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Seasonal prevalence on the Parasitism of *Istiophorus platypterus* (Shaw, 1792) by *Pennella* sp. (Copepoda: Pennellidae) from the Tamil Nadu Coastal waters, India

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ABSTRACT

This study investigates the parasitism of Indo-Pacific sailfish along the Tamil Nadu coastal waters during the December 2023 and November 2024. The examination of 1,207 fish specimens were collected from three landing stations: Annan Koil, Mudasalodai, and MGR Thittu, where we have found 142 infested fish, thereby reporting an overall prevalence of 11.76%. Station-specific prevalence rates were 11.53% at Annan Koil, 12.5% at Mudasalodai, and 11.21% at MGR Thittu. The prevalence was the highest during the summer season (March-May) and the lowest during the monsoon (September-November). The anatomical and morphological studies of the parasites showed attachment to the dorsal and lateral surfaces of the host, with key diagnostic features being cephalothorax, antennary processes, and egg sacs. Chi-Square statistical analyses revealed significant differences in the prevalence and intensity of infestation between stations ($p < 0.05$). Mudasalodai had the highest mean intensity (2.4 parasites per infected fish), followed by Annan Koil (1.7) and MGR Thittu (1.5). Seasonal variation showed higher infestation intensities during the summer and post-monsoon periods. These findings highlight the influence of seasonal factors on the parasitic infestation dynamics of *Pennella* sp. in the coastal waters of Tamil Nadu.

Keywords: Copepoda, *Pennella,* Prevalence, Tamilnadu

1. INTRODUCTION

Copepods belonging to the genus *Pennella* infect a wide range of marine fish and mammal. The size and mesoparasitic behaviors of *Pennella* species make them highly noticeable on the exterior body surfaces of their hosts, making them one of the most well-known parasitic copepods. The taxonomy of the genus is fraught with uncertainties some species of Pennella are identified based on mature females, while

others are classified by their life cycle or developmental stages. After attaching to the final host, Pennella undergoes significant growth and structural changes (Thompson, 1905; Wilson, 1917). *Pennella* species have been distinguished thus far by host specificity, cephalothorax structure, size arrangement of antennary processes on the cephalothorax, number of holdfast horns, and neck-to-trunk-to-abdomen length ratios. *Pennella* species are also known for having a high degree of morphological variation within the same species.

For instance, Hogans, (1987) found that the number of holdfast horns and the antennary processes cephalic papillae in *P. filosa* Linnaeus, (1758) varied widely depending on the host species or the attachment site. Several researchers have reported economic losses in commercial and economic fisheries due to copepod infestations (Ramdani et al., 2021). *Pennella* sp. is known to parasitizes various species globally, particularly those belonging to the family Istiophoridae, which includes marlins, spearfish, and sailfish, such as *Istiophorus platypterus*. In India, *Pennella* sp. infecting *Istiophorus platypterus* was documented by various researchers. Devaraj and Bennet, (1972) who recorded the parasite in sailfish, in addition Varghese et al., (2009), Pradeep et al., (2016), Ramkumar et al., (2024), Surya et al., (2023) investigated seasonal variation, ecological implications, and host-parasite interactions in Indian waters. For the first time, the present study reports the seasonal prevalence of the parasitism of *Istiophorus platypterus* by *Pennella* sp. from the Tamil Nadu Coastal water.

2. MATERIALS AND METHODS

Sample collection

Indo-Pacific sailfish (*Istiophorus platypterus*) specimens were collected between December 2023 to November 2024 from landing stations of the Tamil Nadu coast, Annankoil landing centre (11°30'11"N 79°46'19"E), Mudasalodai landing centre (11°29'12"N 79°46'28"E), and MGR thittu (11°28'05"N 79°46'47"E). Local fishermen used hook and line for one-day fishing and purse seine nets for three to seven days fishing to catch sailfish. After landing, the infested specimens were examined.

Sample preservation

The specimens of *Pennella* sp. were meticulously removed from the host and preserved in 5% formalin to maintain their morphological integrity. The preserved specimens were transported to the laboratory for further examination. Specimens were deposited in Annamalai University Reference Museum Centre of Advanced Study in Marine Biology (CASMB-AU-RM) in Parangipettai, India (Figure 3). The author's personal collection holds the remaining specimens.

Microscopic Examination

The parasite key diagnostic feature was examined under the stereomicroscope (ZEISS Stemi 2000-C). Photographs were taken by using the ZEISS Axiocam 105 and documented to facilitate future reference and comparison.

Statistical analysis

Chi-Square Test: To compare the prevalence of parasitism between stations and seasons.

3. RESULT

Anatomical and Morphological Observations

The parasite predominantly attached on the dorsal and lateral side of the host. A close-up view of the images highlights the infestation site and structural morpho-adaptations made for host attachment by *Pennella sp* (Figure 4). Characteristics features of *Pennella* sp., which include cephalothorax with antennary processes, holdfast horns, neck, trunk, abdomen, and egg sacs, were observed under microscopy (Figure 5).

Prevalence of Seasonal Variations

The highest infestation of *Pennella* sp. occurred during the summer season, March-May, and followed by the post-monsoon period, December-February. Prevalence during the pre-monsoon season, June-August, and monsoon season, September-November, declined, with the lowest rates of infection occurring during the monsoon. Infestation patterns of parasite in Tamil Nadu coastal waters seem to be affected by seasonal and ecological factors, as indicated by the following trends (Table 1).

Table 1 Infestation patterns of parasite in Tamil Nadu coastal waters seem to be affected by seasonal and ecological factors

Seasons	Station Specific Infection Data from Tamil Nadu Coastal Waters		
	I	II	III
Post-Monsoon (December to February)	30	8	4
Summer (March to May)	36	16	4
Pre-Monsoon (June to August)	14	12	2
Monsoon (September to November)	10	4	2
Total	90	40	12

Table 2 Infection data of fish from three different stations: Annan Koil Landing (I), Mudasalodai Landing (II), and MGR Thittu (III)

S. No	Stations	No of fish examined	No of fish Infected (% Prevalence)	Total no of parasite (Mean Intensity)
01	Annan Koil Landing (I)	780	90 (11.53)	160 (1.7)
02	Mudasalodai Landing (II)	320	40 (12.5)	96 (2.4)
03	MGR Thittu (III)	107	12 (11.21)	18 (1.5)

Prevalence Analysis Using Chi-Square Test

Table 2 displays the infection data of fish from three different stations: Annan Koil Landing (I), Mudasalodai Landing (II), and MGR Thittu (III). The table shows the total number of fish examined, infected fish and the parasites. Station I was the highest number of fish examined (780) and the highest infection count (90 fish infected, or 11.53%). Station II 320 fish specimens were examined of these 40 specimens were infected (12.5%), and Station III was the lowest number of fish examined (107), with 12 infected (11.21%). These infection counts suggest a potential relationship between station and infection prevalence, which needs further statistical analysis to determine if these differences are statistically significant.

A Chi-Square test of independence was applied to determine whether the infection prevalence significantly differed across the three stations. The results showed a Chi-Square statistic that did not produce a significant p-value (0.89), it shows there is no substantial evidence to reject the null hypothesis. Despite some variations in infection rates and infection prevalence, across the three stations are not statistically significant. The observed variations attributed to random fluctuations rather than systematic differences between the stations. Figure 1 shows that differences in infection prevalence between the three stations are very small, with values ranging between 11.2% and 12.5%. This suggests that infection rates are relatively consistent across the stations, and no single station shows a significantly higher or lower prevalence.

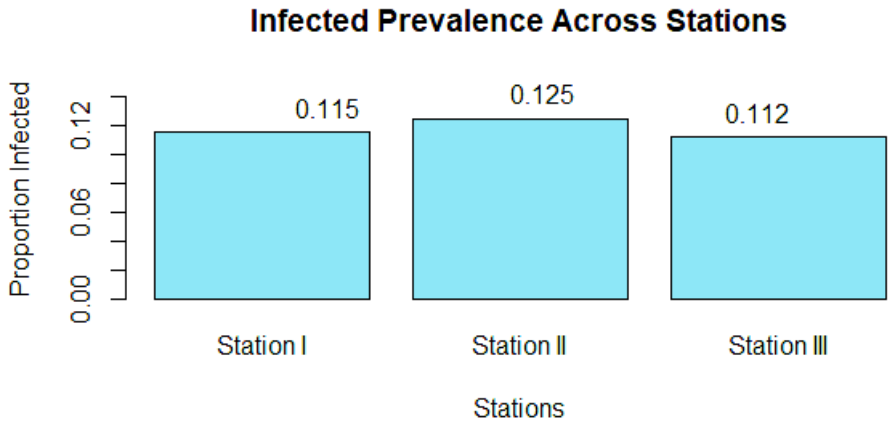

Figure 1 Infected Prevalence across Stations

Seasonal Infection Analysis Using Chi-Square Test

Table 2 presents the station-specific infection data from Tamil Nadu coastal waters across four seasons: Post-Monsoon, Summer, Pre-Monsoon, and Monsoon. Station I recorded the highest infection rate compared to other stations across all seasons. For instance, during the Post-Monsoon season, Station I was recorded with 30 infected fish, whereas stations II and III were recorded only 8 and 4 respectively. A similar trend was observed in other seasons, where infection counts were notably higher in station I. However, it is crucial to determine whether these observed differences are statistically significant or simply due to random variation. Chi-Square tests of independence were performed to assess the relationship between infection counts and seasons across the three stations. The results yielded a Chi-Square statistic of 6.86, a p-value of 0.55, and 6 degrees of freedom.

Since the p-value is more significant than 0.05, the null hypothesis cannot be reject, indicating that the infection counts are not significantly associated with seasons or stations. In other words, the observed variations in infection counts are likely due to chance rather than any systematic influence of seasonal or spatial factors. Figure 2 illustrates seasonal infection trends across three stations (I, II, and III). Each bar represents the infection count observed in a specific season: Post-Monsoon, Summer, Pre-Monsoon, and Monsoon. Station I consistently reports the highest infection counts, particularly during the Post-Monsoon (30 infected fish) and Summer (16 infected fish) seasons. Station II shows moderate infection counts, with the highest recorded during Summer (8 infected fish).

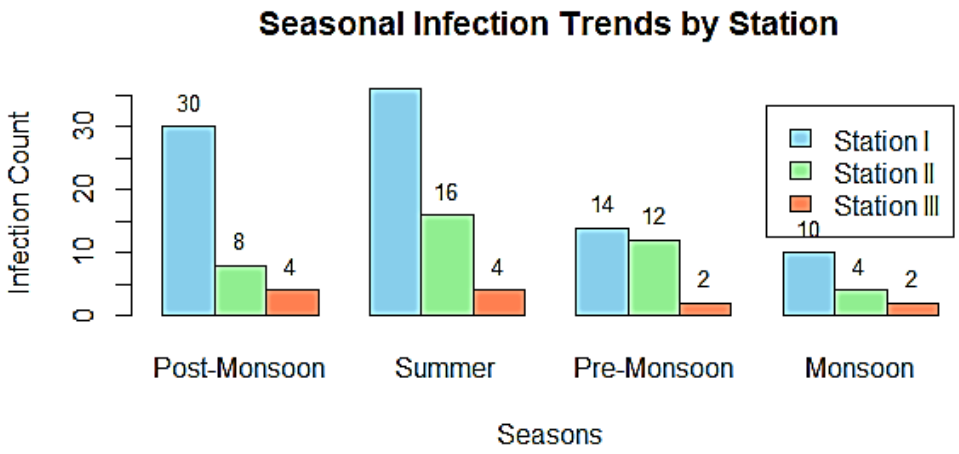

Figure 2 Seasonal Infection Trends by Station

Station III shows the lowest infection counts in all seasons, particularly during Pre-Monsoon (2 infected fish). This visualization helps highlight the seasonal variation in infection counts across different stations (The provided results were obtained by 'r' programming software).

4. DISCUSSION

The classification of the species under the genus *Pennella* has long been ambiguous and disorganized (Suyama et al., 2021). Several regions have reported parasitism by the species in the genus *Pennella*. For example, parasitism in the Andaman Sea is reported by Pradeep et al., (2016) and in the Eastern Arabian Sea by (Ramkumar et al., 2024). Previously, Devaraj and Bennet, (1972) reported the *Pennella* infestations in sailfish along southeast and southwest coasts of India, whereas this study is the first to document the seasonal prevalence of *Pennella* parasitism in sailfish along the Tamil Nadu coast. These findings are critical to be considered as a baseline for future research into the parasitism dynamics and its potential ecological or economic impacts in this region.

Previously the seasonal variation of this parasite was studied along the west coast by. Our result findings from Table 1 and Table 2 demonstrate that infection prevalence in fish populations across the three stations and four seasons does not exhibit significant variation. In Table 2, the Chi-Square test of station-specific infection data yielded a p-value of 0.89, suggesting that infection rates are independent of the station, with observed differences attributed to random fluctuations. Similarly, in Table 1, the infection counts

across the seasons did not show any statistically significant differences, as indicated by a p-value of 0.55. These results imply that seasonality does not have a substantial impact on infection prevalence.

Overall, both tables suggest that random variation, rather than station or seasonal factors, accounts for the differences in infection rates, highlighting the absence of a systematic relationship between these variables and infection prevalence. The comparison of previous studies and the current research shows the same trend pattern for the infestation of *Pennella instructa* on Istiophorus platypterus. There were seasonal fluctuations in size, attachment intensity, and prevalence of parasites in previous studies; larger parasites showed dominance between April and September, whereas mixed population was observed between October and December. Attachment intensity reached its maximum between February and April, then gradually decreased until January, before it finally reached zero again in January.

Interestingly, prevalence of infection constantly high among all the stations as well as all seasons, it reveals slight variation (station-wise 0.89, season-wise 0.55 of the p-values). From all indications, it shows that it is not dependent on those seasonal trends that prevail in parasite size and intensity; meanwhile, the total prevalence for *P. instructa* should persist at a reasonably level. The comparable results from both studies further strengthen the consistent infestation of *Pennella* sp. in the fish regarding peak season presence and gradual reduction after the maximum period, hence pointing to endurance and persistence in the parasitic relationship in sailfish populations.

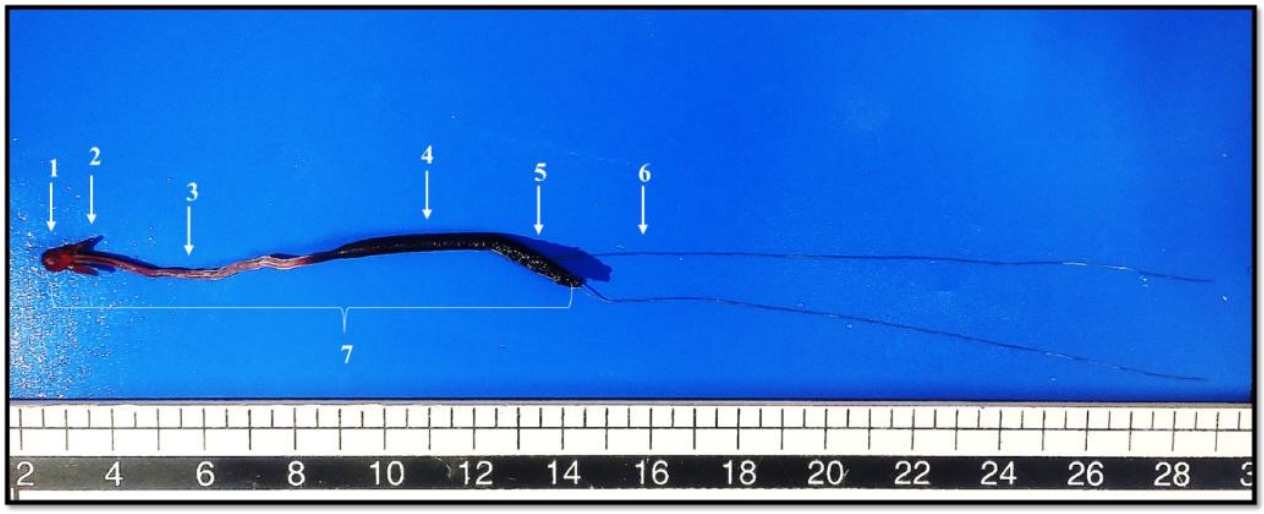

Figure 3 Shows the anatomical structures of *Pennella* sp., including the Cephalothorax (1), Holdfast (2), Neck (3), Trunk (4), Abdomen (5), Egg sac (6), and Total length (7).

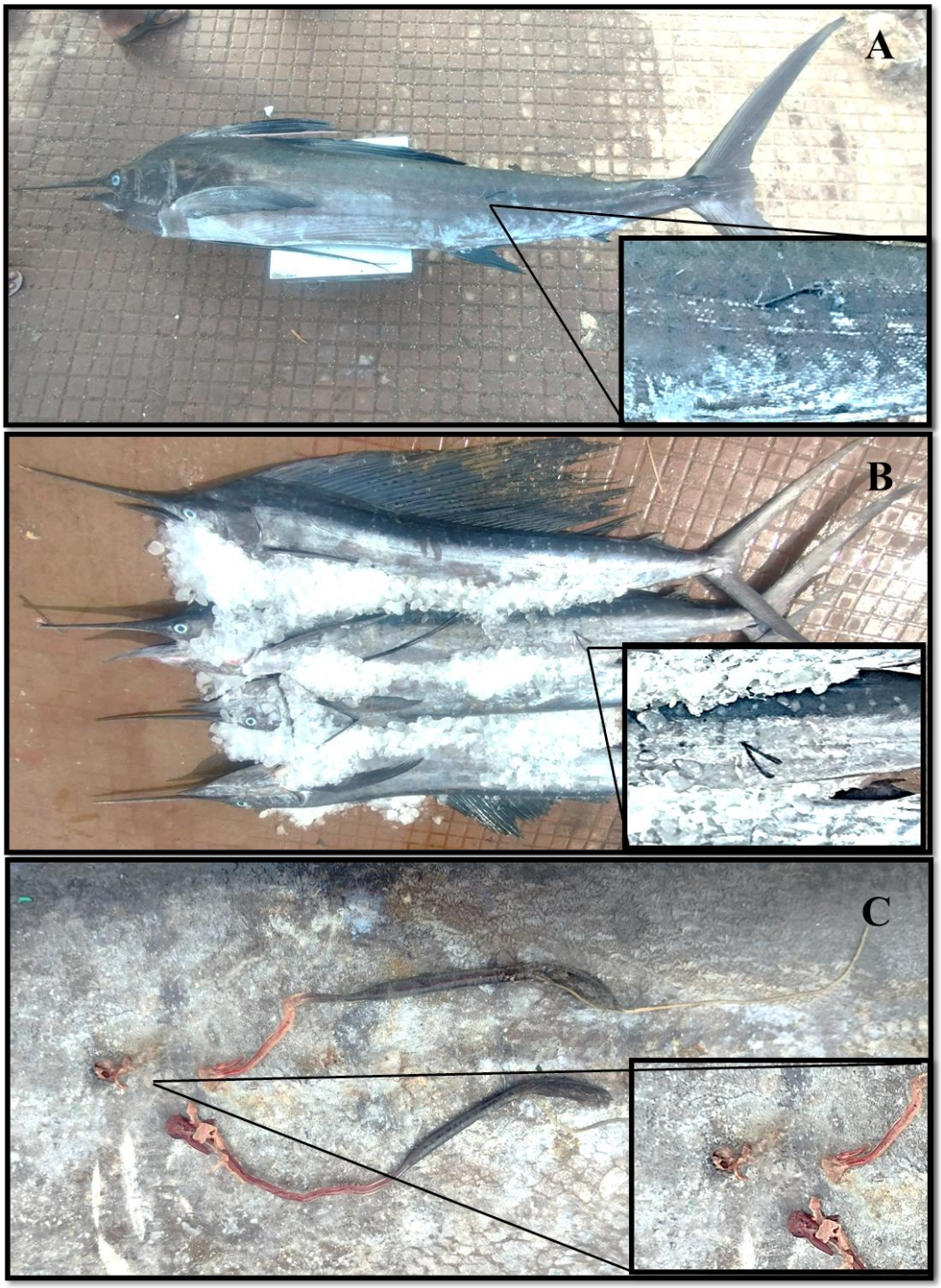

Figure 4 Shows the attachment sites of the parasite attachment site (A) and shows dual parasitic attachment at the same location (B). It also illustrates how the parasite embeds itself into the host at the site of infestation (C)

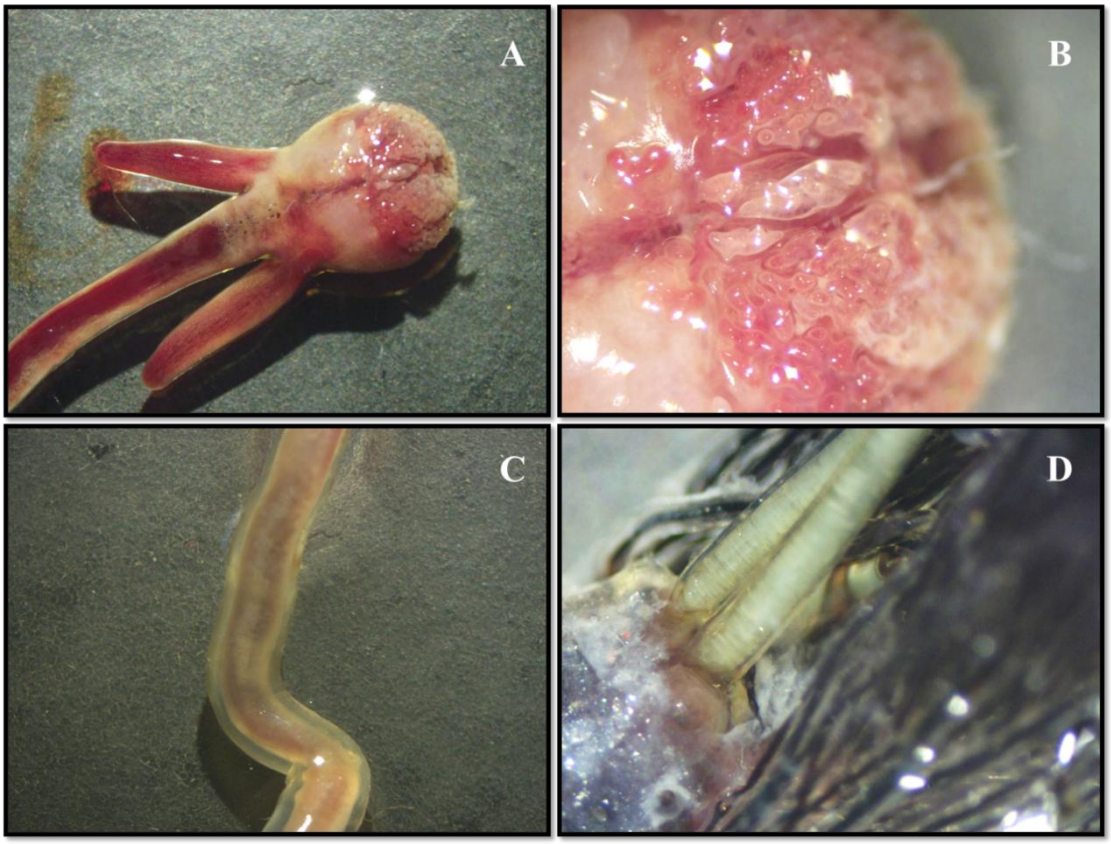

Figure 5 Cephalothorax of Pennella sp. (A). Showing the antennary processes with the unbranched papillae on the outer margin of area covered with small papillae, (B). The neck portion of the parasite is shown, (C). Abdominal region shows the pair of egg sacs.

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Ethical approval & declaration

In this article, as per the animal regulations followed in Centre of Advanced Study in Maine Biology, Faculty of Marine Sciences, Annamalai University, India, the authors observed the seasonal prevalence on the Parasitism of *Istiophorus platypterus* (Shaw, 1792) by *Pennella* sp. (Copepoda: Pennellidae) from the Tamil Nadu Coastal waters, India. The Animal ethical guidelines are followed in the study for species observation, identification & experimentation.

Informed consent

Not applicable.

Conflicts of interests:

The authors declare that there are no conflicts of interests.

Funding:

The study has not received any external funding.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES

1. Devaraj M, Bennet SP. *Pennella instructa* Wilson (Copepoda), parasitic on the sailfish, *Istiophorus platypterus* (Shaw and Nodder). Indian J Fish 1972; 19(1&2):171-175.
2. Hogans WE. Description of *Pennella filosa* L. (Copepoda: Pennellidae) on the ocean sunfish (Mola mola L.) in the Bay of Fundy. Bull Mar Sci 1987; 40:69–72.
3. Linnaeus C. *Systema Naturae per regna tria naturae, secundum classes,ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Edn. 10. Editio decima, reformata, Laurentii Salvii, Holmiae [= Stockholm], 1758; 824.
4. Pradeep HD, Shirke SS, Devi SM. Report of epizootic cirripede, Conchoderma virgatum (Spengler, 1790) on Pennella instructa (Wilson, 1917) parasitic on Indo-Pacific sailfish Istiophorus platypterus caught from Andaman Sea. J Entomol Zool Stud 2016; 4(4):1208-1210.
5. Ramdani S, Trilles JP, Ramdane Z. Pathological effects caused by pennella instructa (wilson, 1917) (pennellidae) to its host, xiphias gladius linnaeus, 1758 (xiphiidae) off the algerian coast. Stud Univ Vasile Goldis Ser Stiint Vietii (Life Sciences Series), 2021; 31(2):85-91.
6. Ramkumar S, Sonawane MP, Mhatre DV, Khandagale PA, Ranjith L, Tawde VM. Parasitism of Pennella instructa on indo-pacific sailfish Istiophorus platypterus and its commensality relation with goose barnacle, Conchoderma virgatum along Eastern Arabian Sea. Int J Adv Biochem Res 2024; 8(6S):187-193. doi: 10.33545/26174693.2024.v8.i6Sc.1287
7. Surya S, Rohit P, Abdussamad EM, Santhosh B, Asha TL, Kingsly HJ, Sini MB, Ambarish GP. Pennella instructa infestations on billfishes caught from the Eastern Arabian Sea. Mar Fish Infor Serv T E Ser 2023; 258:40-41.
8. Suyama S, Yanagimoto T, Nakai K, Tamura T, Shiozaki K, Ohshimo S, Chow S. A taxonomic revision of Pennella Oken, 1815 based on morphology and genetics (Copepoda: Siphonostomatoida: Pennellidae). J Crustac Biol 2021; 41(3):r uab040. doi: 10.1093/jcbiol/ruab040
9. Thompson MT. Immature specimens of *Penella filosa*. Biol Bull 1905; 8(5):296-307.
10. Varghese S, Somvanshi VS, Sijo PV. Occurrence of epizootic Cirripede, Conchoderma virgatum (Spengler, 1790) on Pennella instructa Wilson infected on Sailfish Istiophorus platypterus caught from north-west Indian EEZ. Journal of the Bombay Natural History Society, 2009; 106:344-346.
11. Wilson CB. North American parasitic copepods belonging to the Lernaeidae with a revision of the entire family. Proceedings of the United States National Museum 1917; 53 (2194):1–150, 4 figs., 21 pls. doi: 10.5479/si.00963801.53-2194.1