

New record of an epizoic diatom, *Pseudohimantidium pacificum* on two species of copepods from the Indian Ocean

G. Sahu, S. Panigrahi, A.K. Mohanty, M.S. Achary, M.K. Samantara, S.N. Bramha, K.K. Satpathy¹ & I.V. Dovgal[#]

Indira Gandhi Centre for Atomic Research, Kalpakkam- 603102, India

¹Department of Invertebrate Fauna and Systematics, National Academy of Sciences of Ukraine, Ukraine

*[Email: satpathy@igcar.gov.in]

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Pseudohimantidium pacificum Husted and Krasske, 1941, an epizoic diatom was found on the copepod genera *Corycaeus* Dana and *Euterpina acutifrons* Dana from the coastal waters of Southwestern Bay of Bengal. The present report forms the first record of the epibiont *Pseudohimantidium pacificum* from the Indian coast and the Indian Ocean.

Introduction

Adhesion of micro-organisms to the exoskeleton of crustaceans especially copepods is a very unique phenomenon and moreover, the exoskeleton of crustaceans constitute a convenient shelter for a variety of micro-organisms such as, bacteria, microalgae, protozoans, fungi etc¹. This phenomenon of adhesion is known as 'epibiosis' and in this process of interaction, the micro-organisms are epibionts and the crustaceans are basibionts ref. As a result of epibiosis, host and epibiont have both negative as well as positive effects¹. The disadvantages, mainly for the basibionts, in this relation involve a decrease in fecundity²⁻⁴, perturbation of locomotion³, increasing susceptibility to predation^{2,5-7}, lesions and diseases, increasing energy demands and faster sinking rate⁸⁻¹⁰. Positive effects, mainly for the epibionts, include transfer of epibionts to food and oxygen enriched region and also by fixing themselves to moving bodies; they can easily avoid predation^{3,11}. It was reported that transfer of basibionts cause increase in the rate of sustenance for epibionts¹². According to Wahl¹³, higher intensity of water flow facilitates the excreta to disperse and also regulates the dispersion of epibionts, subsequently improving the gene flow of their population.

Among photosynthetic micro-organisms as epibionts, mostly pinnate diatoms (mostly benthic forms) have been found growing on the body of copepods. The first report on epizoic diatoms was revealed by Giesbrecht¹⁴ from the Adriatic Sea and later it was reported from different regions of the world¹⁵⁻¹⁶. Very few numbers of reports from the Indian Ocean have recorded bacteria and protozoans as epibionts on various hosts. However, in this report, we found *Pseudohimantidium pacificum*, an epizoic

diatom, on two copepod hosts i.e. *Corycaeus* Dana (Order-Poecilostomatoida; Family-Corycaeidae) and *Euterpina acutifrons* Dana (Order- Harpacticoida; Family-Euterpinae), which to the best of our knowledge is the first report from the Indian coast as well as Indian Ocean. Among different epizoic diatoms, *P. pacificum* is one of the important one and was confirmed from our sample by detailed morphological investigations. Though the study on this epibiont was not done with an objective, we came across this phenomenon during our regular zooplankton monitoring program.

Material & Methods

Samples were collected from the coastal waters (up to 5 km away from the shore) and offshore waters (up to 30 km away from the shore) of Southwestern Bay of Bengal, India. Zooplankton samples were collected using plankton nets of 200 µm mesh size. After collection, zooplankton samples were preserved with 5% buffered formalin. Preserved samples were taken to the laboratory for further analysis i.e. qualitative and quantitative analysis. Each sample was screened under stereo binocular microscope (Zeiss Axiovert 40 CFL). Individuals were identified up to species level using standard literature of Kasturirangan¹⁷ and Conway et al.¹⁸. Each copepod with epizoic diatom was picked up with a micropipette and placed in 10 ml vials. The diatom cells and copepods were washed in distilled water followed by cleaning of frustules from the organic matter present in it following the technique of Hasle & Fryxell¹⁹. Permanent slides were prepared using DPX (Refractive index = 1.52) as a mounting medium. Specimens were measured and photographed under Zeiss Axio observer A1

microscope with Jenoptik ProgRes CF Scan camera and CapturePro image analysis software.

Result & Discussion

P. pacificum was first described by [Hustedt & Krasske](#) from the northern marine Chilean water masses²⁰. They presented detailed information of shape and size of valves and position of axial area. In the present material also all the above characteristics were described as follows:

Classification:

Empire – Eukaryota **Chatton**
 Kingdom – Chromista **Cavalier – Smith**
 Phylum - Heterokontophyta **Hoek**
 Class – Fragilariophyceae **Round**
 Order – Protoraphidales **Round**
 Family – Protoraphidaceae **Simonsen**
 Genus – *Pseudohimantidium* **Hustedt & Krasske**
 Species – *pacificum* **Hustedt & Krasske, 1941**

Heterotypic Synonym: Hormophora zavodnikia, Jurilj, Acta Botanica Croatia, v. 16, p. 98, Fig. 3, 1957.

*References for identification: Krasske*²⁰, *Gibson*²¹⁻²², *Hendey, N.I.*²³, *Fernandes & Calixto-Feres*²⁴.

Morphology study: Diatom cells attached to the copepod by producing mucilage stalks exactly at the apices of the frustules. Valves are arcuate with subrostrate apices. Plastids in the cells were numerous and oval in shape (Figure 1-4). Apical axis 38-44 µm in 100 µm and transapical axis is 10- 14 µm in 100 µm.

Distribution and host specificity: Reports on *P. pacificum* as epibiont were also available from different regions of Atlantic Ocean and Pacific Ocean^{21,24-25}. As in case of the present study, the first report of *P. pacificum* by [Hustedt & Krasske](#) also revealed one of the hosts was *corycaeus* Dana²⁰. [Gibson](#)²¹ also reported this species from the same host, which was considered as the first report of this epizoic diatom from Florida Current waters of the Western North Atlantic Ocean, off the east coast of Florida. He also found this diatom on other copepods from the orders Harpacticoida and Cyclopoida. [Fernandes and Calixto-Feres](#)²⁴ also recently found *P. pacificum* as the epibiont with the same copepod genera (*corycaeus* Dana and *Euterpina acutifrons* Dana) from Paranagua Bay, Parana state, Brazilian



(a)



(b)

Figure 1: *Pseudohimantidium pacificum* Hustedt & Krasske colonies virtually covering the urosome and a portion of locomotory organs of the copepod *Euterpina acutifrons*



Figure 2: Growth of *Pseudohimantidium pacificum* Hustedt & Krasske colonies on the exoskeleton of the copepod *Corycaeus* Dana

coast and the report was considered as the very first report from the Southwestern Atlantic Ocean.

Although, the epizoic diatom was mostly found on the copepod genus *Corycaeus*, it was also reported on another host copepod *Faranulla gibbula* Giesbrecht by Garate-Lizárraga & Muñeton-Gomez²⁵ from Gulf of California. Coincidentally, the morphology of two copepods (*Faranulla gibbula* and *Corycaeus*) is very similar as they both belong to the same order- **Poecilostomatoida**. This epibiont was also recorded previously from North Atlantic i.e. from the Caribbean Sea to the east coast of North America, the Pacific Ocean and the Mediterranean Sea^{15,22,25}.

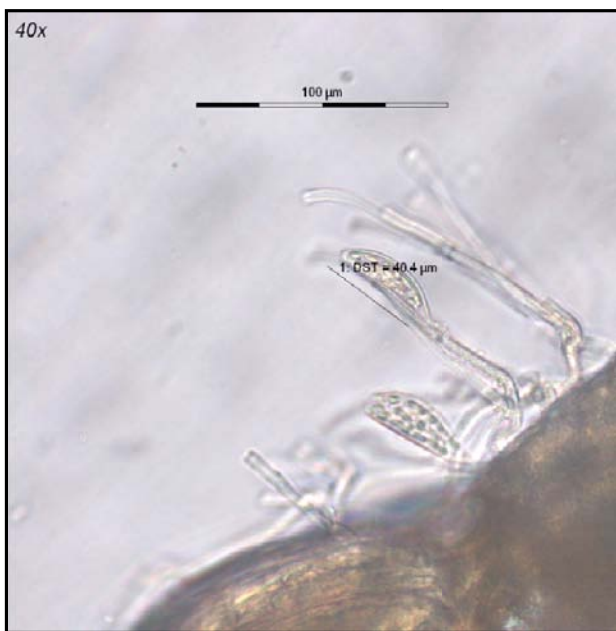


Fig. 4: Details of cells with long mucilage stalks and arcuate cells with oval plastids

Conclusion

In the present study, the diatom species was found attached mostly to the copepods of coastal water samples and rarely found in offshore samples, which indicates the affinity of the diatom towards essential nutrients for its survival as coastal region is a well known nutrient rich zone in the marine environment. Moreover, in the present study, the diatom appeared mostly on the exoskeletons of the copepods rather on the locomotory organs in a few number of copepods.

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