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Short Communication

Micippion asymmetricus: An Entoniscid Parasite of the Coral Crab, *Charybdis feriatus* (Linnaeus, 1758)

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ABSTRACT

Parasite of *Charybdis feriatus* has been identified as *Micippion asymmetricus* Shiino (1942) on the basis of epicraidean larvae's 6th pareopod size and shape. Parasitic castrator retards the development of the gonads or destroys sex cells resultant complete atrophy in *Charybdis feriatus.* Infestation (5%) appears as biological limiting factor which causes fluctuation in *Charybdis feriatus* abundance. Infestation in *C. feriatus* observed throughout the year except August and December. Maximum number of infestation recorded in January with 10 individuals and minimum in February and it effect on their growth, gonad development as well as on population. Among deep sea crabs *C. feriatus* stand first in high fecundity but their population ranked after *P. pelagicus* and *P. sanguinolentus* in Karachi waters. *Charybdis feriatus* is widely distributed throughout the Indo-Pacific region and is fished for human consumption. The crab has very good market potential but more knowledge is required of its basic biology and ecology.

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Authors' Contribution
SM conceived and designed the study. ZK collected samples. SM and SS analyzed the data and wrote the article.

Key words
Entoniscid parasite, Coral crab.

Charybdis feriatus (Linnaeus, 1758) is commonly known as crucifix crab or coral crab. Local fisherman named it "lal kakra" (Red crab) due to its colour. *Charybdis feriatus* has good potential for aquaculture because of its high quality of meat, taste, size and high fecundity (Parado-Estepa *et al.*, 2002; Siddiqui and Ahmed, 1992). Male crabs grow larger than the females, the largest size recorded so far is 200 mm across the carapace (Ng, 1998) and male crabs may reach more than 1 Kg in weight (Parado-Estepa *et al.*, 2002; Abello and Hispano, 2006).

The family Entoniscidae (Isopoda-Epicaridea) has extreme morphological variation (Williams and Boyko, 2012). Morphologically and physiologically entoniscids has suggested external parasite by Giard and Bonnier (1887) and Hartnoll (1960) while Veillet (1945) has suggested as internal parasite. The family has been studied only from few areas of Atlantic and Pacific oceans (Hartnoll, 1960).

The first entoniscid isopod which infects a host becomes a female, and second isopods that settle on this particular host become male. Epicaridean can undergo sex reversal, if female die or removed, the male that remains in direct contact with the host can transform into a female (Bush *et al*., 2001). A positive correlation in host size and infection suggested by many workers (Allen, 1966; Hartnoll, 1967; Pike, 1960; Bourdon 1963). Parasitic castrators (Epicaridean) are found typically host specific (Giard, 1887).

The first described species of Entonoscidae was *Entoniscus porcellanae* from an anomuran crab, *Porcellana* discovered by Muller (1862) in Brazil. Species belonging to the genus were recorded from Europe by Giard (1887), Fraisse (1878) and Shiino (1942). All were parasitic on the brachyuran crabs such as *Pilmnus vespertilio*, *Leptodius exacratus* and *Philyra.*

The objective of the present study was to identify the parasite which causes atrophy of gonad in *Charybdis feriatus*. However, parasites of this commercial crab have never been reported before.

Materials and methods

Crabs were collected monthly from commercial landings at Korangi Fish Harbour (about 24º48'48 N: 67º14'39 E), Karachi. Most of the crabs were dead at the time of landing. Total 416 female crabs and 374 male were dissected for the period of May 2004 to April 2006. After preliminary studies (weighed, sex, numbered) crabs were refrigerated for further study. Carapace of the crabs was carefully removed and the parasite, if present was detached and preserved in 10 % formalin.

Identification criterion and terminology of Shiino (1942) was used. Drawings were made with the help of camera lucida fitted on an Olympus microscope. Photographs were taken by Olympus digital camera. The coastal meteorology and hydrography of Karachi is

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controlled by the seasonal changes in the north Arabian Sea *i.e.* monsoonal system.

Description

Parasites associated with *Charybdis feriatus* has been identified as *Micippion asymmetricus* Shiino, 1942. *Charybdis feriatus* containing an adult parasite can be recognized externally by a lump on carapace; while in a dissected crab it is recognized by unusual mass *i.e.* cephalogaster and marsupium of the parasite (Fig. 1).

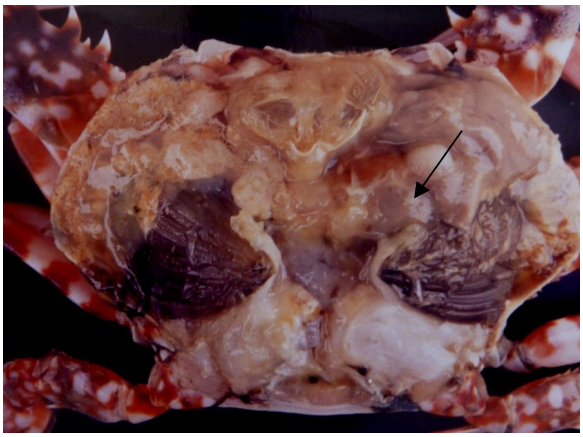

Fig. 1. Infected *C. feriatus*, unusual mass, marsupium full of ova marked with an arrow.

Fig. 2. Mature Female *Micippion asymmetricus* Shiino, 1942, with marsupium (as per scale)

Family: Entoniscidae Kossmann, 1881

Type locality

Karachi (Pakistan)

Diagnosis

Entoniscidae have appearance of internal parasites, but they are actually external (Shields and Ward, 1998). Shiino (1942) described different characters for entoniscidae family; which are other than Giard and Bonnier (1887) and Atkins (1933). He recognized entoniscidae family on the basis of "V" shape body, in which one arm is made up from head and thorax and the other by abdomen. The change of curvature occurs somewhat earlier, when the ovarian processes begin to develop and is maintained throughout its life only in the genus *Entoniscus*. Body continued beneath the alimentary canal, directing both its end towards anterior side of host but ventral curvature not maintained throughout its life in the genus *Micippion.* He described three developmental stages of entoniscid female. Remarkable sexual dimorphism has been shown in Entoniscidae.

Micippion asymmetricus Shiino, 1942

Locality

Arabian Sea, Pakistan, Karachi, Korangi creek (collected from harbor)

Host

Charybdis feriatus (Linnaeus, 1758), (Crucifix crab)

Parasite

Micippion asymmetricus Shiino, 1942

Diagnosis

Females (Fig. 2) are greatly deformed and lack any traces of metamarism whereas males retain isopods characters, being dwarf and usually found within the marsupium of female. Marsupium is full of ova, yellow ovary and white cephalogaster and abdomen.

Cephalon or cephalogaster are the paired rounded white structure distinctly separated from the thorax. Thorax is nearly cylindrical, greater part of the thoracic surface represents morphologically the ventral surface. The thorax bears on its ventral surface conspicuous processes which contain the ovary; they may be called ovarian processes. Ovarian processes are thick and closely bordering at thorax. *Micippion* shows appreciable asymmetry in its body, the dorsal ovarian processes is dissimilar on each side. Hepatopancreas are red and ventrally situated (Fig. 3). Lamellar process is of great depth and has wrinkle appearance and shrink and pack in membrane when immature. On maturity they come out from host sheath and filled with eggs and larvae. The lamella is supported by cartilaginous hooks. Double infestation has also been observed.

Epicaridean

The first larva or the epicaridea stage stays for some time in marsupium. Epicaridean larvae (Fig. 4) bear isopod appearance and strongly convex dorsally. Body

covered with diffuse and parallel rows of chromatophores. Paired eyes are oval and each divided in four parts. Cephalon strongly curved and rounded. Anntenules are biramouse with four joints; basal segment consist of two distal spines. Antenna composed of seven joints with lateral spines, distally projecting. 1st five periopods are alike in shape and size, 6th periopods is unlike by shape and size. 7th is absent. Pleopods uniramous and all are same in shape and size. Uropoda biramous with subequal rami.

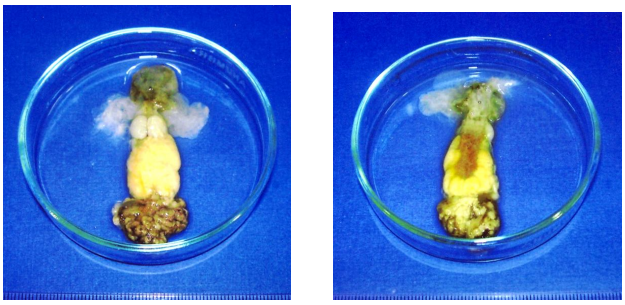

Fig. 3. Female *Micippion asymmetricus* Shiino, 1942 (Dorsal and Ventral view) (as per scale).

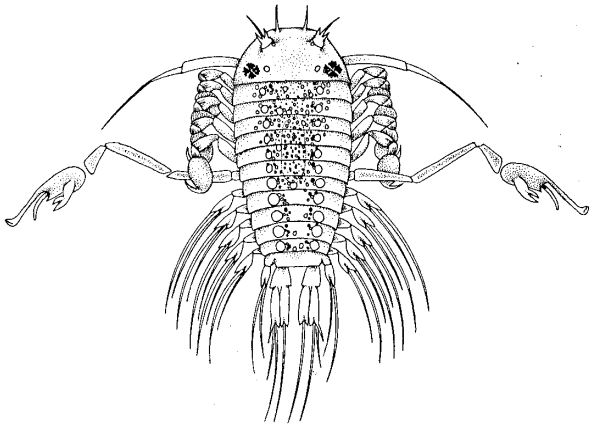

Fig. 4. Epicaridean larva of *Micippion asymmetricus* Shiino, 1942.

Eggs

Brood pouch filled with a mixture of eggs and advanced larval forms which represent batch spawning. Sacs colours progress creamy, yellow, peach and then grey. Within a host two sacs are of same or different colours observed. Following embryogenesis eggs attain round to kidney shape (Fig. 5).

Maximum infestation was recorded in January with 10 individuals (Fig. 6). The collection in June 2005 showed 16% infestation in overall sampling periods. The infestation was observed all the year around except August and December.

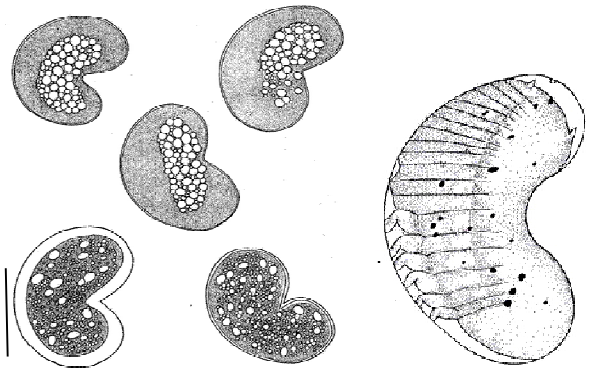

Fig. 5. Developmental stages of *Micippion asymmetricus* Shiino, 1942, Bar= 25µm

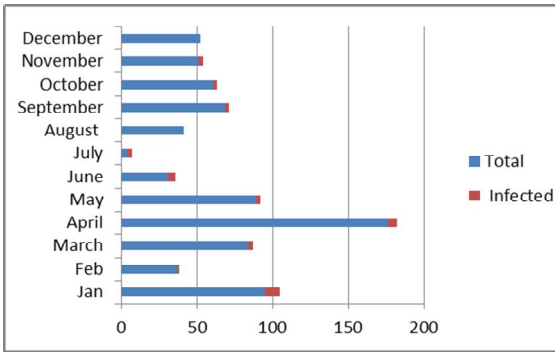

Fig. 6. Infestation in monthly catches of *Charybdis feriatus*

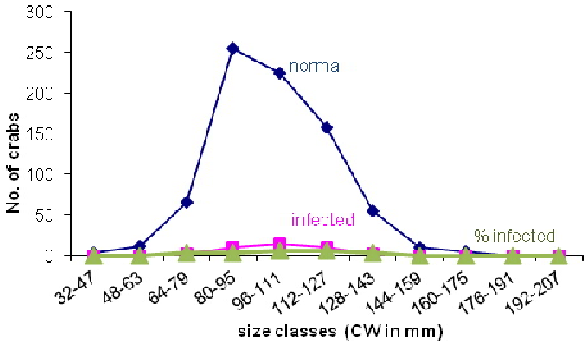

Fig. 7. Infestation in size classes of *Charybdis feriatus*

Developmental stage

Parasite of infected crab has been identified as *Micippion asymmetricus* Shiino, 1942 on the basis of

Epicaridium 6th periopod's shape and size. Entoniscid invasion (5%) appeared as biotic limiting factor for *Charybdis feriatus* populations. Total 790 crabs were studied in which 38 were found infected. Out of 416 female crabs 18 (4.33%) while out of 374 male 20 (5.35%) were found infected by entoniscid.

Highest crabs collection belongs to 80-95 mm size class but most of infested crabs found in 96-111 mm and 112-127 mm size classes (Fig. 7). The smallest host found with 76 mm CW; while the largest having 134 mm CW. No marked difference was found in male and female host infestation. All crabs were found sexually immature. None of the females was found in ovigerous condition. Transformation of cryptoniscan larva has not been observed. The cryptoniscan (last larval stage) larva, which is to become a male, seems to enter the female marsupium in 3rd stage (stage before 1st oviposition). No sign of entoniscid female moulting was observed. Females were categorized as immature, those without ooestigites. Mature have completely develop oostegites as described by McDermott (1998).

Discussion

The superfamily Bopyrina included three families as Dajidae (parasitic in the incubatory chamber or on the dorsal surface of the Mysids and Euphosiids), Bopyridae (in branchial cavity or on the abdominal cavity of the Anomuran and Macrura) and Entoniscidae (in visceral cavity of Brachyura and Anomura) (Hartnoll, 1960).

Castration of crustacean host has been suggested as nutritional drain by the parasite and secretion of toxic substance (Cencig *et al.,* 2013; Reinhard, 1956), reduction in circulating reproductive hormones (Robert, 1997; Lafferty and Kuris, 2009; Walker, 1977), indirect hormonal castration (Hechinger, 2010; Baudoin, 1975) or in male host, decline of secretion by the androgenic gland (Chariniaux-Cotton, 1960). Castrators may use advantage by the reduction of host reproductive efforts by the sense of increased host survivorship (Shawal *et al.,* 2008; Caladona *et al.,* 2005; Wecker, 1962); increased host growth (Calado *et al.,* 2005; Cheng, 1971) and increased energy availability (Hughes, 1940). Fisher (1962) has shown that in insect only one individual of a species can survive. Arrival of second castrators causes the death of earlier castrator (Veillet, 1945).

Infection causes seizing of the gonads development in both male and female crabs and castration of the secondary sexual characteristics (Raffi *et al.,* 2012). Hence the reproductive potential of the infected host was zero in all (Duneau *et al.,* 2012; Trottier and Jeffs, 2015). Infected hosts were also not capable of mating (Ocampo *et al.,* 2014; Trottier and Jeffs, 2015). Shields and Ward (1998) reported 3.2% infestation in majid crab from Lizrd Island; Reinhard (1945) reported 0.8 % infection rate in hermit crabs from Woods Hole; whereas Adkison and Heard (1978) reported 3% infestation in hermit crab in North Carolina. In this study infection rate is 5 % in *C. feriatus* populations from coastal water of Karachi. Infected crabs also commensalized by barnacles. Intersexuality, protogyny or protendary not observed in *C. feriatus* like in other crustacean (Bouchereau *et al.,* 2012; Sagi *et al.,* 1996; Subramonium, 1981).

Double infestation also observed in this study. Multiple infections are usually rare then randomly expected for more entoniscids, bopyrids as well as sacculinids (Hartnoll, 1967); in connection with many terminologies used; like symparasitisum; superparasitisum, multiparasitisum. Fisher (1962) described in insect only one individual of a species can survive, arrival of second castrators causes the death of earlier castrator. In crustacea mixed infection by parasitic castrators are not common.

Remarks

Parasite *Micippion asymmetricus* Shiino, 1948 reported first time from host *Charybdis feriatus* (Linnaeus, 1758) as earlier by Shiino (1942) in *Micippa philyra* (Herbst) crab.

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Statement of conflict of interest

Authors have declared no conflict of interest.

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