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Maiden occurrence of the isopod, *Norileca indica* (H. Milne Edwards, 1840) in pelagic and demersal finfishes of Visakhapatnam waters along north-west Bay of Bengal

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Species of Cymothoid isopod, *Norileca indica* (H. Milne Edwards, 1840) was very often observed to infest the fishes. Detailed morphological features of the parasitic species are presented along with their incidence and prevalence in the three host fishes from June, 2013 - March, 2014. Prevalence, mean intensity and abundance were 39.03±8.04%, 1.13±0.00 and 0.44±0.10 for *R. kanagurta*, 40.34±1.73%, 1.35±0.12 and 0.54±0.02 for *S. insidiator* and 45.43±5.68%, 1.25±0.07 and 0.56±0.04 for *N. randalli*. Sex of the host was found to have an effect on prevalence and abundance of the parasite, with higher values reported from females. High prevalence and abundance of the parasite during post trawl ban period coincided with the peak landings of their hosts. Prevalence and abundance were relatively higher in smaller specimens of the host fishes. This is the first instance wherein cymothoid isopod, *N. indica* has been recorded in finfishes from the waters of Visakhapatnam along north-west Bay of Bengal.

[Keywords: *Rastrelliger kanagurta*, *Nemipterus randalli*, *Secutor insidiator*, Visakhapatnam and *Norileca indica*]

Introduction

Crustacean ectoparasites on marine fishes are diverse. Most of marine fishes are infected by crustacean isopod belonging to family Cymothoidae. Isopod parasites of the family Cymothoidae have been reported in about 350 species of fishes[1]. There are about 330 species of isopods reported worldwide belonging to the family Cymothoidae[2]. However, only around 56 species are reported from Indian waters. Most cymothoid are highly host and site specific. They are protandric hermaphrodites and holoxenic as they complete their life cycle in a single host. They live on the skin, buccal, branchial and body cavities and feed on the blood of the host.[2, 3, 4]. Parasitism by cymothoids has been found to decrease fecundity in adult fishes[5]. These large sized parasites retard growth and cause emaciation followed by death[2] thus causing significant economic losses to fisheries.

Norileca indica (Milne-Edwards, 1840), a cymothoid isopod, is reported to be widely distributed in the pelagic marine teleosts of Thailand[6] off Sumatra in Indonesia, Philippines, New Guinea[7, 8], Pakistan[9], China[10], Mozambique[11] as well as eastern and western Australia waters [12,13]. In the Indian seas, *N. indica* has previously been observed from *Rastrelliger kanagurta* off south-eastern India[14] and from *Selar crumenophthalmus* off Mumbai coast[15] but nothing has been reported till date from waters of north-west Bay of Bengal. As a matter of fact, so far none of the isopod parasites have been recorded from the marine fish landings along the north-east coast of the country bordering Bay of Bengal. The present study, on the occurrence and infestation of cymothoid isopod parasite *N. indica* in marine finfishes landed at Visakhapatnam, forms the first of its kind along the north-east coast and therefore assumes paramount importance.

Materials and Methods

Samples of most commercial finfishes were collected from the landings of gillnets and trawlers at Visakhapatnam Fishing Harbor (17^0 70' N and 83^0 30' E) during the months from June, 2013 - March, 2014 and were brought to the laboratory and examined for the presence of parasites. No samples were collected during April and May due to monsoon fishing ban. Out of all, Indian mackerel *Rastrelliger kanagurta*, pugnose ponyfish *Secutor insidiator*, and threadfin breams, *Nemipterus randalli* were found to be regularly infested with isopods. Fishes were measured for length and weight, dissected to determine sex and investigated for the presence of isopods in the skin, buccal,

branchial and body cavities with the help of a dissecting microscope. The number of isopods, their attachment site and orientation in each host were observed. The number of isopod infested and non-infested fishes was also recorded. Live isopods from host were removed using dissecting needles and forceps and measured for length and weight. Isolated isopods were cleaned and fixed in 4% formaldehyde solution in physiological saline and preserved in 70% ethanol for taxonomic identification. Photomicrographs were taken using an Olympus digital camera C7070 fitted to the Olympus CX41 microscope. The isopod parasites were identified as *N. indica* [2,16]. Specimens of the isopod parasites were deposited at National Marine Biodiversity Repository of Central Marine Fisheries Research Institute, Cochin, and India with accession number Misc.25. Prevalence, mean intensity and abundance of the parasite in each host were calculated [17, 18]. Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) was employed to study the differences at 5% probability level and make comparisons on the effect of month, host size and sex to the prevalence, mean intensity and abundance of *N. indica*.

Results

Apart from *R. kanagurta*, *S. insidiator* and *N. randalli*, regular isopod infestation was not observed in any specimens of other commercially important finfishes landed at Visakhapatnam. A total of 366 specimens of *R. kanagurta* (average weight of 92.86 g ± 4.5g), 246 specimens of *S. insidiator* (average weight of 11.02 g ± 3.5g) and 168 specimens of *N. randalli* (average weight of 51.34 g ± 2.5g) were examined for the presence of isopod parasite. One hundred and forty four specimens of *R. kanagurta* (Fig. 1), 100 specimens of *S. insidiator* (Fig. 2) and 77 specimens of *N. randalli* (Fig. 3) were found to be parasitized by the isopod as depicted in the figures.

Fig. 1- *N. indica* attached to the operculum of *R. kanagurta*

Isopod parasites attached mostly on the body surface and the branchial cavity of the host fishes causing considerable atrophy and necrosis. They were found to be positioned ventrally with their body twisted to the right in left branchial cavity and to the left in right branchial cavity. Both adults and mancae (juvenile parasitic stages of cymothoid) of *N. indica* were observed in the fishes. Egg laying gravid females was found in the buccal cavity and their laid eggs were found on the gill filaments (Fig. 4). As regards to the morphometry of the parasite, their body is about 2.27-2.75 times as long as its width and twisted to one side; widest at fourth pereonite and dorsum moderately convex with ill-defined longitudinal median ridge. The cephalon is not deeply immersed in first pereonite with the anterior

Fig. 2- *N. indica* attached to the operculum of *S. Insidiator*

Fig. 3- *N. indica* attached to the operculum of *N. randalli*

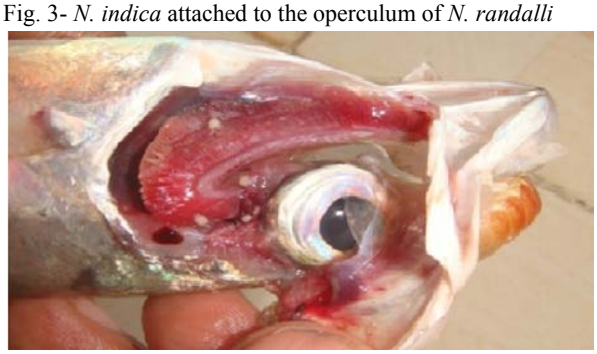

Fig.4- Egg laid by gravid females on gill filaments of *R. kanagurta*

margin subtruncate. The posterior margin of seventh pereonite is weakly concave. The fifth Pleonite is as wide as first pleonite and the mandible palp third article is much smaller than second article. Pleotelson is triangular and the anteromedial surface vaulted. Antennule extends to first pereonite and antenna slightly longer than the antennule. The color was dark reddish over dorsal surface particularly on pleon with brown on sides and pleotelson appeared red with white patches on ventral side (Fig. 5). Their size ranged from 11 to 25 mm (17.92±2.33 mm). This species could easily be distinguished from *Norileca triangulata* by the larger size, twisted body shape, straight sided pleon, shorter uropods and shorter mandible palp.

Prevalence was 39.03±8.04% in *R. kanagurta*, 40.34±1.73% in *S. insidiator* and 45.43±5.68% in *N. randalli*. Average number of parasite (mean intensity) was 1.13±0.00 for *R. kanagurta*, 1.35±0.12 for *S. insidiator* and 1.25±0.07 for *N. randalli.* The abundance was 0.44±0.10 in *R. kanagurta*, 0.54±0.02 in *S. insidiator* and 0.56±0.04 in *N. randalli*. For *R. kanagurta*, though the mean intensity (1.13±0.05) was more or less equal between the sexes, prevalence and abundance were higher in females (47.37±8.12% and 0.54±0.09) when compared to males (30.68±5.67% and 0.35±0.07). Prevalence was higher in females of *S. insidiator* (42.07±4.22%) than males (38.61±4.59%) whereas mean intensity and abundance was higher in males (1.46±0.06 and 0.56±0.07) in comparison to females (1.23±0.06 and 0.52±0.06). In *N. randalli*, mean intensity was higher in males (1.32±0.08) than females (1.17±0.06), however prevalence and abundance were found to be higher in females (51.11±5.15% and 0.60±0.06) than in males (39.74±6.08% and 0.53±0.09). The prevalence, mean intensity and abundance of *N. indica* in *R. kanagurta*, *S. insidiator* and *N. randalli* in relation to months, host length and sex is presented in Tables 1, 2 and 3 respectively. Prevalence and abundance of *N. indica* differed significantly ($p<0.05$) among various months in *R. kanagurta* (F_{cal} 4.38 and 5.10), *S. insidiator* (F_{cal} 7.94 and 5.52) and *N. randalli* (F_{cal} 8.07 and 6.49). With relation to host length, *N. indica* prevalence and abundance were significantly ($p<0.05$) different only in *S. insidiator* (F_{cal} 10.62 and 14.40). With relation to sex, *N. indica* prevalence and abundance were significantly ($p<0.05$) different in *R. kanagurta* (F_{cal} 10.62 and 14.40) *and N.randalli* (F_{cal} 10.62 and 14.40).

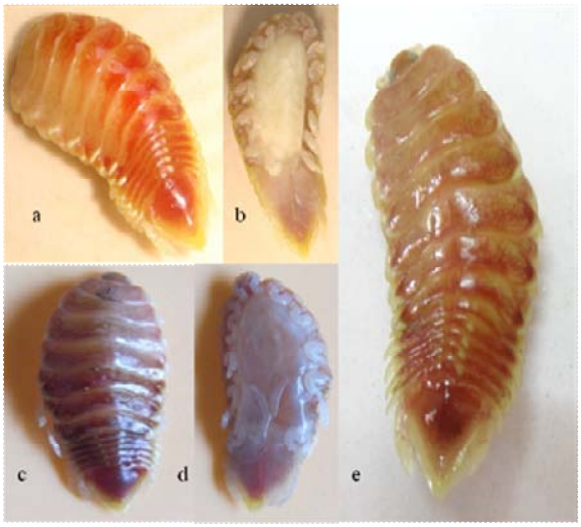

Fig.5- Gravid female of *N. indica* collected from *R. kanagurta (a, b), N. randalli (c, d) & S. insidiator (e)*

Significantly ($p<0.05$) higher prevalence and abundance for *R. kanagurta* was observed during July and August, whereas higher mean intensity was recorded during August to November (Table 1). In *R. kanagurta*, smaller fishes (upto 185 mm) exhibited higher prevalence and abundance whereas; in larger fishes (more than 185 mm) higher mean intensity of the parasite was observed (Table 1).For *R. kanagurta*, though the mean intensity of parasite was more or less equal between the sexes, the prevalence and abundance of parasite were higher in females when compared to males (Table 1).

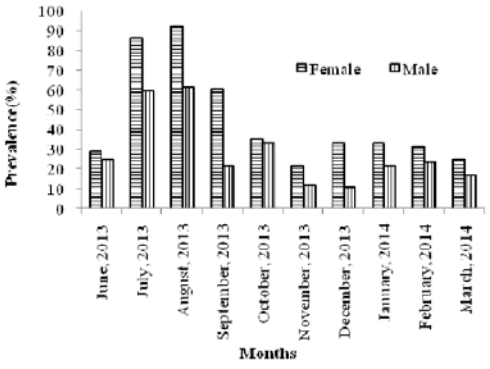

Fig.6: Prevalence of *N. indica* in relation to sex of *R. kanagurta* during different months

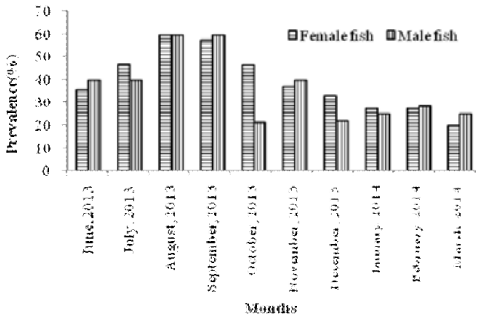

Fig.7: Prevalence of *N. indica* in relation to sex of *S. insidiator* during different months

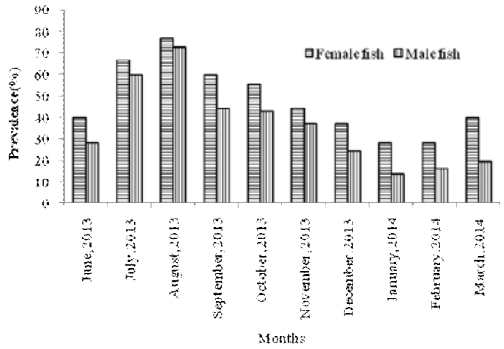

Fig.8: Prevalence of *N. indica* in relation to sex of *N. randalli* during different months

Months of August and September recorded significant ($p<0.05$) higher prevalence and abundance of parasite in *S. insidiator* (Table 2). Mean intensity of parasite in *S. insidiator* was highest in June, followed by March and October. Prevalence, mean intensity and abundance in relation to body size depicted significantly ($p<0.05$) higher prevalence and abundance in fishes ranging in lengths from 75 mm to 105 mm and highest mean intensity was observed in fishes measuring more than 105 mm (Table 2). Prevalence of parasite was higher in females of *S. insidiator* than males, whereas mean intensity and abundance was higher in males in comparison to females (Table 2).

Table1. Prevalence, mean intensity* and abundance of *Norileca indica* on *Rastrelliger kanagurta* in relation to months and host length

	Prevalence (%)	M.I.*	Abundance
	Month		
June, 2013	26.79±1.79	1.08±0.08	0.29±0.04
July, 2013	72.73±13.64	1.10±0.05	0.80±0.11
August, 2013	76.27±15.40	1.16±0.02	0.89±0.19
September, 2013	40.53±19.47	1.33±0.17	0.51±0.19
October, 2013	34.17±0.83	1.14±0.14	0.39±0.06
November, 2013	16.41±4.64	1.25±0.25	0.22±0.10
December, 2013	21.92±11.40	1.00±0.00	0.22±0.11
January, 2014	27.38±5.95	1.17±0.17	0.31±0.02
February, 2014	26.92±3.85	1.00±0.00	0.27±0.04
March, 2014	20.83±4.17	1.00±0.00	0.21±0.04
	Length class (mm)		
< 145	40.63±7.29	1.08±0.01	0.44±0.08
145-165	52.41±11.87	1.16±0.04	0.60±0.11
165-185	48.33±11.67	0.91±0.18	0.46±0.20
185-205	25.40±3.17	1.21±0.04	0.31±0.05
205-225	25.87±4.13	1.57±0.23	0.37±0.02
>225	24.71±4.71	1.23±0.03	0.30±0.05
	Sex		
Male	30.68±5.67	1.13±0.05	0.35±0.07
Female	47.37±8.12	1.13±0.05	0.54±0.09

Table 2. Prevalence, mean intensity* and abundance of *Norileca indica* on *Secutor insidiator* in relation to months and host length

	Prevalence (%)	M.I.*	Abundance
	Month		
June, 2013	37.86±2.14	1.60±0.40	0.61±0.19
July, 2013	43.53±3.53	1.31±0.19	0.56±0.04
August, 2013	60.00±0.00	1.35±0.10	0.81±0.06
September,2 013	58.95±1.05	1.39±0.06	0.82±0.02
October, 2013	34.05±12.62	1.48±0.19	0.48±0.12
November, 2013	38.75±1.25	1.13±0.13	0.44±0.06
December, 2013	27.78±5.56	1.25±0.25	0.33±0.00
January, 2014	26.14±1.14	1.25±0.25	0.32±0.05
February, 2014	27.92±0.65	1.42±0.08	0.40±0.03
March, 2014	22.22±2.5	1.50±0.00	0.34±0.04
	Length class (mm)		
< 75	29.17±4.17	1.35±0.15	0.39±0.01
75-85	45.58±2.25	1.42±0.03	0.65±0.05
85-95	47.62±4.76	1.39±0.11	0.65±0.01
95-105	43.78±1.67	1.18±0.12	0.52±0.07
>105	20.83±4.17	1.60±0.40	0.32±0.02
	Sex		
Male	38.61±4.59	1.46±0.06	0.56±0.07
Female	42.05±4.22	1.23±0.06	0.52±0.06

Highest mean intensities of the parasite for the species were recorded in October and December. *N. randalli* measuring less than 175 mm, showed higher prevalence and abundance of the parasite, whereas still smaller ones, measuring less than 155 mm showed higher mean intensity of parasite infection (Table 3). In *N. randalli*, mean intensity of parasite infection was higher in males compared to females, however prevalence and abundance of parasite

were found to be higher in females than in males (Table 3).

Prevalence of *N. indica* in relation to sex of *R. kanagurta*, *S. insidiator* and *N.* ra*ndalli* in different months is also given in Figs. 6, 7 and 8. Females of *R. kanagurta* and *N. randalli* exhibited higher prevalence in all months compared to males. For *S. insidiator*, prevalence was higher in females in July, October, December and January and in males in June, September, November, February and March.

Discussion

N. indica was previously reported as *Livoneca (or Lironeca) indica*, Milne Edwards, 1840 or *Livoneca ornata,* Heller, 1868. Later, it has been assigned to present genus[13]. Six species of marine pelagic fishes so far has been reported as natural host for *N. indica* viz., *Atule mate* (Blackfin scad)[12], *S. crumenophthalmus* (Bigeye scad) [6,13,11&15], *Alepes apercna* (smallmouth scad)[7], *Decapterus russelli* (Indian scad)[9], *R. kanagurta*[9,11&19],and *Herklotichthyes sp*[9,13]. Fishes of the family Carangidae are considered as their preferred hosts because four of the six species belong to this family. In the present study, in addition to *R. kanagurta*, two new hosts, *S. insidiator* and *N. randalli* are reported to be parasitized by *N. indica*. Unlike previous studies, wherein carangids were found to be their preferred hosts, apart from infestation in few stray specimens of *A. mate*, *N. indica* was neither observed in *S. crumenophthalmus* nor in *D. russelli*. Negating earlier studies on the host specificity of *N. indica* [14&15] wherein it has been stated that *N. indica* is limited to one host species in a given environment, in the present study the parasite was isolated regularly from three hosts occupying three distinct ecological niche. In India, *N. indica* has been reported from *R. kanagurta and S. crumenophthalmus* from west and south-east coast of India[15&19]. The occurrence of the parasitic *Norileca triangulata* was reported on lesser sardine, *Sardinella gibbosa* from south-east coast of India[21]. This is the first study on the occurrence of *N. indica* in marine finfishes landed at Visakhapatnam along the north-east coast of India bordering north-west Bay of Bengal. Till date, *N. indica* infestation in finfishes was restricted to six pelagic fishes of the families Carangidae, Clupeidae and Scombridae. This is the first reported occurrence of *N. indica* in demersal fishes belonging to the family Leiognathidae and Nemipteridae. Therefore, it can be inferred from the present study that *N. indica* has undergone extension in its horizontal geographic distribution towards the northern latitudes of Bay of Bengal, and has also undergone extension in their vertical distribution.

Table 3. Prevalence, mean intensity* and abundance of *Norileca indica* on *Nemipterus randalli* in relation to months and host length

	Prevalence (%)	M.I.*	Abundance
	Month		
June, 2013	34.29±5.71	1.25±0.25	0.41±0.01
July, 2013	63.33±3.33	1.23±0.10	0.78±0.02
August, 2013	74.83±2.10	1.29±0.09	0.96±0.04
September,2013	52.22±7.78	1.21±0.04	0.63±0.07
October, 2013	49.21±6.35	1.43±0.23	0.61±0.06
November,2013	40.97±3.47	1.00±0.00	0.41±0.03
December,2013	31.25±6.25	1.42±0.08	0.44±0.06
January, 2014	21.43±7.14	1.25±0.25	0.29±0.14
February, 2014	22.62±5.95	1.00±0.00	0.23±0.06
March, 2014	30.00±10.00	1.25±0.25	0.40±0.20
	Length class (mm)		
< 135	60.00±20.00	1.50±0.00	0.90±0.30
135-155	50.00±10.00	1.42±0.08	0.70±0.10
155-175	59.72±15.64	1.19±0.06	0.70±0.15
175-195	47.00±3.00	1.23±0.05	0.58±0.06
195-215	35.38±4.62	1.04±0.21	0.36±0.03
>215	23.33±3.33	1.38±0.13	0.32±0.02
	Sex		
Male	39.74±6.08	1.32±0.08	0.53±0.09
Female	51.11±5.15	1.17±0.06	0.60±0.06

Parasitic infestation of finfishes depends mainly upon host factors such as age, size, sex, maturity stage, behaviour, feeding and breeding. Prevalence, mean intensity and abundance of the parasite were all higher in *S. insidiator* and *N. randalli* in comparison to *R. kanagurta*, contradicting earlier notion where pelagic finfishes have been told as its preferred host for attachment. For *R. kanagurta* and *N. randalli*, prevalence and abundance were higher in females than males. Similarly in *S. insidiator*, females recorded more prevalence than males. This is found to be in agreement with the findings of earlier studies [15, 20 & 22].This could be due to the lowering of estrogen levels in female fishes during breeding season which makes them more susceptible to parasitic infestations [23]. Mean number of *N. indica* in all the three host fishes ranged from 1.13±0.00 to 1.35±0.12. Similarly, Lanzing and O'Connor (1975) found

it uncommon for the occurrence of more than two isopod parasites on the same host fish. The occurrence of cymothoid isopods in natural population is patchy and levels of prevalence are extremely variable[24]. Higher prevalence compared to the present study is reported for *N. indica* from gill cavities of *S. crumenophthalmus* [6&11] caught off Mozambique and Thailand, whereas the prevalence was more or less similar in *S. crumenophthalmus* landed at Mumbai[15]. The parasite-host interactions among isopods and marine fishes have shown high parasite prevalence coinciding with a high abundance of the host fish[25]. At Visakhapatnam, along north-west Bay of Bengal, peak landings of most finfishes are recorded in the post trawl ban period during the months of July, August and September[26]. This could have resulted in an increased prevalence of *N. indica* in *R. kanagurta*, *S. insidiator* and *N. randalli* due to higher availability of host fishes in these months[25]. There are also report on the parasitic preference towards certain body sizes which varies depending upon the species of the host[27]. Similarly, in the present study, prevalence and abundance of *N. indica* infestation were higher in relatively smaller fishes of *R. kanagurta* and *N. randalli*. The reason could be the physiological condition of the hosts which were preferred by *N. indica.*

N. indica infestation in finfishes is recorded for the first time from the waters of Visakhapatnam along north-west Bay of Bengal. Demersal finfishes viz., *S. insidiator* and *N. randalli*, for the first time in history are recorded as hosts for the highly host specific isopod parasite. Thus, the findings of the present study is highly important considering the fact that it deals with the extension in horizontal as well as vertical distribution of the parasitic isopod, *N. indica* along the Bay of Bengal.

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References

1. Sethi, S., Occurrence of isopod parasites in clupeids off Chennai coast, India. *Indian J. Fish.,* 59(3) (2012): 153-155**.**
2. Trilles, J.P., Ravichandran S., and Rameshkumar G., A checklist of the Cymothoidae (Crustacea, Isopoda) recorded from Indian fishes. *Acta. Parasitol.* 56(4) (2011) 446–459.
3. Ramdane, Z., Bensouilah, M. A. and Trilles, J. P., The cymothoidae (Crustacea, Isopoda), parasites on marine fishes, from Algerian fauna. *Belgian J. Zool.,* 137(2007) 67-74.
4. Trilles, J. P., Les Cymothoidae (Crustacea, Isopoda) du monde. *Studia Marina,* 21/22(1994) 5-288.
5. Fogelman, R. M., Kuris, A. M. and Grutter, A. S., Parasitic castration of a vertebrate: effect of the cymothoid isopod, *Anilocra apogonae*, on the five-lined cardinal fish, *Cheilodipterus quinquelineatus*. *Int. J. Parasitol.,* 39 (2009) 577–583.
6. Nagasawa, K. and Petchsupa, N., *Norileca indica* (Isopoda, Cymothoidae) parasitic on Bigeye Scad, *Selar crumenophthalmus* in Thailand. *Biogeography* 11 (2009) 131–133.
7. Trilles, J.P., Les Cymothoidae (Isopoda, Flabellifera) des cotes Francaises. Ill. Les Lironecinae Schiodte et Meinert, 1884. Bull du Mus Nat d'hist Nat Paris 3-serie, no. 392. *Zoologie* 272(1976) 801–820.
8. Yamauchi, T., Ohtsuka, S. and Nagasawa, K., Ectoparasitic Isopod, *Norileca indica* (Crustacea, Isopoda, Cymothoidae), obtained from the Stomach of *Coryphaena hippurus* (Perciformes, Coryphaeniadae) in the Philippines. *Biogeography* 7(2005) 25–27.
9. Ghani, N., Isopod parasites of marine fishes of Pakistan. *Proc. Pakistan Con. Zool.,* 23 (2003) 217-221.
10. Yu, H. Y., Li, X. Z., Study on the Cymothoidae from Chinese waters. *Stud. Mar. Sin*. 45(2003) 223–238.
11. Rokicki, J., *Lironeca indica* Edwards, 1840 (Crustacea, Isopoda) from *Selar crumenophthalmus* (Bloch). *Wiad. Parazytol*. 38 (1982) 205–206.
12. Avdeev, V.V., Notes on the distribution of the marine Cymothoidae (Isopoda, Crustacea) in the Australian-New Zealand region. *Folia Parasitol.* 25 (1978) 281–283.
13. Bruce, N. L., The genera *Catoessa, Elthusa, Enispa, Ichthyoxenus, Idusa, Livoneca* and *Norileca n.gen*. (Isopoda, Cymothoidae), crustacean parasites of marine fishes, with descriptions of eastern Australian species. *Rec. Aust. Mus.,* 42(3) (1990) 247–300
14. Rameshkumar, G., Ravichandran, S., Sivasubramanian, K. and Trilles, J. P., New occurrence of parasitic isopods from Indian fishes. *J. Parasit. Dis.,* 37(2012) 42-46.
15. Neeraja, T., Gayatri, T. and Ummey, S., Occurrence of the isopod, *Norileca indica* (Isopoda: Cymothoidae) on big eye scad, *Selar crumenophthalmus* (Bloch) off Mumbai coast, India. *Indian J. Fish*., 61(1) (2014) 49-56.
16. Bruce, N. L., Australian *Pleopodias* Richardson, 1910, and *Anilocra* Leach, 1818 (Isopoda, Cymothoidae), Crustacean Parasites of Marine Fishes. *Rec. Aus. Mus.*, 39(1986) 85–130.
17. Bush, A. O., Jeffrey, M. L., Lafferty, K. D. and Shostak, A. W. Parasitology meets ecology on its own terms: Margolis *et al.,* Revisited. *J. Parasit.,* 83 (1997) 575-583.
18. Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M. and Schad, G. A., The use of ecological terms in parasitology (report of an ad hoc committee of the American Society of Parasitologists). *J. Parasit.,* 68 (1) (1982) 131-133.
19. Rameshkumar, G., Ramesh, M., Ravichandran, S., Trilles, J. and Subbiah, S., New record of *Norileca indica* from the west coast of India. *J. Parasit. Dis.* (2014) doi: 10.1007/s12639-014-0416-8.

20. Ravichandran, S., Rameshkumar, G., Mahesh Babu, B. and Kumaravel, K., Infestation of *Rastrelliger kanagurta* with cymothoid isopod, *Joryma brachysoma* in the colachel environment of south-west coast of India. *J. Fish. Mar. Sci*., 1(2009) 80-84.
21. Rameshkumar, G. and Ravichandran, S., First occurrence of *Norileca triangulata* (Crustacea: Isopoda: Cymothoidae) from Indian marine fishes. *J. Parasit Dis*. (2014) doi: 10.1007/s12639-013-0274-9.
22. Radhakrishnan, N. and Nair, N. B., Nature of crustacean infestation of fishes along the south-west coast of India. *Acta. Incti. Et. Pisc*., 13 (2)(1983) 93-115.
23. Thomas, J. D., A comparison between the helmimth burdens of male and female brown trout, *Salmo trutta L.,* from a natural population in the river Teify, West Wales. *Parasit.,* 54(1964) 263-272.
24. Brusca, R. C., A monograph on the Isopoda Cymothoidae (Crustacea) of the eastern Pacific. *Zoo. J. Linnean Soc.,* 73(1981) 117-199.
25. de Carvalho-Souza, G. F., de Souza Neto, J. R., Aleluia, F. T., Nascimento, I. A., Browne-Ribeiro, H., Santos, R. C. and Tinôco, M. S. Occurrence of isopods ectoparasites in marine fish on the Cotegipe Bay, north-eastern Brazil. *Mar. Biodiv. Rec*., 2(1) (2009).
26. Maheswarudu, G., Rao, G. S., Rohit, P., Laxmilatha, P., Ghosh, S. and Muktha, M., Marine fisheries of Andhra Pradesh: a decadal analysis. *Indian J. Fish*., 60 (3) (2013) 27-33.
27. Romestand, B. and Trilles, J. P., Influence of Cymothoidae (Crustacea, Isopoda, Flabellifera) on some hematological constants of host fishes. *Z. Parasitenkd* 52(1) (1977) 91–95.