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# Acanthocephalan (*Echinorhynchus* sp.) infection of yellowfin tuna (*Thunnus albacares*) from Nagapattinam, south east coast of India

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**Comments**

Experiment was conducted at satisfactory level and result has been reported accordingly. This information could be particular interested by the groups working on parasitic infections in fish.
Details on Page 600

ABSTRACT

**Objective:** To recored the infection of Acanthocephalan parasite, (*Echinorhynchus* sp.) in adult yellowfin tuna (*Thunnus albacares*). This is the first report of acanthocephalan *Echinirhynchus* sp attached to yellowfin tuna and moreover prevalence, mean intensity and mean abundance was observed.

**Methods:** Totally 1 001 yellowfin tuna fishes were collected throughout the year of 2012 from the coast of Nagapattinam (10°45´ 36.25" N and 79°50´ 59.54" E), Tamil Nadu, India. The collected fishes were washed with fresh water to remove debris and immediately stored in ice, and brought to the laboratory. Intestines were placed in normal saline (0.85% NaCl). The worms were fixed in alcohol/ formalin /(AFA) fixative and in 70% ethanol until processed for identification.

**Results:** Totally 1 001 yellowfin tuna was examined out of 387 (52.67%) hosts were infected with acanthocephalan (*Echinorhynchus* sp.). The proboscis *Echinorhynchus* sp. was long, cylindrical with cylindrical with a uniform width measured (0.41±0.02) mm in length and (0.12±0.03) mm in width. The endo parasite prevalence, intensity and abundance was recorded as 52.67%, 12.46%, and 5.43% respectively.

**Conclusions:** This current phenomena was carried out to report of acanthocephalan *Echinorhynchus* sp. attached the new host of yellowfin tuna from Nagapattinam coast. Moreover, parasitological investigations are required to determine endo parasites of host due to its importance and numerous occurring among most important marine food fishes in world wild.

KEYWORDS
*Thunnus albacares*, Internal infection, *Echinorhynchus* sp., Prevalence, Intensity, Abundance

## 1. Introduction

*Thunnus albacares* (*T. albacares*) (Family Scombridae) occur throughout the world's tropical and temperate seas and contribute to many national food fisheries[1]. Tunas range along the Western Atlantic Oceans from Nova Scotia to Brazil and support important fishery. Yellowfin tuna is one of the potential and most common food fish in India. Parasite disease processes great problems in the culture and captive maintenance of marine water fishes[2]. Yellowfin tuna is infected by many parasites like isopod, copepod, nematode, trematode and acanthocephalan (*Echinorhynchus* sp.). Acanthocephalans are helminth parasites that use arthropods and vertebrates as the intermediate host to complete their life cycles. These helminthes lack alimentary tract and are characterized by the presence of a proboscis armed with recurred hooks, a syncytial epidermis and a lacunas system with circulatory channels that promotes direct absorption of nutrients through the body wall[3]. Acanthocephalan is frequently seen in the intestines of wild fresh water, salt water fish and other vertebrates. Previously, Zdzisla Laskowski reported the occurrence of acanthocephalans in notothenioid fishes in the Beagle Channel (Magellanic subregion, sub Antarctic)[4]. But in the case of the present study, it was observed the marine fish yellowfin tuna affected by the *Echinorhynchus* sp. The affected fish intestine were irreversible mechanical damage caused by the attachment of the armed proboscis affects the architecture of the intestinal tissues leading to pathological changes. Damege of the intestinal villi, formation of the granular tissues and capsule

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formation associated with host immune responses which seriously affect the digestive and absorptive efficiency of the animal[5].

It causes several damage to the intestinal walls at the site of its attachment. Moreover in this attachment caused serious illness or high mortality induced by acanthocephalan infections in fish were seldom reported due to the much lower infection intensity compared with other helminth parasites[6]. Acanthocephala may have more than an impact upon intestinal parasite communities than other kinds of helminthes. And they are more likely to exhibit negative interactions with their own and other species, under both field and experimental conditions[7]. Immune evasion might be achieved either through molecular mimicry, when the parasite prevents its immune detection by mimicking host epitopes or through direct alteration of the host immune system that leads to immunosuppressant[8].

Parasitic diseases, either alone or in conjunction with other environmental stresses, may influence weight or reproduction of the host, alter its population characteristics and affect its economic importance[9]. The ecological parameters like prevalence, mean intensity and mean abundance were calculated to determine the abundance of parasitic species[10]. The goal of the current investigation was carried out the occurrence of intestinal acanthocephalan (*Echinorhynchus* sp.) reported on the new host of yellowfin tuna (*T. albacares*) prevalence, intensity and abundance of acanthocephalan from Nagapattinam, south east coast of India.

## 2. Material and methods

The yellowfin tuna samples were collected throughout the year of 2012 from the Nagapattinam coast (10°45′ 36.25″ N and 79°50′ 59.54″ E), Tamil Nadu. In total 1 001 were examined for visceral parasitic infection. The total length and weight of the fishes were measured (range of size and weigth). The fishes stored in ice immediately, and brought to the laboratory. The fishes were examined for the endo-parasites by killing them by the usual method of a blow on the head. Fishes were dissected and body cavity was thoroughly examined for parasites. Intestines were placed in Petri dish containing normal saline (0.85% NaCl) to allow adhering parasites to be released from the lumen. The worms were fixed in alcohol/formalin/(AFA) fixative and in 70% ethanol until processed for identification. Infected fish photographs were taken using on a Nikon D 40 camera. In case the anterior end of acanthocephalans was deeply buried in the mucosa of the intestine, a few crystals of the methanol were added to the normal saline, containing the parasites adhered to the intestinal wall. This led to immobilization of the parasites and loosening of the grip on the intestinal wall and facilitated the detachment of the proboscis in case of acanthocephalans without causing any distortion in the arrangement of hooks. Prevalence, mean intensity and mean abundance of acantocephalan parasitesand their confidence intervals, were calculated according to[11,12].

## 3. Results

Total 1 001 yellowfin tuna (*T. albacares*) was examined, out of which 387 hosts were infected with acanthocephalan (*Echinorhynchus* sp.). The infestation with the parasites was observed in the posterior region of the intestine, liver, and spleen (Figures 1 and 2). *Echinorhynchus* sp. proboscis penetrates through the fish spleen about 0.3-0.5 mm deep (Figure 3). Length and weight of the fishes varied from 45 cm to 70 cm and 3.5 kg to 5 kg, respectively. The highest infestation was 12 acanthocephalan collected from a single host. Many examined fish species were infected by acanthocephalan (*Echinorhynchus* sp.). Cylindrical sac like intestine worms, measured up to 2.4-6.8 cm in length and 0.012-0.072 g in weight. Liver worms measured up to 1.3-3.7 cm in length and 0.060-0.051 g in weight; whereas the same fish spleen *Echinorhynchus* sp. measured up to 1.8-5.4 cm in length and 0.090-0.068 g in weight.


**Figure 1.** Liver of *T. albacares* showing heavy infection of (*Echinorhynchus* sp.) parasite.

**Figure 2.** *T. albacores* spleen showing heavy infection of (*Echinorhynchus* sp.) parasite.

**Figure 3.** Stereo microscopic views of *Echinorhynchus* sp. occurs in yellowfin tuna spleen.

The *Echinorhynchus* sp. hook was a regular arrangement (Figure 4). Moreover, this adult worm possessed a proboscis which was long, cylindrical with a uniform width measured (0.41±0.02) mm in length and (0.12±0.03) mm in width (Figure 5). Proboscis and anterior end is one of the most important identical organs of this parasites to detect (Figure 6). In general, examined fish appeared the yellowfin tuna are torpedo-shaped with dark metallic blue backs, yellow sides and a silver belly. They have very long anal and dorsal fins and fin lets that are bright yellow. The vital organs of the infected fish with *Echinorhynchus* sp. appeared a nodule-like structure. These parasites were seen to have penetrated through the intestinal wall with their ensheated ends floating freely in the coelom and the part of the trunk in the lumen of the intestine.

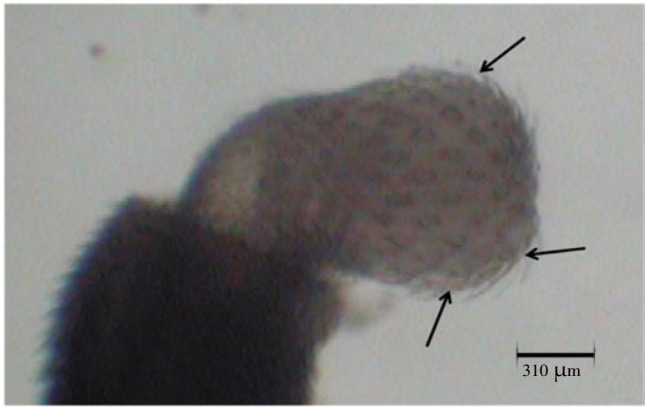


**Figure 4.** Light microscopic views of proboscis of *Echinorhynchus* sp. arrow showing head with clear hooks.

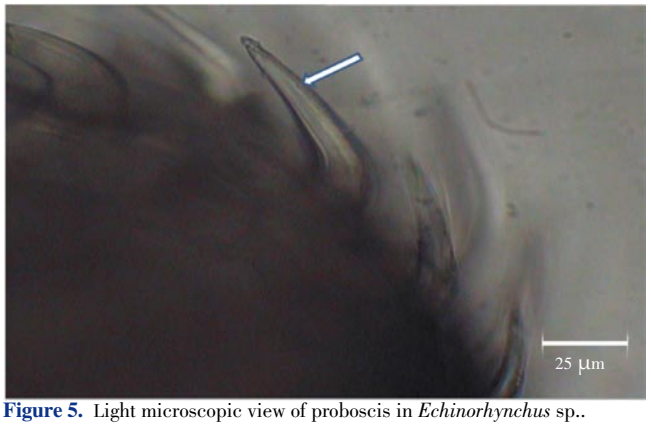


**Figure 5.** Light microscopic view of proboscis in *Echinorhynchus* sp..

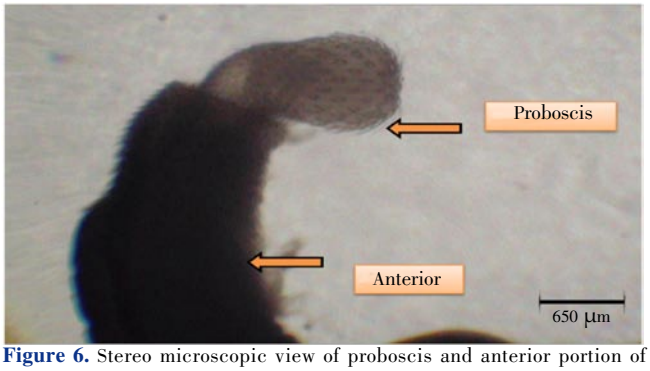


**Figure 6.** Stereo microscopic view of proboscis and anterior portion of *Echinorhynchus* sp.

In some cases, only few acanthocephalans were attached to the lumen but the outer side of the intestine contained several *Echinorhynchus* sp. parasites entangled in the pink and yellow color cysts. So much entangled in the intestinal tissue that they could only be separated with much difficulty. Moderate values of prevalence, mean intensity and mean abundance were noticed throughout the year of 2012. A higher prevalence of 52.67% was observed during pre-monsoon 2012 and lower infestation 22.41% during summer 2012 (Figure 7). The highest mean intensity was reported 12.46% during the monsoon and lower mean intensity was observed 10.03% in the post-monsoon (Figure 8). Higher mean abundance of 5.43% was observed in during the premonsoon and lower mean abundance of 2.91% was observed in post monsoon period (Figure 9). Finally, the high infection was observed from the post-monsoon (Figure 10). The goal of the current investigation was carried out; this is the first report of acanthocephalan *Echinorhynchus* sp. attached the new host of yellowfin tuna from Nagapattinam coast.

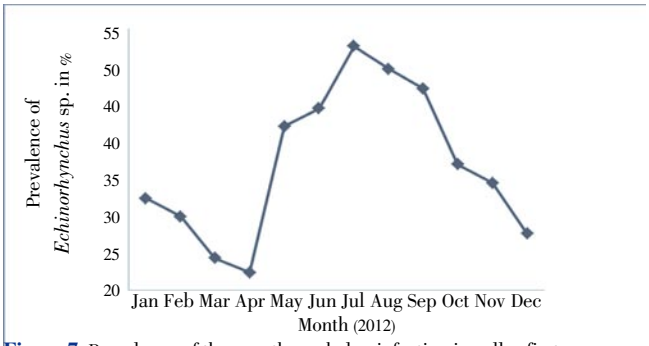


**Figure 7.** Prevalence of the acanthocephalan infection in yellowfin tuna.


**Figure 8.** Intensity of the acanthocephalan in *T. albacares*.

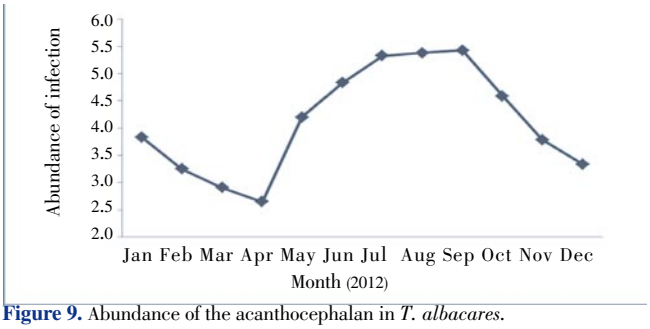


**Figure 9.** Abundance of the acanthocephalan in *T. albacares*.

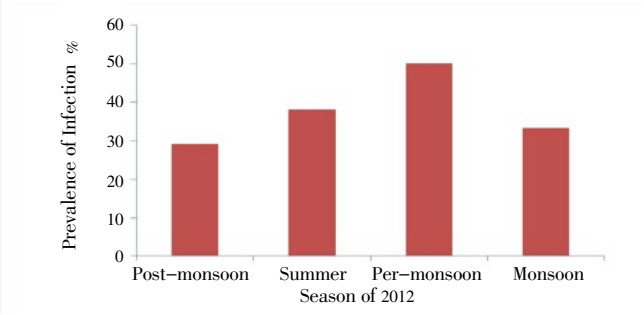


**Figure 10.** Seasonal wise fluctuation of *Echinorhynchus* sp. in yellowfin tuna.

## 4. Discussion

The objective of the current investigation was carried out on parasitic infection acanthocephalan in the internal organ of liver, spleen and intestine of the new host reported from Nagappattinam host. The maximum length of the *Echinorhynchus* sp. is 6.8 cm and the maximum weight of the *Echinorhynchus* sp. is 0.072 g. Infected fish weight was gradually decreased because of the sucking of the *Echinorhynchus* sp. on host blood. Generally, co-infection with nematode and acanthocephalan has been observed but the present case showed that mono-infected with acanthocephalans alone in the intestinal tract in heavily infected fish yellowfin tuna acanthocephalan may perforate the gut wall with their proboscis and cause considerable damage with severe local inflammatory reaction[13]. Previously, Zdzisław Laskowski recorted that only one echinorhynchid species, *Heterosentis heteracanthus*, was found in *Platycleis tessellata* (prevalence 15%). However, the maximum intensity (17) was only a little lower than that in the case of *Panulirus longipes*[4]. But in the case of the present study, it was observed 52.67% of *Echinorhynchus* sp. infection from Nagapattinam coast.

In this infection rate, it was deepened upon examining fish feeding habited and climatic changes. The role of acanthocephalan within the parasitism with its fish host is more complicated than an intestinal parasite. These variations in the rate of parasitism could be attributed to abiotic and biotic conditions of the environments where the studies were carried out. Unfavourable conditions may offset fish physiology favouring parasite infestation and invasion[14]. Rohlenova *et al.* has reported that unfavourable temperature may alter fish physiology including immune function favouring parasite invasion[15]. Pollution of the fish environment also contributes to parasitizing of fish significantly[16]. Shores stated that certain parasites, particularly intestinal acanthocephalans and cestodes of fish can accumulate heavy metals at concentrations that are orders of magnitude higher than those in the host tissues or the environment[17].

The present study focused on the vital parts of yellowfin tuna, such as liver, spleen and intestine which were heavily infected by acanthocephalan *Echinorhynchus* sp. Indeed, the parasites contained significantly higher lead concentrations than their host tissues following only 1 week of exposure to a low lead dose (0.01 mg/L). Immature *Pomphorhynchus laevis* have the capacity to accumulate lead immediately after establishment in the fish host and the metal uptake rate did not differ significantly between the immature and adult worms at the same exposure concentration despite a higher mean lead content in the latter[18]. The amount of lead accumulated in the different tissues investigated suggests that lead is mainly taken up by the gills. It is known from the literature that lead ions are able to pass across the epithelial membrane by Para cellular diffusion and enter the bloodstream[19].

In the blood Pb binds to the membrane of erythrocytes and is transported by the circulatory system through various organs in the body. The liver, one of the main excretory systems in freshwater fish, is believed to expel metal ions by binding them to steroids in the bile[20]. *Echinorhynchus gadi* was the dominant intestinal parasite species found in cod from all geographical locations sampled. Prevalence and intensity of infection was significantly higher in the Baltic Sea samples than that in any of the others. Heavy infections in this area result from heavy infections in intermediate hosts and a high level of egg production by the acanthocephalans[21].

Adult Baltic cod also feed on a variety of other food items, including young cod already infected with *Echinorhynchus gadi*[22]. That tissue of certain endoparasites, namely acanthocephalans or cestodes, accumulates heavy metals easily and contains significantly higher concentrations in comparison with tissues and organs of its host. Usually in acanthocephalan infections, pathology appears to be negligible when parasites attach to the epithelial mucosa only. Kabata opined that the number of worms presented is important in determining the severity of damage[23]. However, adult acanthocephalans are not long-lived parasites compared with nematode larvae and cestodes, and their life spans in definitive host are usually less than 1 year[24].

Majidah and Khan described the distribution pattern of the helminth populations in different fish hosts, which exhibited a regular seasonal trend and the infrapopulation concentration was relatively greater during summer[25]. This pattern of infection does not conform the study done by various researchers like Chishti and Peerzada who working on seasonal occurrence of acanthocephalan infection in fishes of Wular Lake observed that the infection was high in spring and low in summer in all fish hosts. Most likely, vagility of the hosts, even in slowly moving benthic species, exposes different host individuals to those parasites most frequently whose infective stages occur at the greatest densities, *i.e.*, both prevalences and abundances of infection have the same cause: a great density of infective stages[26]. The goal of the current investigation was carried out the occurrence of intestinal acanthocephalan (*Echinorhynchus* sp.) reported from the new host, the Thunnus albacores as well as prevalence, mean intensity and mean abundance of acanthocephalan Nagapattinam Coast South East coast of India.

The prevalence, intensity and abundances of acanthocephalans (*Echinorhynchus* sp.) as observed in yellowfin tuna species is in consonance with the various findings and can be linked with many ecological factors. The parasites are normally in a complex dynamic equilibrium with their hosts. Many parasites were responsible for high mortality rate, particularly in younger stages. Therefore, the authors suggest a comprehensive research in the identification of other factors that are responsible for the survival of this acanthocephalan in the liver, intestine and spleen of fish and also the decline of this economically important native fish in Nagapattinam coast.

## Conflict of interest statement

We declare that we have no conflict of interest.

## Acknowledgements

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period. This work was financially supported by Department of Biotechnology, (BT/ PR14992/SPD/11/1332/2010), Government of India, New Delhi. We are also thankful to the fisher woman and man onthe Nagapattinam coast for supply of host fishes both on landing and also in the market.

## Comments

### *Background*

Manuscript reports the identification and some of the pathology of Acanthocephalan parasite, (*Echinirhynchus* sp.) in adult yellowfin tuna (*Thunnus albacares*). Fish has been collected for 1 year (2012) and from specific area and screened for the parasites. Morphological characterization of identified parasite has been done.

### *Research frontiers*

Study of parasites helps to understand the, host parasite relationship, parasitic effects to host (fish) and reduce the secondary infectious diseases and other health issues of fish. It's important to investigate the new parasites which can effect to different aquatic animals that has been covered in this study.

### *Related reports*

Several reports are available on new parasites of Acanthocephalan from fish species in different part of the world. However, this manuscript shows the presence of *Echinirhynchus* sp. in specific part (India) and that could be useful to conduct the comparative studies with other *Echinirhynchus* spp. in fish and other aquatic systems.

### *Applications*

Further study on *Echinirhynchus* sp. is required for characterization of the parasite, understand the mode of infection, life cycle, other host, pathology, control measures and treatments.

### *Peer review*

Experiment was conducted at satisfactory level and result has been reported accordingly. This information could be particular interested by the groups working on parasitic infections in fish.

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