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Pradeep HD

Fishery Survey of India, Port Blair Zonal Base, Port Blair, Andaman and Nicobar Islands, India

Swapnil S Shirke

Fishery Survey of India, Port Blair Zonal Base, Port Blair, Andaman and Nicobar Islands, India

Nashad M

Fishery Survey of India, Port Blair Zonal Base, Port Blair, Andaman and Nicobar Islands, India

S Moalisha Devi

Fisheries Resource Management Division, Central Islands Agricultural Research Institute, ICAR, Port Blair, Andaman and Nicobar Islands, India

New host and geographical record of the pandarid copepod, *Pandarus cranchii* (Leach, 1819) on the pelagic thresher shark, *Alopias pelagicus* Nakamura, 1935 from Andaman Sea

Pradeep HD, Swapnil S Shirke, Nashad M and S Moalisha Devi

Abstract

The present study reports the first occurrence of ectoparasite *Pandarus cranchii* infested on new host species “pelagic thresher shark, *Alopias pelagicus*” from the Andaman Sea. Total 11 specimens of *P. cranchii* were collected from the region of cloacal aperture and pelvic fins of a female *A. pelagicus* having a total length of 2650 mm and weighing 35 kg. It was caught by multifilament tuna longline vessel *MFV Blue Marlin* during July 2015 voyage as bycatch in the Andaman Sea. The sea surface temperature (SST) recorded at the sampling area was 28 °C. All the parasite specimens collected were found to be females with a size range of 4.3–6.5 mm (excluding egg sacs). The hanging–drop method was applied to examine the dissected appendages under the compound microscope and hand drawings were made to establish their identity. Detailed reports of *P. cranchii* from different geographical locations and diversity of the host species are also provided.

Keywords: Ectoparasite, cephalothorax, appendages, siphonostomatoida, lamniformes sharks

1. Introduction

The pelagic thresher sharks (*Alopias pelagicus* Nakamura, 1935) are large lamniform sharks of the family, Alopiidae, characterized by the greatly elongated upper lobes of their caudal fins, which comprises half of the total body length and found in all temperate and tropical oceans of the world [1]. Currently they are exploited by the commercial and sport fishing industry and have been listed as ‘vulnerable to extinction’ by the International Union for Conservation of Nature and Natural Resources [2].

The known parasites documented from the common thresher sharks include the trematodes: *Campanula oblonga* [3]; *Paronatrema vaginicola* [4], protozoan: *Giardia intestinalis* [5] tapeworms: *Acanthobothrium coronatum* [6], *Anthobothrium laciniatum* [7]; *Crossobothrium angustum* [8]; *Hepatoxylon trichuri*, *Mollicula uncinatus* [9], *Paraorygmatobothrium exiguum* [10]; *P. filiforme* [11]; *Sphyricephalus tergetinus* [12], copepods: *Dinemoura discrepans*, *Echthrogaleus denticulatus* [13]; *Gangliopus pyriformis* [14], *Kroeyerina benzorum* [15]; *Nemesis aggregatus*, *N. robusta*, *N. tiburon* [16]; *Nesippus orientalis* [17]; *Pandarus smithii* [13].

Copepods parasitic on fishes belong to three sub-orders, viz. Poecilostomatoida, Cyclopoida and Siphonostomatoida. The sub-order Siphonostomatoida consisting of 14 families [18] including family Pandaridae. The members of the genus *Pandarus* are frequently encountered pandarid copepod in elasmobranch fishes [13]. They commonly infest on the body surface, fins, gills, nasal passages and near to the cloacal aperture. They are exclusively parasitic on elasmobranchs but occasionally present on teleost which is purely accidental [19]. In elasmobranchs, they were mainly infested on the members of the family Carcharinidae, Lamnidae, Stegostomatidae [13, 20-22]. In Indian waters, Asok Kumar [23] reported the infestation of *P. cranchii* on *Eulamia dussumieri*, *E. ellioti*, *E. Melanoptera* and *Sphyrna zygaena*. Ectoparasites infested sharks suffer a variety of health problems, which may include anaemia [24] reduced respiratory efficiency [25, 26], and retarded development of reproductive organs [27], chronic and debilitating skin disease. The present study adds a new host to the list of *P. cranchii* infestation on elasmobranchs and reports the parasite from the Andaman and Nicobar waters of the Andaman Sea for the first time.

Correspondence**Pradeep HD**

Fishery Survey of India, Port Blair Zonal Base, Port Blair, Andaman and Nicobar Islands, India.

2. Materials and Methods

Parasites samples were collected close to the cloacal aperture and pelvic fin of a female *Alopias pelagicus* of Total Length (TL) 2650 mm and weighing 35 kg. It was caught by the multifilament tuna longlining vessel *MFV Blue Marlin* during July 2015 voyage from area (08° 40' N, 93° 49' E, depth: 3,672m) as bycatch. The sea surface temperature (SST) in the sampling station was 28 °C. Eleven female *Pandarus cranchii* of size range 4.3 to 6.5 mm (excluding egg sacs) were collected. Specimens collected were washed in fresh water on board the vessel, photographed and stored in 70% ethanol for further studies at shore laboratory. Largest specimen of size 6.5 mm (excluding egg sacs) was photographed with a stereo zoom microscope (LEICA M 205, DFC 500). The parasite specimens were dipped in a drop of 85% lactic acid for 1 to 2 hours before making dissection. The hanging – drop method devised by Humes and Gooding [28] was applied to examine the dissected appendages by a compound microscope and was also hand drawn. Later the same details were matched with the available literature to establish the identity of the parasites. The parasite was identified based on the morphological features given by [13, 18, 19, 20, 23, 29]. The parasite specimens were deposited in the museum of Zonal Base of Fishery Survey of India, Port Blair (Ref. No. MUS.FSI.PB/EBP/02/2015).

3. Results

a. Species identification: A detailed examination of dissected specimens and comparison with the available literature revealed that all the examined copepod parasites are *Pandarus cranchii* [29]. Further, microscopic observation of examined specimens deeply matches with the published illustrations for this species (cf. [20]: 249, figs. 141–148; cf. [19]: 159–162, figs. 39–42). Hence, the identity of the species was confirmed as *Pandarus cranchii* (Leach, 1819).

b. Host: Female *Alopias pelagicus* (Total Length, TL: 2650 mm; Pre-caudal length, PCL: 1300 mm; Weight, Wt. 35kg).

c. Taxonomy

Phylum: Arthropoda

Class: Maxillopoda Dhal, 1956

Order: Siphonostomatoida Thorell, 1859

Family: Pandaridae Milne Edwards, 1840

Genus: *Pandarus* Leach, 1819

Pandarus cranchii (Leach, 1819)

3.1 Description of *Pandarus cranchii* (female) Fig.1 (A&B): Cephalothorax prominently broadening backwards, postero-lateral lobes large, reaching middle of the dorsal plates of the second thoracic segment, posterior border having four pairs of tubercles with each carrying a spinule. Frontal border rather wide and frontal plates not projecting. Hind border of second thoracic segment with two pairs of spines, its dorsal plates elongate oblong and oblique. Dorsal plates of third thoracic segment comparatively small, fused together, with narrow median sinus and a pair of spines just above the sinus. Plates of fourth segment large, fused, with fairly wide sinus and a pair of spines as in the third plates. Genital segment with large postero-larateral lobes with two pairs of spines. Abdominal plate large, with indistinct transverse groove. Caudal rami (Fig.2E) reaching beyond the abdominal

plate. Antenna associated with a large pad, first segment short, second longest, with outer small pad, third segment irregular, with two spines, tip irregular and grooved (Fig.2A). Maxillule with one outer seta, two inner distal spines and a stout distal process (Fig 2B). Maxilla with basal segment longer than distal, latter slender, with the usual armature (Fig. 2C). Basal segment of maxilliped with prominent pad, distal segment spatulate, with a long spine. Basipod of first leg with four spiny lobes and that of the second leg is with several spiny pads. The distal exopod and endopod segment of the third leg with six and two claws each. Exopod of fourth leg longer than endopod, with one outer and six distal claws and endopod without claws.

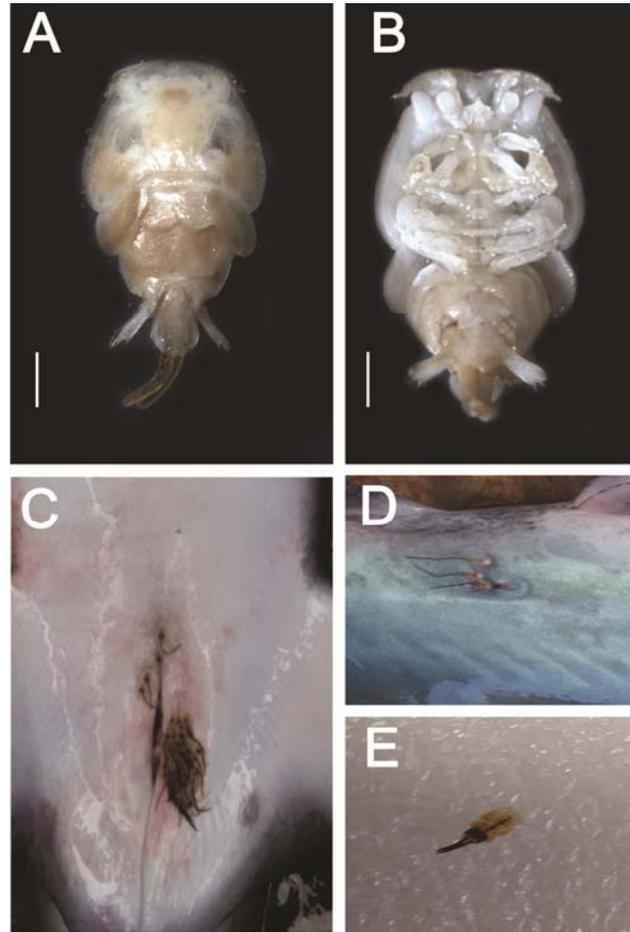


Fig. 1: *Pandarus cranchii* (Leach, 1819): Female (6.5 mm), dorsal (A) and ventral (B) view; Aggregation near cloaca and pelvic fins of *A. pelagicus* (C, D); Female *P. cranchii* prior to preservation (E). Scale bars = 2mm (A, B).

The dorsal and ventral view of the female specimen of *Pandarus cranchii* with a body length of 6.5 mm (excluding egg sacs) and cephalothorax width of 4.05 mm Fig.1 (A & B) and a fresh specimen (Fig.1E). It was observed that the pandarid parasites were segregated near the cloacal aperture and near pelvic fins (Fig.1C & D) of the female pelagic thresher shark. The diagrams of the appendages are hand drawn (Fig.2 A–F) to establish their identity.

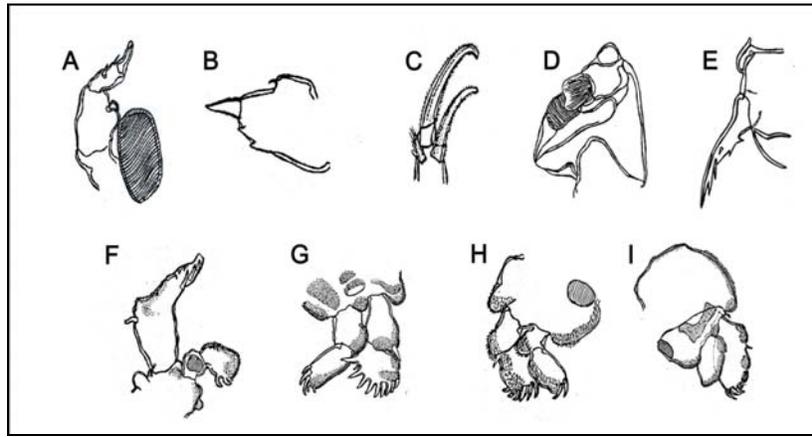


Fig. 2: *Pandarus cranchii*: A– antenna; B– maxillule; C– maxilla; D– maxilliped; E– caudal ramus; F– I, female, legs 1– 4.

4. Discussion

The pelagic shark family, Alopiidae has been infested by different parasites like trematodes, tapeworms and copepod parasites [3, 10, 13, 17]. In 2009, Watchariya *et al.* [30] reported two species of ectoparasites, *Echthrogaleus denticulatus* and *Nogagus ambiguus* from the body surface of *A. pelagicus* from the Andaman continental shelf in the Exclusive Economic Zone (EEZ) within Thailand's territorial waters. Other copepod parasites infesting on *A. pelagicus* include *Dinemoura discrepans* and *E. asiaticus* [31]. Ho and Lin [32]

reported the *Dinemoura discrepans* infestation on four sharks namely *Alopias pelagicus*, *A. superciliosus*, *C. limbatus* and *C. longimanus* off southeast coast of Taiwan. From Indian waters, Pillai [19] reported *E. denticulatus* from *Alopias pelagicus* and *A. vulpinus*. Further, he also reported *Bariaka alopiiae*, *Dinemoura discrepans* and *Pagina tunica* from *Alopias superciliosus*. The detailed reports of *P. cranchii* from different geographical locations and diversity of the host species are given in Table-1.

Table 1: Records of *Pandarus cranchii* (Siphonostomatoida: Pandaridae) showing geographic localities and diversity of host species.

Geographic Location	Host	Reference(s)
Western Indian Ocean	<i>Alopias vulpinus</i> (Bonnaterre, 1788); <i>Carcharhinus falciformis</i> (Muller & Henle, 1839); <i>Carcharhinus galapagensis</i> (Snodgrass & Heller, 1905); <i>Carcharhinus leucas</i> (Muller & Henle, 1839); <i>Carcharhinus longimanus</i> (Poey, 1861)	Cressey [13]
Coastal waters of Oman	<i>Carcharhinus amboinensis</i> (Muller & Henele, 1839)	Henderson <i>et al.</i> [22]
Hawaiian Islands	<i>Carcharhinus brachyurus</i> (Gunter, 1870)	Lewis [34]
Southern Africa	<i>Carcharhinus longimanus</i> (Poey, 1861)	Dippenaar [21]
Hawaiian Islands	<i>Carcharhinus obscurus</i> (Lesueur, 1818)	Lewis [34]
Atlantic Ocean		Rokicki <i>et al.</i> [35]
Western Australia		Newbound <i>et al.</i> [36]
Mediterranean		Raubaut <i>et al.</i> [37]
Mediterranean	<i>Carcharhinus signatus</i> (Poey, 1868)	Rokicki <i>et al.</i> [35]
Southern Africa	<i>Carcharodon carcharias</i> (Linnaeus, 1758)	Dippenaar [21]
Western Indian Ocean		Cressey [13]
West Coast of Florida		Cressey [38]
Southern Africa		Dippenaar [21]
Western Indian Ocean	<i>Galeocerdo cuvier</i> (Pearon & Lesueur, 1822)	Cressey [13]
Western Australia		Newbound <i>et al.</i> [36]
New Zealand waters		Hewitt [20]
New Zealand waters	<i>Isurus oxyrinchus</i> (Rafinesque, 1810)	Hewitt [20]
West Indies		Williams [39]
Central Atlantic Ocean		Rokicki <i>et al.</i> [35]
Hawaiian Islands	<i>Lamna nasus</i> (Bonnaterre, 1788)	Lewis [34]
Southern Africa	<i>Poroderma africanum</i> (Gmelin, 1789)	Dippenaar [21]
Central Atlantic Ocean	<i>Prionace glauca</i> (Linnaeus, 1758)	Rokicki <i>et al.</i> [35]
Japanese waters		Izawa [14]
Central Atlantic Ocean	<i>Sphyrna lewini</i> (Griffith & Smith, 1834)	Rokicki <i>et al.</i> [35]
Western Indian Ocean	<i>Sphyrna zygaena</i> (Linnaeus, 1758)	Cressey [13]
Japanese waters		Izawa [14]
Southern Africa	<i>Stegostoma fasciatum</i> (Hearmann, 1783)	Dippenaar [21]
Kerala Coast (Indian southwest coast)	<i>Eulamia dussumieri</i> (Muller and Henle, 1839); <i>E. ellioti</i> (Day); <i>E. Melanoptera</i> (Quoy and Gaimard); <i>Sphyrna zygaena</i> (Linnaeus, 1758)	Asok Kumar [23]
Andaman Sea	<i>Alopias pelagicus</i> (Nakamura, 1935)	Present study

Family Pandaridae has been revised and redescribed with 12 genera and 28 species along with the new genus *Pannosus* and five new species [13]. Most of the pandarid copepod infests on elasmobranchs, especially on the members of the family Carcharinidae, Lamnidae, Stegostomatidae [13, 20-22]. Asok Kumar [23] reported *P. cranchii* from four elasmobranchs, *Eulamia ellioti*, *E. melanoptera*, *E. dussumieri* and *Sphyrna zygaena*. Females of pandarid copepods are heavily pigmented and occur in large numbers (> 100 individuals) on shark fin [13]. In the present study most of the parasites were found gathered around the cloacal region of its new host *A. pelagicus*.

Close similarities between the pandarid species resulted in the misidentification and obscurity in the classification. The affinity of the *P. cranchii* with *P. satyrus* was noticed by Cressey [13]. Due to the close similarity in structure and morphology of this species with *P. satyrus*, Shiino [33] considered it has synonym of *P. cranchii*. After a detailed examination Cressey [13] distinguish the two species based on the length of caudal ramus. In *P. cranchii*, the ramus just reaches the tip of the lower border of abdominal plate (Fig A & B), whereas the rami of the *P. satyrus* extend only about half the length of abdominal plate. The setal formulae of both species are same, but the patches of spinules are much heavier in *P. cranchii* [13].

Even though many pandarid parasites other than *P. cranchii* have been reported from *A. pelagicus* [19, 31-33] the present study for the first time reports *P. cranchii* infestation on *A. pelagicus* and its occurrence in the Andaman Sea, thus describing new host and locality for them. The geographical distribution of the parasite *P. cranchii* has been extended to Andaman and Nicobar waters of the Andaman Sea from Indo-pacific region. The present findings provide new information and open the way for further studies on the copepod parasites from the Andaman and Nicobar waters of the Andaman Sea.

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