J Parasit Dis (Jan-Mar 2016) 40(1):124–128
DOI 10.1007/s12639-014-0460-4

ORIGINAL ARTICLE

Distribution of isopod parasites in Carangid fishes from Parangipettai, Southeast coast of India

Ganapathy Rameshkumar · Samuthirapandian Ravichandran · Mathan Ramesh

Received: 7 March 2014 / Accepted: 26 March 2014 / Published online: 18 April 2014

Abstract Crustacean parasites absorb their nourishment directly from hosts for feeding. The present study was aimed at collecting information as possible on this so far neglected group of isopod parasites of the Carangid fishes of Parangipettai coastal environment. A very little information is available regarding the isopod parasites of Carangid fishes. In the present study six species of isopods belonging to 3 genera were found on four species of fishes. The distribution of *Catoessa boscii* is found throughout the year.

Keywords Distribution · Isopod · Carangid fishes · Parangipettai

Introduction

Isopods occur very commonly as parasites in food fishes. Isopod parasites are usually large and fierce looking and the damage they cause to the host fishes is considerable (Overstreet 1978). Rokicki (1985) studied the specificity of isopod parasites, zoogeography and the vertical distribution of isopod parasites in host systems in the north-west African shelf. Host specificity is the tendency of a parasite to occur on one or a few host species and is a product of co-existence between both parasite and host lineages (Poulin 2007).

According to Trilles (1986), 46 species of Cymothoidae have been reported in Africa (12 Anilocrinae and 34 Cymothoidae). Horton and Okamura (2002) reported distribution of the recently discovered association of the parasitic isopod *Ceratothoa steindachneri* (Isopoda: Cymothoidae) with the lesser weever fish (*Echiichthys vipera*). *Anilocra frontalis* which feed mainly on blood (Trilles et al. 1989; Bragoni et al. 1984) are frequent on different fish species.

The Indian cymothoid fauna is relatively poorly known and until now studies on these parasitic isopods were scanty on marine fishes from the Indian coasts (Pillai 1954, 1964; Rameshkumar and Ravichandran 2010; Rameshkumar et al. 2011, 2012, 2013). Those cymothoids which live on the surface of the fish, however, would seem to be less specific in their environmental requirements and to thus occur in various positions. Certainly such an assumption accounts for the paucity of information on the positioning of these forms; most authors generalise by locating the parasites with reference to the major sub-divisions of the body e.g. the head or trunk. A few related works are available on the nature of infestation of isopods parasites in fishes (Williams and Williams 1994; Cuyas et al. 2004). But no specific studies on the distribution of isopod parasites in Carangid fishes were done. Hence an attempt has been made to study the distribution of the isopod parasites in Carangid fishes.

Materials and methods

The study was based on one year observations during December 2012 to November 2013. Fishes were collected

G. Rameshkumar (✉) · M. Ramesh
Unit of Toxicology, Department of Zoology, School of Life Sciences, Bharathiar University, Coimbatore 641 046, Tamil Nadu, India
e-mail: grkumarcas@gmail.com

S. Ravichandran
Centre of Advanced Study in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai 608 502, Tamil Nadu, India

directly from the trawlers landed at Parangipettai coast. Isopods were removed from the body surface and the buccal cavities of the fish hosts and immediately placed into 70 % ethanol. Mouthparts and appendages were carefully dissected using dissecting needles and forceps. Fish samples were examined thoroughly for the presence of isopod parasites. Host nomenclature and fish taxonomy are according to Fish Base (Froese and Pauly 2013). The host species and site of attachment of parasites were noted. The parasites were identified according to Brünnich (1783), Milne Edwards (1840), Bleeker (1857) and Bovallius (1887).

Results

During the present study six species including three genera (*Catoessa, Cymothoa* and *Nerocila*) of isopods belonging to the family Cymothoidae infesting four species of Carangid fishes along the Parangipettai coast were studied (Table 1). Two species were found to penetrate on the body surface of the hosts and another two were collected from the buccal cavity while two was noted on the fins (Figs. 1, 2, 3, 4, 5, 6 and 7).

Distribution of isopod parasites

A total of 294 specimens of isopods represented by six species belonging to 3 genera were found on four species of fishes (Table 1). Of these nineteen, *Nerocila phaeopleura* was found on *Carangoides* sp. and one on each of the fishes. Of the twelve *N. depressa* were found on the left and right side of the body surface of the two fishes *Selaroides leptolepis* and *C. malabaricus* and seven parasites of the *N. sundaica* and five parasites of *N. loveni* were found on the body surface and fin regions of *C. malabaricus*, eight parasites of *C. eremita* were found in the buccal cavity and mouth region of *Parastromateus niger*. Maximum number of 243 parasites of *Catoessa boscii* was distributed in the buccal cavity of *C. malabaricus* (Fig. 8). The 4 different parasites belonging to

Fig. 1 *N. sundaica* on *C. malabaricus*

Fig. 2 *N. depressa* on *C. malabaricus*

Fig. 3 *N. loveni* on *C. malabaricus*

Fig. 4 *N. depressa* on *S. leptolepis*

Table 1 Cymothoid isopods collected from carangid fishes

Species	Number of parasites	Host	Capture
Nerocila phaeopleura	19	*Carangoides* sp.	Trawlers
Nerocila depressa	12	*Selaroides leptolepis* and *C. malabaricus*	Trawlers
Nerocila sundaica	7	*C. malabaricus*	Trawlers
Nerocila loveni	5	*C. malabaricus*	Trawlers
Cymothoa eremita	8	*Parastromateus niger*	Trawlers
Catoessa boscii	243	*C. malabaricus*	Trawlers

Fig. 5 *N. phaeopleura* on *Carangoides* sp.

Fig. 6 *C. boscii* in *C. malabaricus*

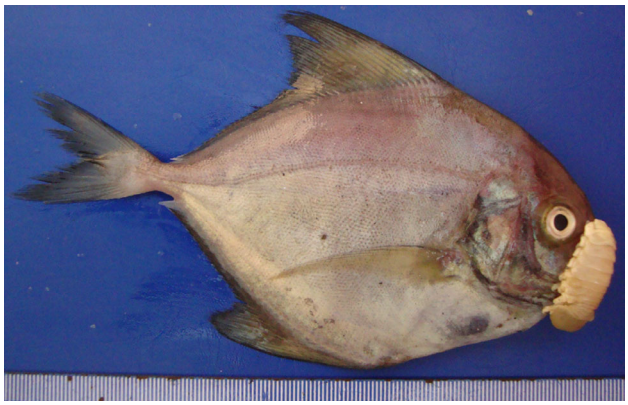

Fig. 7 *C. eremita* on *P. niger*

the genus *Catoessa* and *Nerocila* were recorded (*C. boscii, N. depressa, N. loveni* and *N. sundaica*) from *C. malabaricus.*

Mode of attachment of parasitic isopods

Catoessa boscii and *C. eremita* invading the buccal cavity of *C. malabaricus* and *Parastromateus niger* respectively. The parasites are normally seen protruding through the mouth opening of the host. Many cymothoids occur in the mouth and buccal cavity of the host fish and their position is thus highly specific. The parasite was attached in such a way that the broader posterior part of the parasite was lodged in the wider portion of the floor of the buccal cavity and the narrow anterior part was either located towards the mouth opening or protruding out through the mouth. In some fish, two *C. boscii* parasites was normally found, of which one was the large ovigerous female found in mouth and the other one small and more active male observed in the buccal cavity. Most of the females of these species attach right-side up on the tongue of fishes. Only two parasites specifically attach up-side-down on the roof of the mouth of fishes. During the study period *C. boscii* was recorded through out the year.

Species belonging to the genus *Nerocila* are generally found as external parasites on fishes. *N. phaeopleura* invading on the body surface of *Carangoides* sp. *N. depressa* attached on the body surface of *S. leptolepis* and *N. depressa, N. sundaica* and *N. loveni* has been found at different areas of body, including the upper pectoral fin, between pectoral and pelvic fin, the upper pelvic fin, between pelvic and anal fin, the upper anal fin, under the dorsal fin and the caudal peduncle (Table 2) of *C. malabaricus*. They were found attached to the host by hook-like projections mandibles and first maxillae and first two thoracic legs. In all cases of the attached position, the body was directed towards the anterior end of the fish.

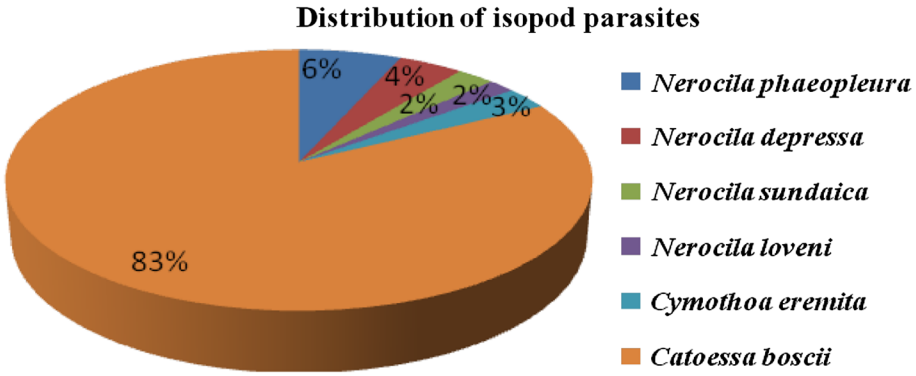

Fig. 8 Distribution of cymothoid isopods from carangid fishes

Table 2 Microhabitats of isopod parasites in host fishes

Buccal parasites	Body surface parasites
Catoessa boscii	*N. depressa*
Cymothoa eremita	*N. loveni*
	N. phaeopleura
	N. sundaica

Discussion

Too little is known about isopods associated with fishes in the southern Caribbean to adequately discuss their zoogeography (Bunkley-Williams et al. 2006). In Kuwait Bowman and Tareen (1983) reported that nine species of Cymothoidae. Later Bruce and Harrison-Nelson (1988) recorded twenty-nine species from the genera *Anilocra, Creniola, Nerocila, Pleopodias* and *Renocil*a are recorded or reported from the Indo-West Pacific. Fourteen species of cymothoids were reported from the eastern Pacific (Brusca 1981). Fourteen Cymothoidae have been reported from Algeria, the majority being widely distributed in the Mediterranean (Ramdane et al. 2007). Nine new species of *Anilocra* were reported from the West Indian coral reef fishes (Bunkley Williams and Williams 1981). In India seven species of cymothoid isopods parasitic on the marine fishes of the Kerala coast were reported (Pillai 1964). Veerappan et al. (1999) reported that seven species of isopod parasites from marine food fishes of Parangipettai. However, it seems to also occur in some fish-parasitic isopods *C. boscii, C. eremita, N. sundaica, N. loveni, N. depressa* and *N. phaeopleura* have a widely distributed in the Carangid fishes of Parangipettai coastal waters.

Isopods of broad specificity are characterized by a distribution of potentially wider range than species of narrow specificity. Bowman (1960) reported the narrow host specificity of *Lironeca puhi*, as the parasite is a common one of *Gymnothorax eurostus* in the Hawaiian island. Williams and Williams (1982) reported that *Anilocra chromis* prefer the host fish *Chromis multilineatus*. Rokicki (1985) stated that the distribution of *C. plebia* is limited to the environment of one host species *Brachydeuterus auritus* and considered the parasite as phylogenetically order. In this study revealed that *C. eremita*, *C. boscii, N. loveni*, *N. sundaica* and *N. phaeopleura* have narrow host specificity. Veerappan et al. (1999) reported that *Joryma* sp, *J. brachysoma, Agarna engraulidis*, *Glossobius* sp., *C. indica* and *Ryukyua circularis* have narrow host specificity. Hence the present study shows only a narrow host specificity, when a complex of host species is restricted.

Trilles (1964) distinguished ecologic and neogenic specificity of Cymothoidae in the Mediterranean Sea. Ecologic specificity has a broad range, this being connected with feeding behaviour of the host and possibility of infestation in natural conditions. The host fishes may form shoals and may live in homologous biotopes at least for a part of year, so that they mix partly. Migration of fishes may influence and enhance broad host range. Broad host specificity especially in pelagic fishes may be due to the reason that the fishes would produce numerous actively swimming levels and this enables the infestation of wide range of hosts (Rokicki 1985). Within the present study observed *N. depressa* had broad host specificity, when the hosts are represented by a variety of species viz., *C. malabaricus* and *S. leptolepis*. The specificity can be discussed only as a result of interaction between ecological, physiological and phylogenetic factors, and cannot as an independent property of some genera.

Trilles (1964) significantly showed that a number of cymothoids, including *N. orbignyi* and *N. bivittata* are specific in their choice of hosts, whereas other genera are less specific. The results of this investigation indicate that *N. phaeopleura*, although comparatively primitive in being an external parasite and being highly host specific is also highly specialized to a mode of life upon a pelagic, fast swimming host. It lives on a highly specific region of the body. This position is determined by the needs of the parasite and the limitations exerted by the morphology and habits of the host. In the present study specificity was observed in the host of 4 species of *Nerocila* species collected, than other genera of *Cymothoa* and *Catoessa*.

Panikkar and Aiyar (1937) recorded *C. indica* on *Etroplus maculatus*, *E. suratensis* and *Glossogobius giuris* from the Adyar estuary. Evangeline (1963) reported the occurrence of this parasite, in the Adyar fish farm, from a variety of host's, viz., *E. suratensis*, *Tilapia mossambica*, *Macrones gulio*, *Gobius giuris*, *Polynemus tetradactylus*, *Pomadasys hasta* and *Sphyraena obtusata*. It is thus evident that *C. indica* exhibits a wide geographic and host distribution. The findings of the present study also supports with earlier works. Jayadev Babu and Sanjeeva Raj (1984) noticed infestation in several regions like the chin, nape and pectoral fin base and the buccal cavity. The damage of gill filaments thus was not only due to feeding but also by the pressure exerted by the dorsal side of the parasite. In the present study also *C. boscii, N. depressa, N. loveni* and *N. sundaica* from *C. malabaricus* and *C. boscii* and *C. eremita* invading the buccal cavity of *Parastromateus niger* and *C. malabaricus* respectively and *N. depressa* attached on the body surface of *S. leptolepis.* The parasite *C. boscii* was mostly collected through out the 1 year December 2012 to November 2013 compared to other species. *C. boscii* was attached and damage only in the buccal region of *C. malabaricus*.

The site of attachment of *C. boscii* in *C. malabaricus* the brush like pads on the roof of the buccal cavity, renders much protection to the parasite. The threat of being washed into oesophagus with the incoming water current, which parasites of the buccal cavity have overcome by resorting to firm attachment to the host tissue. *C. boscii*, although comparatively primitive in being a buccal parasite and being highly host specific is also highly specialised to a mode of life upon a pelagic, fast swimming host. It lives on a highly specific region of the body. This position is determined by the needs of the parasite and the limitations exerted by the morphology and habits of the host. Although, the infestation did not cause immediate death, it had affected the normal growth of the host fish.

Acknowledgments Author (G.Rameshkumar) are thankful to UGC, New Delhi for the grant of Dr. D. S. Kothari Post-Doctoral Fellowship No. F.4-2/2006 (BSR)/13-1011/2013(BSR) and The Head, Department of Zoology, Bharathiar University, Coimbatore for providing facilities and encouragement.

References

Bleeker P (1857) Recherches sur les Crustacés de l'Inde Archipélagique. II. Sur les Isopodes Cymothoadiens de l' Archipel Indien. Natuurkundige Vereeniging in Nederlandsche-Indie, Batavia, Verhandelingen, 2: 20–40, pls 1–2

Bovallius C (1887) New or imperfectly known Isopoda. Part III—Bihang till Kongelige svenska Vetenskapsakademiens. Handlingar 18(4):1–21

Bowman TE (1960) Description and notes on the biology of *Lironeca puhi* n. sp. (Isopoda: Cymothoidae). Parasite of the Hawaiian moray eel, Gymnothoraxeurostus (Abbott). Crustaceana 1:82–91

Bowman TE, Tareen IU (1983) Cymothoidae from fishes of Kuwait, ArabianGulf (Crustacea: Isopoda). Smith Contrib Zool 382:1–30

Bragoni G, Romestand B, Trilles JP (1984) Parasitoses à Cymothoadien chez le loup *Dicentrarchus labrax* (Linnaeus, 1758) en élevage. I. Ecologiesitaire dans le cas de l'étang de Diana (Haute-Corse) (Isopoda: Cymothoidae). Crustaceana 47(1):44–51

Bruce NL, Harrison-Nelson B (1988) New records of fish parasitic marine isopod crustaceans (Cymothoidae: Subfamily *Anilocrinae*) from the Indo-West Pacific. Proc Biol Soc Wash 101(3):585–602

Brünnich T (1783) Den barbugede Pampelfish (*Coryphaena apus*) en nye Art, og dens Giaest, Strukketrolden (*Oniscus eremita*) en Opdagelse af Dr. Konig paa Madrass. Nye Samling af det Kongelige Danske Videnskabersnes Selkabs Skrifter 2:319–325

Brusca RC (1981) A monograph on the isopods Cymothoidae (Crustacea) of the Eastern Pacific. Zool J Linn Soc 73:117–199

Bunkley Williams L, Williams EH Jr (1981) Nine new species of *Anilocra* (Crustacea: Isopoda: Cymothoidae) external parasites of West Indian coral reef fishes. Proc Biol Soc Wash 94(4):1005–1047

Bunkley-Williams L, Williams EH Jr, Bashirullah AKM (2006) Isopods (Isopoda: Aegidae: Cymothoidae: Gnathiidae) associated with Venezuelan marine fishes (Elasmobranchii: Actinopterygii). Revis de Biol Trop 54:175–188

Cuyas C, Castro JJ, Santana Ortega AT, Carbonnel E (2004) Insular stock identification of *Serranus atricauda* (Pisces: Serranidae) through the presence of *Ceratothoa steindachneri* (Isopoda: Cymothoidae) and *Pentacapsula cutancea* (Myoxoa: Pentacapsulidae) in the Canary Islands. Sci Mar Bare 68:159–163

Evangeline G (1963) Occurrence of the isopod fish parasite *Cymothoa indica*, in the Adayar fish farm, Madras. Mad J Fish 1:7–10

Froese R, Pauly D (2013) Fish stocks. In: Levin S (ed) Encyclopedia of biodiversity, vol 2. Academic Press/Elsevier, Waltham, pp 477–487 Updated version of Pauly and Froese's 2001 entry in the 1st edition

Horton T, Okamura B (2002) The distribution of *Ceratothoa steindachneri* (Crustacea: Isopoda: Cymothoidae) parasitic in *Echiichthys vipera* in the North-East Atlantic. J Mar Biol Ass UK 82:415–417

Jayadev Babu S, Sanjeeva Raj PJ (1984) Isopod parasites of fish of Pulicat lake. Proc Symp Coast Aqu (Fin Fish) 3:818–823

Milne Edwards HM (1840) Histoire Naturelle des Crustacés comprenant l'anatomie, la physiologie et la classification de ces animaux III. Librairie Encyclopédique de Roret, Paris

Overstreet RM (1978) Marine maladies. Worms, germs and other Symbionts from the Northern Gulf of Mexico, Mississippi, Alabama Sea Grant Consortium

Panikkar NK, Aiyar RG (1937) On a cymothoan parasitic on some brackish water fishes from Madras. Curr Sci 5:429–430

Pillai NK (1954) A preliminary note on the Tanaidacea and Isopoda of Travancore. Bull Cent Res Inst Univ Travancore 3:1–21

Pillai NK (1964) Parasitic isopods of the family Cymothoidae from South Indian fishes. Parasitology 54:211–223

Poulin R (2007) Evolutionary ecology of parasites. Chapman and Hall, London

Ramdane Z, Bensouilah MA, Trilles JP (2007) The Cymothoidae (Crustacea: Isopoda), parasites on marine fishes, from Algerian fauna. Belg J Zool 137(1):67–74

Rameshkumar G, Ravichandran S (2010) New host record, *Rastrelliger kanagurta*, for *Nerocila phaeopleura* parasites (Crustacea: Isopoda: Cymothoidae). Mid-East J Sci Res 5(1):54–56

Rameshkumar G, Ravichandran S, Trilles JP (2011) Cymothoidae: (Crustacea: Isopoda) from Indian fishes. Act Parasitol 56(1):78–91

Rameshkumar G, Ravichandran S, Trilles JP (2012) Observation on an isopod parasitizing the edible fish *Parastromateus niger* in the Parangipettai coast of India. J Environ Biol 33(2):191–193

Rameshkumar G, Ravichandran S, Sivasubramanian K, Trilles JP (2013) New occurrence of parasitic isopods from Indian fishes. J Parasit Dis 37(1):42–46

Rokicki J (1985) Biology of adult Isopoda (Crustacea) parasitizing fishes of Northern West Africa shelf. Acta Ichthyol Et Piscatorial 15(1):95–119

Trilles JP (1964) Specificite parasite chez les Isopodes Cymothoidae Mediterraneens. Note preliminnaire-Vie et Milieu 15:105–116

Trilles JP (1986) Les Cymothoidae (Crustacea, Isopoda, Flabellifera) D'Afrique. Bull Mus National Hist Nat 8(3):617–636

Trilles JP, Radujkovic BM, Romestand B (1989) Parasites des poissons Marins du Montenegro: Isopodes. Acta Adriat 30(1–2):279–306

Veerappan N, Perumal P, Ravichandran S (1999) Distribution and infestation of isopod parasites from marine food fishes of Parangipettai, Southeast coast of India. The Fourth Indian Fisheries Forum Proceedings pp 323–325

Williams EH Jr, Williams LB (1982) Predisposition of a pomacentrid fish *Chromis multilineatus* (Guichenot) to parasitism by cymothoid isopod *Anilocra chromis* Williams. J Parasit 68(5):942–945

Williams EH Jr, Williams LB (1994) Four cases of unusual crustacean-fish associations and comments on parasitic processes. J Aquat Anim Health 6:202–208