Volume 13(5)/2020

Picaulima S. M., Wiyono E. S., Baskoro M. S., Riyanto M., 2020 Fleets dynamics of small-scale fisheries in eastern Kei Kecil Island, Maluku Province, Indonesia. AACL Bioflux 13(5):2835-2851.

Parvez I., Mahajebin T., Barman T. R., Khan N., Chhanda M. S., Alam M. A., 2020 Evaluation of body shape variation of indigenous and exotic *Anabas testudineus* (Bloch, 1792) in Bangladesh by geometric morphometric analyses. AACL Bioflux 13(5):2852-2858.

Sahami F. M., Habibie S. A., 2020 Exploration of adult phase of Nike fish to maintain its sustainability in Gorontalo Bay waters, Indonesia. AACL Bioflux 13(5):2859-2867.

Nur M., Rifa'i M. A., Yunita R., Sofia L. A., 2020 Feasibility of floating cage culture based on business scale in Riam Kanan Reservoir, South Kalimantan Province. AACL Bioflux 13(5):2868-2877.

Arsad S., Sari L. A., Suherman S. P., Cahyani D., Nadhira T., Yulinda E. N., Musa M., Lusiana E. D., Prasetiya F. S., 2020 Utilization of tofu wastewater as *Chlorella pyrenoidosa* growth medium. AACL Bioflux 13(5):2878-2885.

Ardiansyah, Amrullah, Dahlia, Jaya A. A., Indrayani, Wahidah S., Hamal R., Jabbar F. B. A., 2020 The selected facultative mixotrophic sulphur-oxidizing bacteria from intensive shrimp ponds. AACL Bioflux 13(5):2886-2896.

Paulus C. A., Soewarlan L. C., Ayubi A. A., 2020 Distribution of marine debris in mangrove ecotourism area in Kupang, East Nusa Tenggara, Indonesia. AACL Bioflux 13(5):2897-2909.

Turisno B. E., Mahmudah S., Yunanto, 2020 The regulaiton and policy models of Pekalongan Local Government toward mangrove conservation. AACL Bioflux 13(5):2910-2920.

Trisyani N., Yusan L. Y., 2020 Proximate analysis and amino acid profile in fresh meat, meat meal, and shell meal of bamboo clam *Solen* sp. from Kwanyar Coast, Bangkalan-Madura, Indonesia. AACL Bioflux 13(5):2921-2927.

Vahira A. D., Riadin A. H., Sarida M., Utomo D. S. C., Setiawan W. A., 2020 Growth performance and sex ratio of *Channa striata* through immersion and bioencapsulaiton of *Artemia* with recombinant growth hormone. AACL Bioflux 13(5):2928-2936.

Zuraida I., Pamungkas B. F., 2020 Effects of acid pretreatment and extraction temperature on the properties of gelatin from striped snakehead (*Channa striata*) scales. AACL Bioflux 13(5):2937-2945.

Taridala S. A. A., Nursavista R., Kurnia A., Purbaningsih Y., Alzarliani W. O., Rayuddin, Hartati, 2020 Abalone marketing and its performance during Covid-19 pandemic. AACL Bioflux 13(5):2946-2955.

Thovyan A. I., Tapilatu R. F., Sabariah V., Venables S. K., 2020 Plankton abundance and community structure in reef manta ray (*Mobula alfredi*) feeding habitat in the Dampier Strait, Raja Ampat, West Papua, Indonesia. AACL Bioflux 13(5):2956-2969.

Sandor Z. J., Biro J. N., Revesz N., Ronyai A., 2020 Comparison of carp filet quality produced in semi-intensive pond system using different type of feeds. AACL Bioflux 13(5):2970-2981.

Kurniawan A., 2020 The metal oxides of abandoned tin mining pit waters as an indicator for bacterial diversity. AACL Bioflux 13(5):2982-2992.

Latiu C., Cocan D., Uiuiu P., Matei M. C., Constantinescu R., Heghedus C., Ihut A., Raducu C., Nicula A. S., Miresan V., 2020 Prespawning and postspawning hematological parameters and oxidative stress biomarkers of brown trout (*Salmo trutta*) (Pisces: Salmonidae), from Somesul Cald River. AACL Bioflux 13(5):2993-3003.

Pronina G. I., Mannapov A. G., 2020 Some aspects of fish breeding for immune resistance as shown through a study of common carp. AACL Bioflux 13(5):3004-3014.

Wakiah A., Mallawa A., Amir F., 2020 Population dynamics of snakehead fish (*Channa striata*) in Tempe Lake, South Sulawesi, Indonesia. AACL Bioflux 13(5):3015-3027.

Ueno-Fukura M., Aya-Baquero E., Collazos-Lasso L. F., 2020 Biofloc application in larviculture of *Pterophyllum scalare* at different stocking densities. AACL Bioflux 13(5):3028-3036.

Danial, Syahrul, Hamsiah, Ernaningsih, Yusuf M., 2020 Evaluation and development strategy of PPI Beba (Fish Landing Port) in Takalar District, Indonesia. AACL Bioflux 13(5):3037-3045.

Nas J. S., 2020 Screening of flavonoids from *Muntingia calabura* aqueous leaf extract and its potential influence on different metabolic enzymes in *Danio rerio*. AACL Bioflux 13(5):3046-3055.

Suratip N., Klahan R., Charoenwattanasak S., Yuangsoi B., 2020 Dietary methionine optimization for the growth performance, nitrogen utilization and proteolytic enzymes activities of snakehead (*Channa striata*) fingerlings. AACL Bioflux 13(5):3056-3067.

Putra D. F., Ulfa M., Zahara S., Abbas M. A., Nasir M., Othman N., 2020 Biological aspects of shrimps *Penaeus merguiensis* and *Exopalaemon styliferus* in Nagan Raya coast, Aceh Province, Indonesia. AACL Bioflux 13(5):3068-3077.

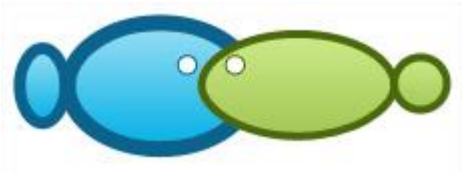
Alfiah H., Tri N., Manikya P., Raden J. K. S., Adamu A. M., 2020 Potential of probiotics and vitamin C on metallothionein and hematological parameters in tilapia (*Oreochromis niloticus*) affected by cadmium exposure. AACL Bioflux 13(5):3078-3085.

Dahlan A., Zahidah, Andriani Y., Herawati H., 2020 Plankton community structure as a bioindicator in Jatigede Reservoir, West Java, Indonesia. AACL Bioflux 13(5):3086-3095.

Hidayatullah W., Kismiyati, Mahasri G., 2020 Prevalence of ectoparasites in milkfish (*Chanos chanos*) from nursery and rearing ponds. AACL Bioflux 13(5):3096-3104.

Juliandri M. R., Radjawane I. M., Tarya A., 2020 Modeling the distribution of floating marine debris movement in tourism area in Pelabuhan Ratu Bay, West Java. AACL Bioflux 13(5):3105-3116.

Harwanto D., Saputro P., Susilowati T., Haditomo A. H. C., Windarto S., 2020 Effect of different N:P ratios application on the cultivation media for the growth and fiber content of *Caulerpa racemosa* reared in tarpaulin ponds. AACL Bioflux 13(5):3117-3125.



Prevalence of ectoparasites in milkfish (*Chanos chanos*) from nursery and rearing ponds

[1]Wahyu Hidayatullah, [2]Kismiyati, [2]Gunanti Mahasri

[1] Department of Aquaculture, Faculty of Fisheries and Marine, Airlangga University, Surabaya, East Java, Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine, Airlangga University, Surabaya, East Java, Indonesia. Corresponding author: Kismiyati, kismiyati.kismiyati@yahoo.com

Abstract. Milkfish (*Chanos chanos*) cultivation is inseparable from the disease problems caused by viruses, bacteria, fungi, and parasites. *Dactylogyrus* sp. often affects the heart organ of *C. chanos*. Young specimens in nursery ponds are more susceptible to the related diseases than adults in enlarged ponds. The current research compared the prevalence of ectoparasites infesting *C. chanos* in the nursery and rearing ponds, in order to prevent parasite infestation. An experimental study was conducted by using survey methods. Simple random sampling used to select 300 samples from nursery and rearing ponds in 3 different cultivation locations. The main investigated parameter in this study was the prevalence of ectoparasites infesting *C. chanos* in nursery and rearing ponds. Besides, water quality parameters were also determined, including temperature, salinity, pH, brightness, dissolved oxygen levels, and ammonia. The study identified *Dactylogyrus vastator* as the ectoparasites that infested *C. chanos* in the nursery and rearing ponds. The average prevalence of ectoparasites in the nursery pond was of 5.33%, while in the rearing pond it was of 2.0%. The Chi-Square test showed a significance value of 0.293 in both, nursery and rearing ponds. The water quality measurements of both ponds resulted an optimum value in temperature (26-28°C), salinity (17-20 ppt), brightness (25-28 cm), pH (7-8), and ammonia levels (0.01-0.05 mg L^{-1}). The *D. vastator* infestation in *C. chanos* in the nursery and rearing ponds was at an occasional level and did not show significant differences in the prevalence values between the two ecosystem pools.

Key Words: fish disease, *Dactylogyrus vastator,* nursery pond, rearing pond, animal parasites.

Introduction. Fish is an important commodity, especially in terms of supplying high protein content. Milkfish (*Chanos chanos*) is classified as high protein fish (20 to 24%) and low fat content (0.7 to 0.8%) (Hafiludin 2015). *C. chanos* is rich in Omega 3 fatty acid, which can prevent blood clots, reduce cholesterol levels, increase endurance and play a role in brain development in the fetus.

In some developing countries such as Indonesia, Philippines, and Malaysia, fisheries production is a source of income for the country, due to the export via the foreign exchange. Milkfish production progressed by 421,757 tons in 2010, 467,449 tons in 2011, 518,939 tons in 2012, 627,332 tons in 2013, 631,125 tons in 2014 and 905,408 tons in 2015, at a rate ranging between 10 and 45% $year^{-1}$ (Direktorat Jenderal Perikanan dan Budidaya and Menteri Kelautan dan Perikanan 2016). Disease issues caused by viruses, bacteria, fungi, and parasites are inseparable from *C. chanos* cultivation. Emerging diseases are related to environmental damage and stress factors (Lin & Liao 2008; Echem et al 2018; Hanke et al 2019). Ectoparasitic infestation can be a way for infection of other pathogenic organisms (Thilakaratne et al 2003). Dried *C. chanos* from several regions in Taiwan contain of high histamine levels that cause digestive diseases (Hsu et al 2009).

Dinoflagellate parasite infestation, *Amyloodinium ocellatum* (Dinoflagellida) often occurs in the fins and skin of *C. chanos* that are kept in fish hatcheries in the Philippines (Dequito et al 2015; Virgula et al 2017). In Lizard Island, Moreton Bay, and Wangetti Beach, three Aporocotylid species infected *C. chanos* heart tissue (Yong et al 2016). Four different species of endoparasites were identified in *C. chanos* through microscopic

examination, namely: *Ichthyobodo* sp., *Trichodina* sp., *Acanthocephala* spp. and *Diphyllobothrium latum*, in the Mindanao, Philipine (Echem et al 2018). *Dactylogyrus* was also found in India, occurring in *Garra gotyla* fish species, with a prevalence value of 16.59 (Ahmed & Sharma 2016). Besides, the result showed that prevalence of *Dactylogyrus* sp. on the gill of juvenile *C. chanos* in two different villages of Indonesia was of 53.33% and 86.67% (Mas'ud 2011). In addition, the *Dactylogyrus* parasite also infested the gills of red tilapia fish commodities from Indonesian waters, with a prevalence value of 90% (Irwandi et al 2017).

Dactylogyrus, commonly called gill worm, is included in the category of monogeneans, an ectoparasites group, because it has a direct life cycle without requiring an intermediate host. *C. chanos* affected by *Dactylogyrus* are found in Indian waters (Bhuiyan & Musa 2008; Peninal et al 2014; Ahmed & Sharma 2016). The other characteristics of *Dactylogyrus* are the presence of two pairs of eye spots between the anterior parts of pharynx and the body (Ling et al 2016). The infestation is followed by secondary infection with viruses, bacteria, and fungi growing in wounds that continue to expand, thus it can result in death. Therefore, it is very important for farmers to know the prevalence value of *C. chanos* ectoparasites in each aquaculture pond, in order to prevent outbreaks of parasite infestation and disease in fish. Hence, this study was aimed to find out the comparison between the prevalence of ectoparasites which infested *C. chanos* on nursery and rearing ponds.

Material and Method

The selection and sampling of C. chanos. This study was conducted experimentally using a survey method, from December 2016 to January 2017. The study used *C. chanos* obtained from fish farming ponds in the central area of Manyar District, Gresik Regency, Indonesia. This study used purposive sampling method to select the samples. The criteria for the juvenile *C. chanos* specimen selection were a size of about 5 to 10 cm and a nursing pond origin. However, the criteria for adult *C. chanos* were a size of 30 to 35 cm and rearing ponds origin. A rearing pond is a place for juvenile *C. chanos* growing to adult stage. *C. chanos* were captured from three different logging ponds with the same plot area of 0.5 ha. The three plots were situated in the villages of Betoyoguci, Betoyokauman, and Banyuwangi (Figure 1). Fish sampling from rearing ponds used the same method and area. Each sample of *C. chanos* counted 50 fish per plot. Thus, the number of fish samples captured from the two pond types amounted to 300 fish.

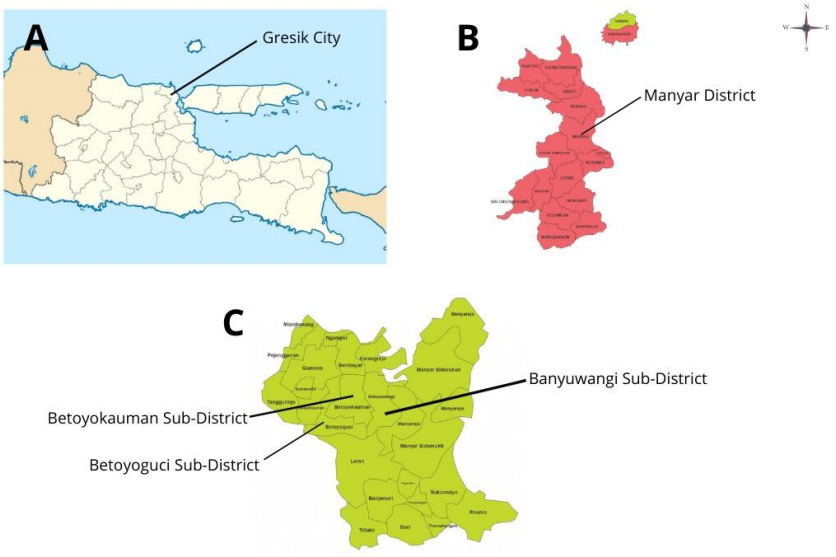


Figure 1. The originate place of nursery and rearing ponds. (a) The location of Gresik City in East Java, Indonesia. (b) The Manyar District of Gresik City. (c) The 3 Sub-districts of nursery and rearing ponds.

After obtaining the appropriate number of *C. chanos* samples, these were packaged with plastic and Styrofoam. The sample examination was conducted for one month in the Education Laboratory of the Faculty of Fisheries and Maritime Affairs, Airlangga University, Surabaya, Indonesia.

Sample inspection and calculation of prevalence of C. chanos ectoparasites. First, *C. chanos* samples' length and body weight were measured. The method used in the examination of the ectoparasite in the samples was scrapping, done on both sides of the body surface, gills, and fish fins. Scrapping results were natively observed under a microscope at magnifications of 100x and 400x. Staining techniques were applied on samples affected by ectoparasites to enhance the observations. Ectoparasite infestation prevalence rate was calculated by the ratio of the number of infested fish against the number of examined *C. chanos* samples. In this study, there were used ten range categories for the ectoparasite prevalence values classification, as shown in Table 1. Chi-square analysis revealed different infestation frequency distributions between the sample groups originating from the two aquaculture ecosystems, namely nursery ponds and rearing ponds. Besides, this study also observed the water quality parameters of both ponds: temperature, salinity, pH, dissolved oxygen (DO), brightness, and ammonia levels.

Table 1

Explanation of ectoparasite prevalence value and range

Category	*Value range (%)*
Almost never	<0.01
Very rare	0.01-0.1
Rare	0.1-1
Occasional	1-9
Often	10-29
Common	30-49
Frequent	50-69
Usual	70-89
Almost always	90-98
Always	99-100

Results. In the collected *C. chanos* samples, the average length of specimens obtained from the mating ponds in the villages of Betoyoguci, Betoyokauman and Banyuwangi was of 7.48 cm, 7.97 cm and 8.27 cm, and the average weight was 5.07 g, 4.70 g, and 5.34 g, respectively. A specimen from the mating ponds is represented in Figure 2 (a).

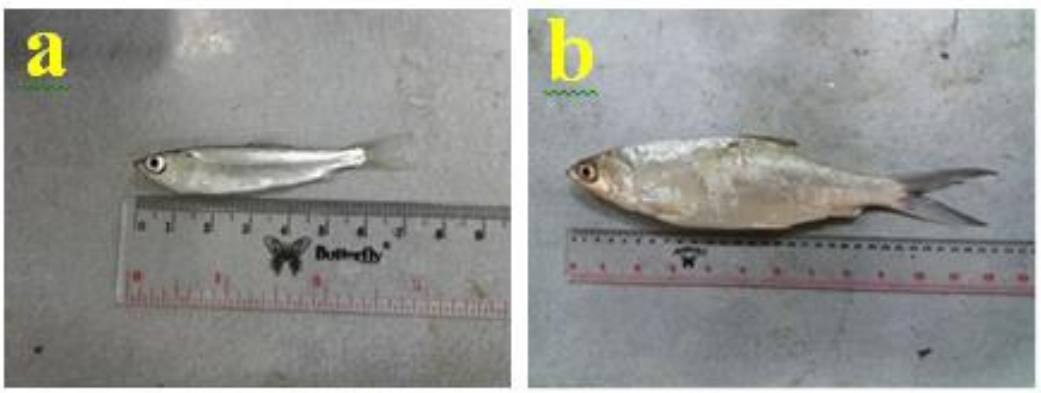


Figure 2. (a) Samples of *Chanos chanos* from a nursery pond. (b) Samples of *Chanos chanos* from a rearing pond (original).

From the harvest areas, i.e. the rearing ponds in the villages of Betoyoguci, Betoyokauman and Banyuwangi, the average length was 32.65 cm, 32.86 cm, and 33.27 cm, respectively, and the weight was 266.46 g, 267.3 g and 272.7 g, respectively. A specimen from the rearing ponds is represented in Figure 2 (b).

Sample inspection and calculation of prevalence of C. chanos ectoparasites. The ectoparasites identified in *C. chanos* samples, through the microscopic examination, were of the genus *Dactylogyrus* (Figure 3a). *Dactylogyrus* ectoparasites were found in all of the nursery pond test areas with an average prevalence value of 5.33% (Table 2), corresponding to the occasional category.

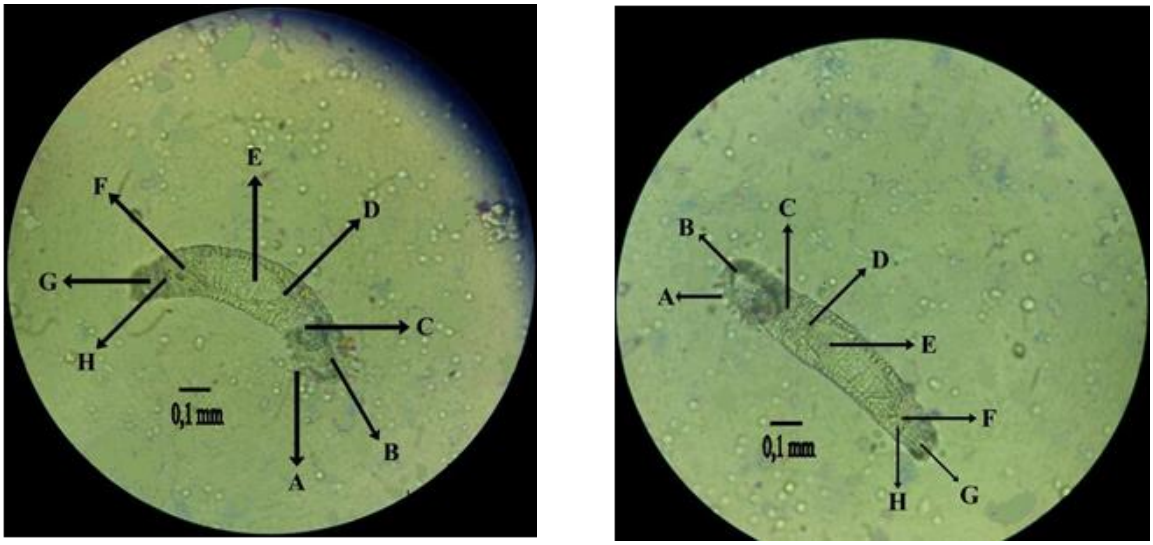


Figure 3. (a) *Dactylogyrus* on nursery ponds (100x magnification); (b) *Dactylogyrus* on an enlarged pond (100x magnification). A. Edge hooks, B. Anchors, C. Vitelline bags, D. Testicles, E. Ovaries, F. Pharynx, G. Cephalic glands, H. Eye spots.

Ectoparasites of the genus *Dactylogyrus* were found also in the samples captured in the rearing ponds (Figure 3b), with an average prevalence of 2% (Table 2), corresponding to the occasional category. The study concludes that ectoparasites present in the ponds only occasionally infested the *C. chanos* living in the aquaculture ecosystems.

Analysis of the prevalence of ectoparasites in *C. chanos* from nursery and rearing ponds was done by non-parametric statistical tests. The result of the Chi-Square test was a significant value (Asymp.sig.2-sided) of 0.293. This test had a degree of freedom value of 5, which showed significant value (11.07) in the probability value (x2) of 0.05. Besides, it also showed significant value (15.09) in the probability value (x2) of 0.01. These results indicated that there was no significant difference of ectoparasites prevalence in *C. chanos* from nursery and rearing ponds.

In addition, this study also produced data on the water quality measurement of each aquaculture pond, indicating that nursery and rearing ponds showed variable water parameters values (Table 3). Average arameter values were: a temperature of 27^{o}C, a salinity of 19 ppt, a pH of 7-8, a brightness of 26.5 cm, a DO level of 4.5 ppm, and an ammonia level of 0.03 mg L-1. In this study, brightness was used as an indicator of light intensity in the water, which shows the fish feasibility.

Table 2

Prevalence calculation results of ectoparasites in *Chanos chanos* in nursery and rearing ponds

District	*Nursery ponds*				*Rearing Ponds*			
	Sample (tails)	*Infected fish (tails)*	*Prevalence (%)*	*Category*	*Sample (tails)*	*Infected fish (tails)*	*Prevalence (%)*	*Category*
Betoyoguci	50	3	6	Occasional	50	1	2	Occasional
Betoyokauman	50	4	8	Occasional	50	2	4	Occasional
Banyuwangi	50	1	2	Occasional	50	0	0	Almost never
Total	150	8	5.33	Occasional	150	3	2	Occasional

Table 3

Observation results of nursery and rearing ponds water quality observations

Parameter	*District*					
	Betoyoguci		*Betoyokauman*		*Banyuwangi*	
	Nursery ponds	*Rearing ponds*	*Nursery ponds*	*Rearing ponds*	*Nursery ponds*	*Rearing ponds*
Temperature (^{0}C)	27	27	28	27	26	26
Salinity (ppt)	18	19	17	18	20	20
pH	8	7	7	7	8	8
Brightness (cm)	28	26	28	27	26	25
DO (ppm)	4	5	3	4	5	6
Ammonia (mg L^{-1})	0.04	0.02	0.05	0.02	0.02	0.01

Discussion. This study aimed to compare the prevalence of ectoparasites which infest *C. chanos* in the mating ponds and enlarged ponds, in order to prevent parasite infestation in both *C. chanos* ponds. Based on the results of the study, it was found that ectoparasites found in *C. chanos* samples from the nursery and rearing ponds were the genus *Dactylogyrus*. *Dactylogyrus* parasites are often found in fish species in the waters of Indonesia, India, Philippines, and several other areas. This parasite is noted to also infect *G. gotyla* fish in Indian waters (Ahmed & Sharma 2016). *Dactylogyrus* attaches to the gills using two anchors and fourteen edge hooks, which cause bleeding and determines pathological changes in the blood, threatening the lives of infested fish (Chaundhary et al 2013). Gills infested with *Dactylogyrus* will have a pale color. *Dactylogyrus* appears like a white nodule which causes the gill cover to always be open (Koyun 2011). The condition of the gills becomes severe if there is necrosis in the tissues, eventually causing the fish death due to the impairment of respiratory function (Kumar & Kumar 2013). Severe lesions of the tissue, under the skin and gills, cause a slow fish movement, a dark body color and alterations of the nervous system (Turgut et al 2012).

Overall, the prevalence of ectoparasites in nursery and rearing ponds is still classified as occasional (sometimes), which is still not a major threat for aquaculture, due to a sampling conducted during the rainy season, when the frequency of *Dactylogyrus* ectoparasites infestations is low. *Dactylogyrus* ectoparasites population density increases in the summer (dry season). The temperature is relatively stable compared to summer and winter, since there were only few temperature fluctuations during the rainy season (Hossain et al 2008). This affects the life cycle of *Dactylogyrus* where eggs hatching depends on the temperature and time of breeding of the parasite: 27 to 28 days at 8°C, 10 to 15 days at 12°C, 3 to 5 days at 20°C, and 2 to 3 days at 24-28°C (Soylu et al 2010). Thus, the results of this study indicate that there is no significant difference in prevalence between ectoparasites in *C. chanos* in nursery and rearing ponds.

In the current study, *Dactylogyrus* ectoparasites were found in the gills of *C. chanos*, a predilection also observed by Mas'ud (2011), because *Dactylogyrus* infestation occurs in host fish during feed ingestion and respiration (Özer & Öztürk 2005). The prevalence of *C. chanos* ectoparasites taken from the sampling ponds is greater than in the specimens captured from the enlarged ponds. This happens because the *C. chanos* in the nursery pond are smaller and younger so that the immune system is not fully developed.

C. chanos seeds move slower than adult milkfish, therefore it is easier for ectoparasites to infest the host (Villaluz et al 1983). Environmental factors such as water temperature and other physical physical-chemical factors tend to influence the parasite's fluctuation cycle (Modu & Shaharom2014). *C. chanos* and mullet (Mugilidae) had significantly higher growth rates during the dry season, compared to the wet season (Mirera 2011).

Other ectoparasites such as *Chilodonella* and *Trichodina* were not found in this study, due To their relatively short life cycle and to the sub-optimal living conditions. The life cycle of *Chilodonella* lasts from 12 hours to 24 hours at a water temperature of 5°C to 20°C (Bellec et al 2014). *Protozoa* ectoparasites can arise due to poor water quality conditions and poor treatment of fish (Martins et al 2015). *Lernaea* ectoparasites were not found in this study because *C. chanos* are fast swimmers. Hence, *Lernaea* ectoparasites will have difficulty infesting the *C. chanos* body using its holdfast (Stavrescu et al 2014). Also, *Lernaea* usually grow at temperatures of 20 to 25^0C, which are are relatively lower than the temperature at the time of sampling (Marina et al 2008).

Water quality in all sampling sites, both in the nursery and in the rearing ponds, was optimal for aquaculture, as indicated by the small prevalence of ectoparasites that infested both *C. chanos* in nursery and rearing ponds. A low DO content affects the oxygen supply in fish, thus the respiration process is disrupted, causing stress. DO measurement results produce an optimal value from 3 to 6 ppm. This study provides information to entrepreneurs, *C. chanos* farmers and scientists, in order to improve the culture management and the understanding of the *C. chanos* health issues. Hence,

preventive activities can be deployed in order to avoid *C. chanos* infestation with several types of ectoparasites living in the *C. chanos* ecosystem.

Conclusions. In the nursery ponds and in the rearing ponds, *Dactylogyrus* occasionally infested *C. chanos*, with an average prevalence value of 5.33% and 2%, respectively. Both aquaculture ponds had no significant differences in the prevalence values (for a significance value of 0.293) and water quality parameters (temperature, pH, brightness, oxygen levels and ammonia) indicated optimal conditions.

References

Ahmed F., Sharma K. K., 2016 First record of *Dactylogyrus racotorabus* (Monogenea) on *Gara gotyla* (Pisces, Cyprinidae) to India from Poonch River and its tributaries, District Poonch, Jammu And Kashmir. International Journal of Recent Scientific Research 7(3):9402–9405.

Bellec L., Maurer-Alcala X. X., Katz L. A., 2014 Characterization of the life cycle and heteromeric nature of the macronucleus of the ciliate *Chilodonella uncinata* using fluorescence microscopy. Journal of Eukaryotic Microbiology 61(3):313–316.

Bhuiyan A. S., Musa A. S. M., 2008 Seasonal prevalence and intensity of infestation by the ectoparasites in carps relating to physico-chemical parameters in some ponds of Mymensingh and Bogra Districts of Bangladesh. Bangladesh Journal of Scientific and Industrial Research 43(3):411–418.

Chaundhary A., Verma C., Saini S., Singh H. S., 2013 A review of Monogenean diversity in India: Pathogens of fish diseases. Journal of Coastal Life Medicine 1(2):151–168.

Dequito A. Q. D., Cruz-Lacierda E. R., Corre V. L., 2015 A case study on the environmental features associated with *Amyloodinium ocellatum* (Dinoflagellida) occurrences in a milkfish (*Chanos chanos*) hatchery. AACL Bioflux 8(3):390–397.

Echem T. R., Barba H. M., Li G., Peng F., Buenaventura N. J. C., 2018 Endoparasites in *Chanos chanos* (Forsskal, 1775) from the wetlands of Zamboanga City, Western Mindanao, Philippines. Journal of Aquaculture Research & Development 9(5):1–6.

Kumar H., Kumar A., 2013 Occurrence of *Dactylogyrus* species in *Cyprinus carpio* from Mawana, Meerut Uttar Pradesh. International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS) 2(7):1562–1570.

Hafiludin, 2015 [The analysis of nutritional content of milkfishes which come from different habitats]. Jurnal Kelautan 8(1):37–43. [In Indonesian].

Hanke I., Ampe B., Kunzmann A., Gardes A., Aerts J., 2019 Thermal stress response of juvenile milkfish (*Chanos chanos*) quantified by ontogenetic and regenerated scale cortisol. Aquaculture 500:24–30.

Hossain M. D., Hossain M. K., Rahman M. H., Akter A., Khanom D. A., 2008 Prevalence of ectoparasites of carp fingerlings at Santaher, Bogra. Bangladesh Journals Online 27:17–19.

Hsu H.-H., Chuang T.-C., Lin H.-C., Huang Y.-R., Lin C.-M., Kung H.-F., Tsai Y.-H., 2009 Histamine content and histamine-forming bacteria in dried milkfish (*Chanos chanos*) products. Food Chemistry 114(3):933–938.

Irwandi, Yanti A. H., Wulandari D., 2017 [The prevalence and intensity of ectoparasites in the *Oreochromis* sp.'s gill in the Keramba Apung, Kapuas River, Kapur District, Kubu Raya City]. Jurnal Protobiont 6(1):20–28. [In Indonesian].

Koyun M., 2011 Seasonal distribution and ecology of some *Dactylogyrus* species infecting *Alburnus alburnus* and *Carassius carassius* (Osteichthyes: Cyprinidae) from Porsuk River, Turkey. African Journal of Biotechnology 10(7):1154–1159.

Lin M. C., Liao C. M., 2008 Assessing the risks on human health associated with inorganic arsenic intake from groundwater-cultured milkfish in southwestern Taiwan. Food and Chemical Toxicology 46(2):701–709.

Ling F., Tu X., Huang A., Wang G., 2016 Morphometric and molecular characterization of *Dactylogyrus vastator* and *D. intermedius* in goldfish (*Carassius auratus*). Parasitology Research 115(5):1755–1765.

Marina H., Beatty S. J., Morgan D. L., Doupe R. G., Lymbery A. J., 2008 An introduced parasite, *lernaea cyprinacea* L., found on native freshwater fishes in the south west of Western Australia. Journal of the Royal Society of Western Australia 91(2):149–153.
Martins M. L., Cardoso L., Marchiori N., Padua S. B., 2015 Protozoan infections in farmed fish from Brazil: diagnosis and pathogenesis. Revista Brasileira de Parasitologia Veterinária 24(1):1–20.
Mas'ud, 2011 [The prevalence and level of Dactylogyrus sp. Infection in the gill of Chanos chanos in the traditional logging ponds, Glagah District, Lamongan]. Jurnal Ilmiah Perikanan dan Kelautan 3(1):27–39. [In Indonesian].
Mirera D. O., 2011 Experimental polyculture of milkfish (*Chanos chanos*) and mullet (*Mugil cephalus*) using earthen ponds in Kenya. Western Indian Ocean Journal of Marine Science 10(1):59–71.
Modu B. M., Zaleha K., Shaharom-Harrison F. M., 2014 Water quality assessment using monogenean gill parasites of fish in Kenyir Lake, Malaysia. Nigerian Journal of Fisheries and Aquaculture 2(1):37–47.
Mustafa K., 2011 Occurrence of monogeneans on some cyprinid fishes from Murat River in Turkey. African Journal of Biotechnology 10(79):18285–18293.
Özer A., Öztürk T., 2005 *Dactylogyrus cornu* Linstow, 1878 (Monogenea) infestations on vimba (*Vimba vimba tenella* (Nordmann, 1840)) caught in the Sinop region of Turkey in relation to the host factors. Turkish Journal of Veterinary and Animal Sciences 29(5):1119–1123.
Peninal S., Rathna G. S., Elavarasi A., Kalaiselvam M., 2014 First report on the record of parasitic infection in the Moray eel (*Thyrsoidea macrura*) along the Parangipettai coastal waters (Southeast coast of India). Journal of Parasitic Diseases 38(3):273–276.
Soylu E., Rüzgar B., Soylu M., 2010 Seasonal dynamics and spatial distribution of *Dactylogyrus crucifer* Wagener, 1857 on the gills of roach (*Rutilus rutilus* L.) from Lake Sapanca, Turkey. Turkish Journal of Zoology 34(3):393–398.
Stavrescu-Bedivan M. M., Popa O. P., Popa L. O., 2014 Infestation of *Lernaea cyprinacea* (Copepoda: Lernaeidae) in two invasive fish species in Romania, *Lepomis gibbosus* and *Pseudorasbora parva*. Knowledge and Management of Aquatic Ecosystems 12(414):1-10.
Thilakaratne I., Rajapaksha G., Hewakopara A., Rajapakse R. P. V. J., Faizal A. C. M., 2003 Parasitic infections in freshwater ornamental fish in Sri Lanka. Diseases of Aquatic Organisms 54(2):157–162.
Turgut N. E., Develi N., Ozgul G., 2012 Occurrence of *Dactylogyrus* species (Platyhelminths, Monogenean) on Cyprinids in Almus Dam Lake, Turkey Emine. Turkish Journal of Fisheries and Aquatic Sciences 12:15–21.
Villaluz A. C., Villaver W. R., Salde R. J., 1983 Milkfish fry and fingerling industry of the Philippines: methods and practices. Southeast Asian Fisheries Development Center International Development Research Centre, pp. 59-72.
Virgula J. C., Cruz-Lacierda E. R., Estante E. G., Corre Jr. V. L., 2017 Copper sulfate as treatment for the ectoparasite *Amyloodinium ocellatum* (Dinoflagellida) on milkfish (*Chanos chanos*) fry. AACL Bioflux 10(2):365–371.
Yong R. Q. Y. Cutmore S. C., Miller T. L., Wee N. Q.-X., Cribb T. H., 2016 A complex of Cardicola short, 1953 (Digenea: Aporocotylidae) species infecting the milkfish *Chanos chanos* Forsskål (Gonorynchiformes), with descriptions of two new species. Systematic Parasitology 93(9):831–846.
*** Direktorat Jenderal Perikanan dan Budidaya, Menteri Kelautan dan Perikanan, 2016 Laporan Kinerja (LKJ) Triwulan, Jakarta, Indonesia. [In Indonesian].

Received: 28 May 2020. Accepted: 23 October 2020. Published online: 30 October 2020.
Authors:
Wahyu Hidayatullah, Airlangga University, Faculty of Fisheries and Marine, Department of Aquaculture, Campus C UNAIR Jl. Dr. Ir. H. Soekarno, 60115 Surabaya, East Java, Indonesia, e-mail: whidayatullah@yahoo.com
Kismiyati, Airlangga University, Faculty of Fisheries and Marine, Department of Aquaculture, Campus C UNAIR Jl. Dr. Ir. H. Soekarno, 60115 Surabaya, East Java, Indonesia, e-mail: kismiyati.kismiyati@yahoo.com
Gunanti Mahasri, Airlangga University, Faculty of Fisheries and Marine, Department of Aquaculture, Campus C UNAIR Jl. Dr. Ir. H. Soekarno, 60115 Surabaya, East Java, Indonesia, e-mail: gunanti.m@fpk.unair.ac.id

How to cite this article:
Hidayatullah W., Kismiyati, Mahasri G., 2020 Prevalence of ectoparasites in milkfish (*Chanos chanos*) from nursery and rearing ponds. AACL Bioflux 13(5):3096-3104.