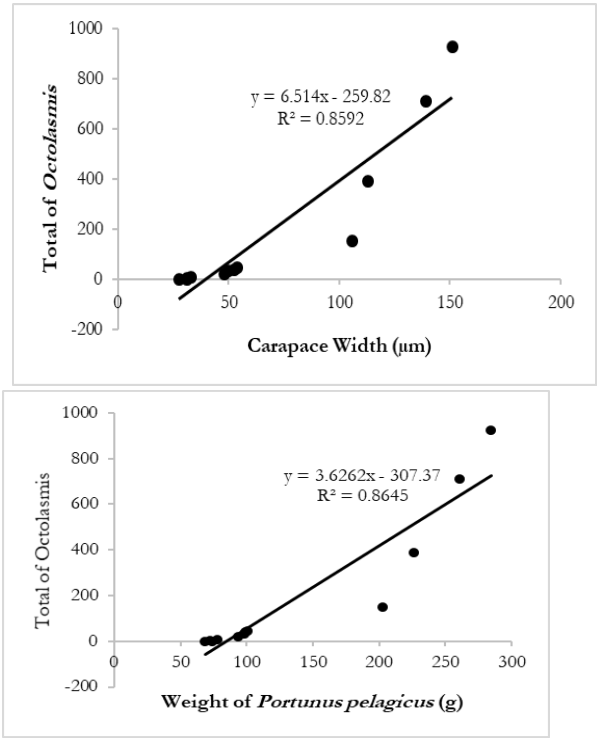

Fig. 3. (A) Correlation between width and total *Octolasmis*; (B) Correlation between weigh and total *Octolasmis*

The equation of the regression where y represents the total number of *Octolasmis* individuals and x represents the carapace width (in µm). The coefficient of determination R2 is 0.8592, indicating that 85.92% of the variation in *Octolasmis* infestation can be explained by the variation in carapace width. The coefficient of determination R2 is 0.8645, indicating that 86.45% of the variation in *Octolasmi* infestation can be explained by the variation in carapace weight. The scatter plot reveals a trend where larger crabs, as indicated by greater carapace widths, tended to host more *Octolasmis* individuals. This suggests that the carapace width and weight of *Portunus* crabs is a significant factor influencing the intensity of *Octolasmis* infestations.

4. Histopathological profile of gills infested with *Octolasmis angulata*

The histological examination of barnacle attachment on the gills of *P. pelagicus* reveals significant structural changes can be seen in Fig. (4). Fig. (4A) illustrates the normal gill morphology, serving as a control for comparison. In Fig. (4B), the penetration region of the barnacle is depicted, highlighting the barnacle's invasive attachment (a) and

its position on the gill surface. Fig. (4C) demonstrates the abnormal lamellar structure caused by barnacle infestation, showing vacuolization (c) and fused lamellae (d), which indicate tissue degeneration and compromised gill function. Finally, Fig. (4D) focuses on *O.angulata*, detailing its anatomical features, including the carina (e) and peduncle (f), which are essential for secure attachment to the host gill. These observations emphasize the pathological impact of barnacle infestation on the respiratory structures of *P. pelagicus*. Vacuolization occurred in the gill stem, the gill lamellae were ruptured, the connective tissue in the gill stem was damaged and destroyed, and hemocyte accumulation was observed in the gill lamellae.

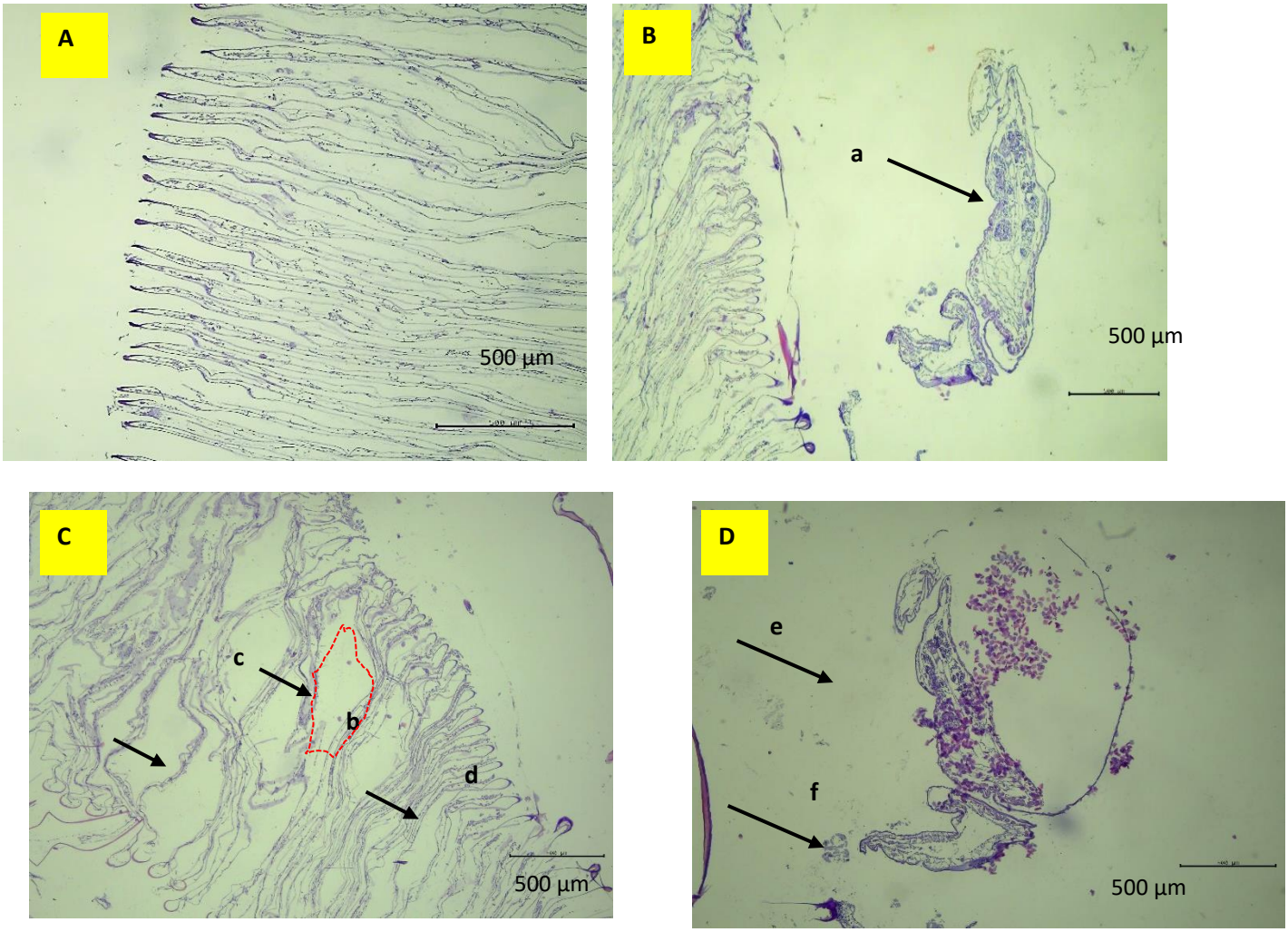

Fig. 4. Histology sectioning for barnacle attachment, (A) normal gill (B) penetration part of barnacle (a) and the barnacle stay in the gill suface (C) abnormal lamella gill of *Portunus pelagicus:* vacuolization (c), fusi lamella (d) (D) *Octolasmis angulata*; carina (e), penducle (f)

DISCUSSION

This study identified the preferred sites of infestation by *O. angulata* infestation on various body parts of *Portunus pelagicus*. More than 90% of the blue crabs examined were found to carry *Octolasmis*, with a prevalence rate of 92% and an average intensity of infestation of 18.5 ± 18.6 (ranging from 0 to 127 epibionts per host) **(Khattab, 2018)**. The distribution of *Octolasmis angulata* within the branchial chamber of the blue *P. pelagicus* is primarily associated with ventilatory flow, which typically follows a U-shaped path. The results of this study reveal a significant positive correlation between carapace width and the total number of *Octolasmis* individuals infesting the *Portunus* crabs at Bulusan Beach in Banyuwangi Regency, East Java, Indonesia. The results of this study revealed a significant positive correlation between carapace width and the total number of *Octolasmis* individuals infesting *Portunus* crabs at Bulusan Beach, Banyuwangi Regency, East Java, Indonesia. Regression analysis indicates that carapace width is a strong predictor of the intensity of *Octolasmis* infestation. This finding is consistent with previous studies that have documented a direct relationship between host size and epibiotic load in marine organisms **(Key *et al.* 1996; Khattab, 2018**).

The findings also align with observations from previous studies by **Adday *et al.* (2019)** who noted the morphological and DNA-based variations in *Portunus* species, including *P. pelagicus*, which is recognized globally. *Octolasmis angulata* has been frequently reported as a commensal on various host species, including *P. pelagicus*. This study provides valuable quantitative insights into the morphology of *O. angulata*, contributing to a broader understanding of barnacle physiology, ecology, and host associations. Larger crabs provide more surface area for attachment and are likely to have greater physiological resources to support larger epibiont populations, making them more attractive and suitable hosts for *Octolasmis*. Consistent with prior studies, larger crabs showed a higher prevalence and mean intensity of barnacle infestation, as has been reported in previous studies of *Octolasmis*. More than 80% of the barnacles were distributed on the inner surfaces of the gills **(Li *et al.*, 2014)**. The trend observed in this study suggests that *Octolasmis* infestation intensity may increase with host ontogeny, as larger individuals represent older stages of the crab's lifecycle. This is consistent with the hypothesis that epibiont load accumulates over time, as larger crabs have been exposed to the environment for longer periods, increasing the likelihood of encountering *Octolasmis* larvae in the water column. Moreover, larger hosts may engage in more active behaviors, such as burrowing or foraging, that enhance their contact with barnacle larvae, further contributing to higher infestation rates **(Yang *et al.*, 2015; Purna *et al.*, 2021)**.

However, while the correlation is strong, it is important to consider the potential implications of *Octolasmis* infestations for crab health and fitness. Previous research has shown that high infestation intensity, particularly on the gills, can impair respiratory efficiency, reduce growth rates, and increase vulnerability to predation and disease

(Jeffries *et al.*, 1982; Key *et al.*, 1996). In this study, larger crabs may be disproportionately impacted by higher infestation loads, suggesting that *Octolasmis* could represent a significant stressor for commercially and ecologically important *Portunus* populations. Environmental factors, such as water quality, salinity, and hydrodynamic conditions, may also influence *Octolasmis* attachment and survival rates. Bulusan Beach's coastal environment provides a unique habitat for marine organisms, and factors like nutrient availability and tidal currents may affect barnacle larval dispersal and settlement patterns. Future studies should explore the role of environmental parameters in shaping *Octolasmis* infestation dynamics to better understand the ecological interactions at play.

In addition, it is worth noting that larger crabs may experience a trade-off between increased epibiont loads and reproductive fitness. Larger body size in crabs is often associated with higher reproductive output, but high infestation levels may impose energetic costs that could reduce fecundity or survival rates. These interactions warrant further investigation to assess the long-term ecological consequences of *Octolasmis* infestations in the studied population **(Hudson & Lester, 1994; Li *et al.*, 2014; Yang *et al.*, 2015; Adday *et al.*, 2019)**. In conclusion, the findings of this study highlight the importance of host size as a key factor influencing *Octolasmis* infestation intensity in P*ortunus* crabs.

The positive correlation between carapace width and *Octolasmis* load underscores the need for continued monitoring of epibiont-host dynamics, particularly in areas of ecological and economic significance like Bulusan Beach. Understanding these relationships can inform the sustainable management of crab populations and their associated fisheries, ensuring the health and productivity of marine ecosystems in the region. The histological examination of barnacle attachment on the gills of *Portunus pelagicus* reveals significant structural alterations, underscoring the detrimental effects of barnacle infestation on gill morphology and function **(Hudson & Lester, 1994; Hassan *et al.*, 2019; Purna *et al.*, 2021; Kismiyati *et al.*, 2024)**. These findings align with previous studies that have documented the destructive impact of epibiotic infestations on host tissues, particularly in crustaceans. The findings of this study highlight the pathological impact of barnacle infestation on the gill structures of *P. pelagicus* and underscore the importance of host size in determining infestation intensity. The anatomical adaptations of *O. angulata* further illustrate the complex interplay between epibionts and their hosts. Future research should explore the physiological consequences of these infestations, particularly their impact on host respiration and overall fitness.

CONCLUSION

This study confirms that *Octolasmis angulata* preferentially infests the branchial chambers, especially the inner gill surfaces of *Portunus pelagicus*, with a high prevalence (92%) and an average intensity of 18.5 ± 18.6 epibionts per crab. A strong positive

correlation between carapace width and infestation load suggests that larger (and likely older) crabs accumulate more barnacles. Histological analysis reveals that attachment causes structural damage to gill tissues, implying potential negative effects on respiration and overall crab fitness. These findings underscore host size as a key determinant of infestation intensity and point toward the need for further study on environmental influences and physiological impacts in managing healthy crab populations.

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