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A NEW REPORT OF ARGULUS INDICUS (CRUSTACEA: BRANCHIURA) INFESTATION IN RED TILAPIA (OREOCHROMIS NILOTICUS X OREOCHROMIS MOSSAMBICUS) IN THAILAND

* Supamas Sriwongpuk[1]

[1]Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi, Thailand

*Corresponding Author, Received: 14 June 2019, Revised: 15 Sept. 2019, Accepted: 08 Feb. 2020

ABSTRACT: *Argulus indicus* (Crustacea: Branchiura), or the fish louse, is an external parasite in Phylum Arthropoda found on the skin, fin or gills of freshwater fish species. It is very flat with an oval or rounded carapace, two compound eyes, sucking mouthparts with a piercing stylet, and two suction cups it uses to attach to its host. Clinical signs in infected fishes include scratching on aquarium walls, erratic swimming and poor growth. It causes pathological changes due to direct tissue damage and secondary infections. In the present study, red tilapia (*Oreochromis niloticus* x *Oreochromis mossambicus*), with symptoms such as abnormal swimming or scratches on their skin, were collected from a cage culture at Klong Rapee-Phat, Nong-Seau District, Pathum-Thani Province in Thailand. The parasites collected from the skin and fins of infected red tilapia were identified as *Argulus indicus*. This is the first report of infection with *A. indicus* of red tilapia (*O. niloticus* x *O. mossambicus*) in Thailand.

Keywords: Argulus indicus, Fish louse, Red tilapia, Oreochromis niloticus x Oreochromis mosambicus, Thailand

1. INTRODUCTION

Among crustaceans, more than 1,500 species of copepods are parasitic on fishes. *Argulus* Müller, 1785 is one genera belonging to the class Branchiura, most commonly known as fish lice or fish louse, a class of crustacean arthropods [1] that are members of a large group of branchiuran parasites related to crabs, lobsters and shrimp [2]. The genus *Argulus* (Crustacea: Branchiura), or fish louse, is a common parasite of freshwater fishes [3]. Nearly 15 species are found in freshwater fishes and several of the species are parasitic on marine fishes [4]. Fish louse belonging to the Argulidae family are skin parasites. About one hundred known species have worldwide distribution [5] and cause damage to skin epithleum by their feeding activity. The wounds bleed slowly and become the sites of secondary infections by pathogens [6]. The injury to tissue manifests as inflammation and secondary infections by microbes. If the infection is high, these parasites can cause great damage to populations of fishes in pond culture and cage culture systems [7].

Parasitic crustaceans are among the most harmful pests for fishes. Certain species cause mass infestation and mortality in fish cultures, sometimes even in nature, resulting in considerable economic losses. Fish cultures now include raising fishes not only in man-made ponds and tanks, but also in cages and pens built or suspended in large bodies of water such as reservoirs, lakes, and even marine coastal areas [8]. Fishes serve as a potential source of animal protein for humans [9]. About 40% of the protein diet of 2/3 of the entire global population comes from fishes [10]. The majority of fishes serve as an intermediate host for many parasites which can cause mass mortality thereby reducing the food value of fishes [11]. Tilapia species are freshwater fishes belonging to the family of Cichlidae which are considered to be more resistant as compared to other species of cultured fishes [12]. Crustaceans constitute one of the four recent subphyla of phylum Arthropoda which includes 1,242,040 species [13].

Tilapia is a freshwater fish belonging to the family Cichlidae. It is native to Africa, but was introduced into many tropical, subtropical and temperate regions of the world during the second half of the 20th century [14]. Tilapia is a worldwide fish of great commercial importance and it is recognized as one of the most important aquaculture species of the 21st century. Tilapia is currently ranked second only to carp in global production [15]. The world's total tilapia production in 2012 was 4.2 million tonnes. Tilapia aquaculture is rapidly expanding with a global production of about 2.8 million metric tonnes in 2008 [16] and estimated to increase to 8.89 million metric tonnes by the year 2020 [17]. The red tilapia (*Oreochromis* hybrids or *O. niloticus* x *O. mossambicus*) developed from crosses of the main *Oreochromis* culture species has also become popular in recent years [18].

The parasites use the fish for their shelter and food and destruct more or less each and every organ resulting in pathogenic effects [19]. Crustacean is an important disease producing parasites of

freshwater fishes. *Argulus* is one of a serious pathogen of fish in natural and intensive fish cultures. Many problems associated with argulid infections are a reduced rate of growth and impact on the aesthetic value of the fish host which results in economic losses in fisheries [20]. This is the first report of infection with *A. indicus* of red tilapia (*O. niloticus* x *O. mossambicus*) in Thailand. As such, the present study aims to make a survey to elucidate the morphological characteristics of *A. indicus*.

2. MATERIALS AND METHODS

In March 2017, thirty red tilapias were collected using gill nets from a cage culture at Klong Rapee-Phat, Nong-Seau District, Pathum-Thani Province in Thailand. These fishes were examined for external parasites. Twenty four fishes were found to be infected with copepod parasites. *Argulus* were found attached to the bodies on scales and fins. The parasites were carefully removed with the help of a needle and a soft brush. The specimens of *Argulus* collected from the body surface of the red tilapias were preserved in 70% ethyl-alcohol and then transferred to 2% formalin for detailed study. Using a compound light microscope at x10 and x40 magnifications, the fishes were dissected and examined. The *Argulus* parasites were fixed in 70% ethyl-alcohol and then transferred to the laboratory. The identification of the morphometric characteristics of this parasite was carried out as described previously [5, 21, 22, 23 and 24].

3. RESULTS AND DISCUSSION

Specimens of fish louse were collected in March 2017 of the body surfaces (scales, skin and fins) of red tilapias (Fig. 1) in a cage culture at Klong Rapee-Phat, together with the number of infestation values are given in Table 1.

Table 1 Infestation values of *Argulus indicus* on Red Tilapia caught from Klong Rapee-Phat

Infestation values	Number
Number of fish investigated	30
Number of fish infested	24
Prevalence (%)	80
Number of *A. indicus* on 1 fish	1-28
Total number of *A. indicus*	736

Twenty four red tilapias were found to be heavily infested with *A. indicus*. Acute haemorrhagic septicemia inflamed skin wounds (Figure 2), an increased production of mucosal material, loss of scales and corrosion of fins were observed in these red tilapias. Fish louse causes damage to the skin epithelium by their feeding activity. The wounds bleed slowly and become the site of secondary infection by pathogens [6]. The small lesions and collagen of the dermis were secondarily infected by bacteria and fungi leading to further degeneration of the epidermal layer and disruption of the basal membrane [25].

Fig.1 Fish louses (*A. indicus*) (arrow) were collected on the body surfaces (scales, skin and fins) of red tilapias

Fig.2 Acute haemorrhagic septicemia inflamed skin wounds (arrow)

The systematic position of the genus *Argulus* is as follows:

Class: Crustacea
Subclass: Branchiuran
Order: Arguloidea
Family: Argulidae
Genus: Argulus
Argulus indicus Weber, 1892

The morphological description of *Argulus indicus* can be expressed as follows (Figure 3 to 5); a wide, oval body, dorso-ventrally flattened and 2 complex faceted eyes. The cephalothorax is covered

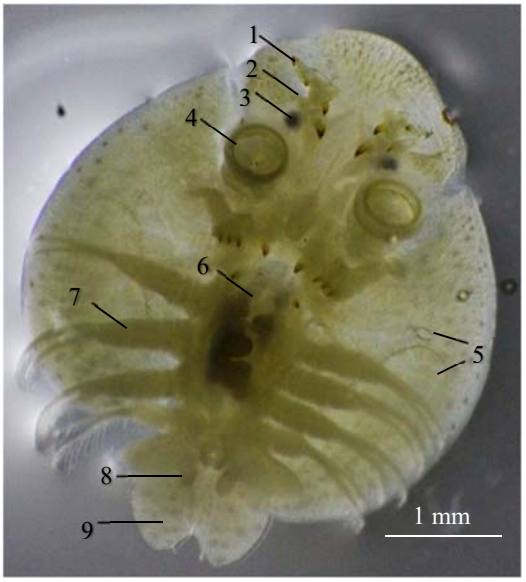

Fig.3 Ventral view of *A. indicus* (female) (scale = 1 mm), where 1=1st antenna, 2=2nd antenna, 3=eye, 4=1st maxilla or suction cup, 5=respiratory area, 6=thorax, 7=thoracic appendage, 8=spermathecal, 9=abdomen (urosome or caudal fin)

Fig.4 Ventral view of *A. indicus* (male) (scale = 1 mm), where 1=1st antenna, 2=2nd antenna, 3=eye, 4=1st maxilla or suction cup, 5= thoracic appendage, 6= abdomen (urosome or caudal fin), 7=testes

with a wide convex scutum and its posterior margin is indented. First maxillae are usually modified as powerful suctorial organs, which are clearly visible at the ventral surface. The second maxilla or suction cup, posterior to the sucker, has 5 segments. Four pairs of thoracic legs are modified for swimming. Each thoracic segment bears a single pair of biramous swimming legs (thoracopods), the first 2 pairs of which in both sexes have a backwardly projecting process or flabellum. The urosome with rounded lobes is covered marginally with small spines. The anterior end of the cephalothorax forms a broad protrusion and is delimited laterally by shallow grooves. The posterior incisures of the urosome do not reach into the center.

The carapace is almost as broad as it is long with a deep posterior sinus. The lateral lobes of the carapace convex overlap all the swimming legs. The dorsal paired ridges of the carapace curve outward beyond the paired eyes anteriorly and discontinue posteriorly with the posterior straight pieces ending near the posterior transverse groove of the cephalic region (Fig. 5).

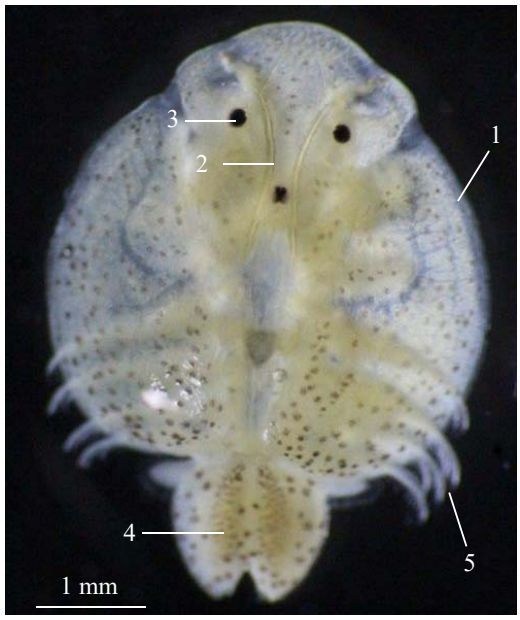

Fig.5 Dorsal view of *A. indicus* (Male) (scale = 1 mm), where 1= carapace, 2=ridges, 3=eye, 4=testes, 5=swimming leg

The minute anterior respiratory area just anterior to the very large and oblong posterior one (Figure 3 and Fig. 6); the ribs of the suction cup with 3 rods and not of the imbricate plates (Fig. 7); the second maxilla slender, basal plate with three large teeth.

The species of the fish louse *Argulus* (Crustacea: Branchiura) are found distributed throughout the world and 143 species in the genus have been described, although it is likely that many of these are synonymous [6]. Species of *Argulus* are characterized by a depressed ovoid and broad body. The head is fused with the thoracic segment forming a cephalothorax covered by a dorsal, broad, flat

shield (carapace) with posterolateral lobes. Two pair of maxillae are present, the first maxillae in the genus *Argulus* is highly modified to form cup-like suckers with strongly reinforced walls [26].

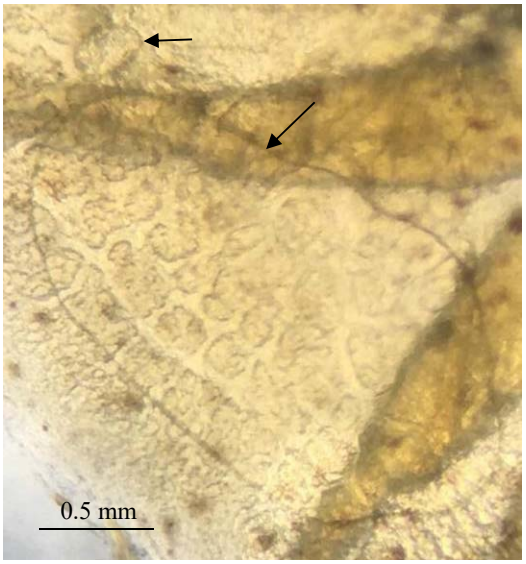

Fig.6 The respiratory area of *A. indicus* (arrow) (scale = 0.5 mm)

Fig.7 Ribs of the suction cup with 3 rods (arrow) (scale = 0.5 mm)

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This genus is distributed worldwide in both marine and freshwater habitats [5]. The genus *Argulus* causes problems in many types of aquatic systems throughout the world. Although there is a considerable literature available on the group of parasites, most is concerned with the taxonomy, morphology and development of the parasite, about which aspects are fairly well understood. There is much less reliable information available on other aspects of the biology of *Argulus*; in particular there is a need for quantitative and experimentally based studies. *A. indicus* was found on *Ophiocephalus punctatus* from West Bebgal [27], *Ophiocephalus micropeltes* from Tasik Temengor, Parak from Malasia [28] and on Major carps from Hyderabad from Pakistan [29]. There are four species of *Argulus* reported in Thailand such as *A. foliaceus, A. indicus, A. siamensis and A. alosae* [21]. *A. indicus* was found on the skin of Siam fighting fish (*Betta splendens* Regan, 1910) from Bangkok, Thailand [30]. If it is physically possible the best control method for Argulus-infected waters is to empty them of fish and allow a fallow period before re-stocking. This would have to be long enough to allow for the hatching of eggs and the death of resulting parasites. Alternatively lakes could be drained and left empty for sufficient time for eggs to be killed by desiccation or frost [31].

4. CONCLUSIONS

This research has identified and characterized the parasites residing in the red tilapia (*O. niloticus* x *O. mossambicus*) from Klong Rapee-Phat, Nong-Seau District, Pathum-Thani Province in Thailand. This is valuable information given the widespread local consumption of the fish and its significance as the main source of protein. In the study, a total of thirty red tilapia fish samples were examined and the findings revealed the existence of fish louse or *A. indicus* (Crustacea: Branchiura). The external copepod parasitic species were found on the scales, skin and fins with the highest prevalence of parasitic infection (80%) (Table 1) with the characteristic of the anterior respiratory area minute just anterior to the very large and oblong posterior one; ribs of suction cup with three rods and not of imbricate plates. All of parasites from this study were fish louse in genus *Argulus* and were identified as *A. indicus*. This is the first report of infection with *A. indicus* of red tilapia (*O. niloticus*

x *O. mossambicus*) in Thailand.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] Piasecki W. and Avenant-Oldewage A., Diseases caused by Crustacea. In Eiras J.C., Segner H., Wahli T. and Kapoor B.G. (Eds) Fish Diseases. Enfield (N.H.): Science Publishers, 2008, pp. 1115-1200.

[2] Natalie S. and Roy P.E.Y., *Argulus* (Fish Louse) Injections in Fish, The Institute of Food and Agricultural Science (IFAS), University of Florida., 2012, pp. 1-2.

[3] Mirzaei M. and Khovand H., Prevalence of *Argulus foliaceus* in Ornamental Fishes [Goldfish (*Carassius auratus*) and Koi (*Cyprinus carpio*)] in Kerman, Southeast of Iran, J. Parasit. Dis., Vol. 39, Issue 4, 2015, pp.780-782.

[4] Noaman V., Chelongar Y. and Shahmoradi A.H., The First Record of *Argulus foliaceus* (Crustacea: Branchiura) Infestation on Lionhead Goldfish (*Carassius auratus*) in Iran, Iranian J. Parasitol., Vol. 5, No.2, 2010, pp.71-76.

[5] Kabata Z., Parasites and Disease of Fish Cultured in Tropics. Tylor and Francis, London, 1985, pp. 1-317.

[6] Kabata Z. Diseases of Fishes, Book.1: Crustacea as Enemies of Fishes, T.F.H. Publication, New Jercy, 1970, pp. 1-171.

[7] Yambot A.V. and Lopez E.A., Gill Parasite *Lamproglena monodi* Capart, Infecting the Nile Tilapia, *Oreochromis niloticus* L. Cultured in Phillipines. In Diseases in Asian Aquaculture III (Flagel T.W. and Mac Rae I.H. eds.), As. Fish. Soc. Manila, 1997, pp. 175–177.

[8] Lopez N.C., Helminth and Arthropod Parasites of Some Freshwater Fishes from Laguna Lake and Vicinities. In Fish Health Problems in Laguna de Bay and Environs. PCARRD Book Series, No. 49, Los Baños, Laguna, 1988, pp.7-14.

[9] Abdel-Gaber R., Abdel-Ghaffar F., Bashtar A.R., Morsy K. and Saleh R., Interaction between the Intestinal Cestode *Polyonchobothrium clarias* (Cestode: Ptychobothriidae) from the African Sharptooth Catfish *Clarias gariepinus* and Heavy Metal Pollutants in an Aquatic Environment in Egypt, J. Helminthol., Vol 90, Issue 6, 2016, pp. 742-752.

[10] Abdel-Ghaffar F., Abdel-Gaber R., Bashtar A.R., Morsy K., Al Quraishy S., Saleh R. and Mehlhorn H., Molecular Characterization and NewG record of *Lecithochirium priacanthi* (Digenea: Hemiuridae) Infecting the Moontail Bullseye Fish *Priacanthus hamrur* (Perciformes: Priacanthidae) from the Red Sea, Egypt, Parasitol. Res., Vol. 114, Issue 12, 2015, pp. 4471-4477.

[11] Bunkley-Williams L, Williams E.H. and Bashirullah A.K.M., Isopods (Isopoda: Aegidae, Cymothoidae, Gnathiidae) Associated with Venezuelan Marine Fishes (Elasmobranchii, Actinopterygii), Rev. Biol. Trop., Vol. 54 (Suppl. 3), 2006, pp. 175-188.

[12] Akoll P., Konecny R., Mwanja W.W., Nattabi J.K., Agoe C. and Schiemer F, Parasite Fauna of Farmed Nile Tilapia (*Oreochromis niloticus*) and African Catfish (*Clarias gariepinus*) in Uganda, Parasitol. Res., Vol. 110, Issue 1, 2012, pp. 315-323.

[13] Zhang Z.Q., Animal Biodiversity: an Outline of Higher-Level Classification and Survey of Taxonomic Richness, Zootaxa, Vol. 3148, 2011, pp. 1-237.

[14] Pillay T.V.R., Aquaculture: Principle and Practices, Fishing Book News, London, 1990, pp. 1-575.

[15] Ridha M.T., Comparative Study of Growth Performance of Three Strains of Nile Tilapia, (*Oreochromis niloticus* L.) at Two Stocking Densities, Aquaculture Research, Vol. 37, Issue 2, 2005, pp. 172-179.

[16] FAO, FAOSTAT. Food and Agriculture Organization of the United Nations, 2010, pp. 12-14.

[17] Tacon, A.G.J. and Metian M., Global Overview on the Use of Fish Meal and Fish Oil in Industrially Compounded Aquafeeds: Trends and Future Prospects, Aquaculture, Vol. 285, No. 1-4, 2008, pp. 146-158.

[18] Teichert-Coddington D.R., Green B., Boyd C.E., Harvin J.L., Rodriguez R., Martinez D., and Ramírez E., Effect of Diet Protein on Food Conversion and Nitrogen Discharge During Semi-Intensive Production of *Penaeus vannamei* During the Wet Season. In Burke D., Goetze B., Clair D. and Egna H. (Editors), Fourteenth Annual Technical Report, Pond Dynamics/Aquaculture CRSP, Office of International Research and Development, Oregon State University, Corvallis, Oregon, 1997, pp. 71-77.

[19] Lilley J.H., Philips M.J. and Thongutai K., A Review of Epizootic Ulcerative Syndrome (EUS) in Asia. Publ. Aquatic Animal Health Research Institute and Network of Aquaculture

Center in Asia-Pacific, Bangkok, Thailand, 1992, pp. 1-73.

[20] Taylor N.G.H., Sommerville C. and Wootten R., The Epidemiology of *Argulus* spp. (Crustacea: Branchiura) Infections in Stillwater Trout Fisheries, Journal of Fish Diseases, Vol. 29, Issue 4, 2006, pp. 193-200.

[21] Sirikanchana P., Parasites of Aquatic Animal, Sky Word Advertising Partnership Ltd., Bangkok, 2003, pp. 1-270.

[22] Bykhoskaya-pavlovskaya I.E., Gusev A.V., Dubinina M.N., Izvumova N.A., Smimova T.S., Sokolo-vskava I.L., Shietin G.A., Shulman S.S. and Epstein V.M., Key to Parasites of Freshwater Fish of USSR, Israeli Program for Scientific Translation, Jerusalem, 1964, pp. 1-694.

[23] Hoffman G.L., *Argulus*, a Branchuiran Parasite of Freshwater Fishes, U.S. Fish and Wildlife Service. Fish Disease Leaflet 49, 1977, pp. 1-9.

[24] Thomas M.M. and Devaraj M., Two New Species of *Argulus* Müller (Crustacea: Branchiura) from River Cauvery with a Key to Indian Species, Central Marine Fisheries Research Inst., Regional Centre, Mandapam Camp (India), 1977, pp. 215-220.

[25] Bauer O.N., Musselius V.A. and Strelkov Y.A., Disease of Pond Fishes, Israel Program for Scientific Translations, Jerusalem, 1973, pp. 152-154.

[26] Richard H., Other Ectoparasites Infesting Fish; Copepods, Branchiurans, Isopods, Mites and Bivalves, Aquaculture Magazine November/ December, 2003, pp. 1-7.

[27] Ramakrishna G., Note on the Indian Species of the Genus *Argulus* Müller (Crustacea, Copepoda) Parasitic on Fishes, Indian Museum Calcutta Records, Vol. 49, Issue 2, 1951, pp. 207-215.

[28] Seng L.T., Two Ectoparasitic Crustaceans Belonging to the Family Argulidae (Crustacea: Branchiura) in Malaysian Freshwater Fishes, Malayan Nature Journal, Vol. 39, 1986, pp. 157-164.

[29] Jafri S.I.H. and Ahmed S.S., A New Record of Ectoparasitic Crustaceans (Branchiura: Argulidae) from Major Carps in Sindh, Pakistan, Pakistan Journal of Zoology, Vol.17, Issue 1, 1991, pp. 11-13.

[30] Wilson C.B., A Copepod (*Argulus indicus*) Parasitic on the Fighing-Fish in Siam, Journal of the Siam Society, Natural History Supplement, Vol. 7, Issue 1, 1972, pp. 1-3.

[31] Tonguthai K., Control of Freshwater Fish Parasites: a Southeast Asian Perspective, International Journal of Parasitology, Vol. 27, Issue 10, 1997, pp. 1185-1191.