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Protistology

SHORT COMMUNICATION

New records of epibiont suctorians *Actinocyathula homari* and *Acineta nitocrae* (Ciliophora: Suctorea) on harpacticoid copepod from the west coast of India

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Summary

The paper deals with the discovery of ciliate epibionts *Actinocyathula homari* and *Acineta nitocrae* on harpacticoid copepods from Gujarat, the west coast of India. This is also the first record of *A. homari* as an epibiont on a harpacticoid copepod. Both species are reported here from the Indian coast for the first time. This is also the first record of *A. nitocrae* from the marine waters with salinity 34.4 ‰.

Key words: suctorian ciliates, epibiosis, Crustacea, India

Introduction

Various species of epibiont ciliates were found on benthic harpacticoid copepods during the investigations on the west coast of India (Chatterjee et al., 2013, 2020a, 2020b, 2020c, 2021a, 2021b). During the study of benthic invertebrates at the Veraval coast, Gujarat, two suctorian ciliates, *Actinocyathula homari* (Sand, 1899) and *Acineta nitocrae* Dovgal, 1984, were found attached to a harpacticoid copepod. The present communication deals with some characteristics of the discovered ciliate species, including measurements and data on the species' ecology and distribution.

Material and methods

This study was conducted along the Veraval coast of Gujarat, India (Fig. 1).

The material was collected in Out Fall point (OFS), a subtidal region off the Veraval coast, the west coast of India, latitude 20°54'41.10'' N, longitude 70°20'36.10'' E (Fig. 1); water depth 23 m; bottom water temperature 25.1 °C; salinity 34.4 ‰; pH 8.1; sediment type is silty sand texture.

The infested copepod was mounted on a 50% glycerine slide and sealed with Dibutylphthalate Polystyrene Xylene (DPX). Photomicrographs were obtained by the program Nikon Eclipse Ei with the

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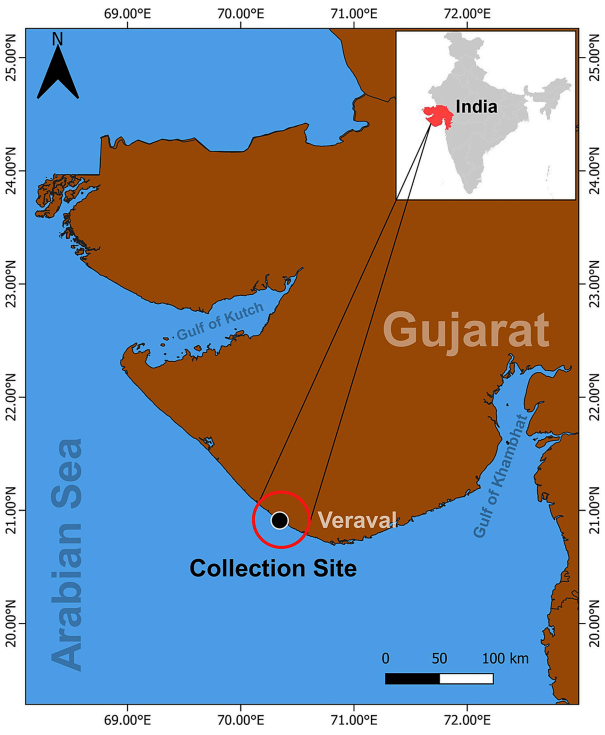

Fig. 1. Map of the collection site.

attached Digital sight 1000 camera, mounted on a stereo Nikon SMZ1270. Measurements of ciliates were made using the software NIS Elements and Top View 3.7 for processing of digital images. The terminology and systematic position of the suctorian ciliates follow Dovgal (2002b, 2013) and Jankowski (2007).

Specimens are kept in the collection of the second author of this publication (Sabyasachi Sautya) in the museum of the National Institute of Oceanography Regional Centre, Mumbai, India.

Results and discussion

The description of the examined material, results of measurements and some remarks on the species' taxonomy, distribution, environmental preferences and favorable habitats are presented in two sections below.

I. Class Suctorea Claparéde et Lachmann, 1859
Subclass Exogenia Collin, 1912
Order Metacinetida Jankowski, 1978
Family Paracinetidae Jankowski, 1975
Genus *Actinocyathula* Corliss, 1966
Actinocyathula homari (Sand, 1899)
Synonyms: *Acineta homari* Sand, 1899
Paracineta homari (Sand, 1899)
Corynophrya homari (Sand, 1899)

Material examined (Fig. 2, A, B, C, D, F)

One individual of *Actinocyathula homari* was found on the exoskeleton (dorsum) of a female harpacticoid copepod (assigned to the family Pseudotachidiidae, with some reservation) (Fig. 2, A, B), collected from the subtidal region off the Veraval coast (latitude 20°54'41.10'' N, longitude 70°20'36.10'' E), Gujarat, India, at water depth 23 m (collected by Sabyasachi Sautya, March 2022).

Description

A marine loricate suctorian ciliate with ovoid body that protrudes from the stylotheca aperture (Fig. 2, B, C, D, F). Tentacles clavate, retractile, arranged at the apical body surface. Stylotheca unflattened, smooth, triangular to bell-shaped, equipped with a robust rigid pseudostyle, which is of the same length or shorter than the rest of the stylotheca. Macronucleus spherical, located at posterior end of body.

Measurements (in μm, based on one individual)

Body length 44; body width 37; macronucleus length 11; macronucleus width 14; stylotheca length 30; stylotheca width 39; pseudostyle length 17; pseudostyle diameter 4; retracted tentacle length 4–7.

Remarks

Actinocyathula homari was first described (cited as *Acineta homari*) on the setae of the telson and orbit of a lobster from Roscoff, France (Sand, 1899). Collin (1912) reported this organism on the setae of the pagurid *Pagurus cuanensis* Bell, 1845 from Séte, France. This species was also recorded on pereopods of *Homarus americanus* H. Milne Edwards, 1837, and on exoskeleton of *Pagurus* sp. (Kahl, 1934; Morado and Small, 1995). Curds (1987) mentioned *A. homari* as an epibiont of the decapod crustaceans.

Later, *A. homari* was reported on the decapod crustacean *Liocarcinus depurator* (Linnaeus, 1758), a portunid crab collected off the Mediterranean coast of Spain (Fernandez-Leborans et al., 1997; Santhanam, 2018). In addition, the species was reported on other decapod crustaceans: *Corystes cassivelanus* (Pennant, 1777), *Diogenes pugilator*

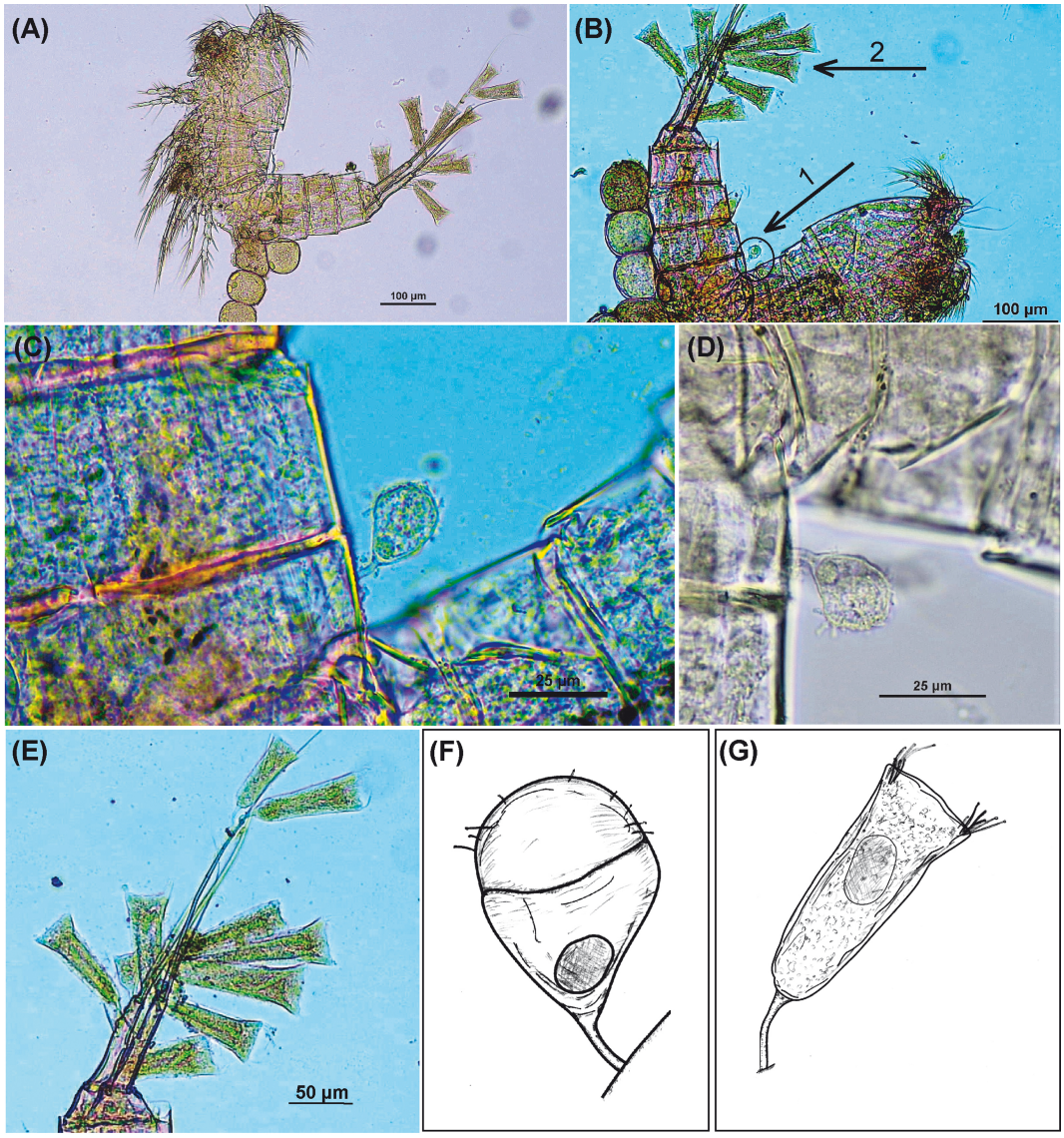

Fig. 2. A – Host harpacticoid copepod (complete view) with ciliate infestation; B – harpacticoid host with *Actinocyathula homari* (arrow 1) and *Acineta nitocrae* (arrow 2); C, D. – magnified view of *Actinocyathula homari*; E – magnified view of *Acineta nitocrae*; F – schematic diagram of *Actinocyathula homari*; G – schematic diagram of *Acineta nitocrae*.

(Roux, 1829), *Goneplax rhomboids* (Linnaeus, 1758), *Liocarcinus depurator* (Linnaeus, 1758), *Medorippela nata* (Linnaeus, 1767), *Pagurus excavatus* (Herbst, 1791), *Paguristes oculatus* (Fabricius, 1775), *Pagurus prideaux* Leach, 1815, and *Perthenope angulifrons* Latreille, 1825, from the north-west Mediterranean coast (Fernandez-Leborans, 2003). Fernandez-Leborans (2003) also commented that this species might be a special case, being found as epibiont on most decapod species.

However, besides decapods, the species was also found as epibiont on the marine isopods *Heteromesus quadrispinosus* (G.O. Sars, 1879) and *Munna acanthifera* Hansen, 1916 from deep waters near Iceland (Ólafsdóttir and Svavarsson, 2002).

A. homari was also reported as a hyperepibiont on the hydrozoan *Dicoryne conferta* (Alder, 1856), which was found attached to the shell occupied by the hermit crab *Pagurus bernhardus* (Linnaeus, 1758) from the west coast of Scotland (Fernandez-Leborans et al., 2013).

Baldrighi et al. (2020) reported the species as epibiont on the nematodes *Desmodora* de Man, 1889, *Paradesmodora schuurmans* Stekhoven, 1950,

and *Pseudochromadora* Daday, 1899 from the NW Madagascar margin-deep sea pockmark, the Gulf of Naples shallow vent area, French Guiana Mangrove forest.

Recently, *A. homari* was reported as epibiont on the nematode *Tricoma* sp. from the Arabian Sea, at the 4,119 m depth (Chatterjee et al., 2022). This species is also known from Mexico, dwelling on the rhodophyceae *Polysiphonia* sp. (Martinez-Murillo, 1997; Aladro-Lubel et al., 2006).

Thus, *A. homari* is a widely distributed marine species inhabiting different macro- and meiobenthic invertebrates and benthic algae.

II. Class Suctorea Claparéde et Lachmann, 1859
Subclass Endogenia Collin, 1912
Order Acinetida Raabe, 1964
Family Acinetidae Ehrenberg, 1838
Genus *Acineta* Ehrenberg, 1834
Acineta nitocrae Dovgal, 1994

Material examined (Fig. 2, A, B, E, G)

Ten individuals of *Acineta nitocrae* were found attached on the furca of a female harpacticoid copepod host (assigned to the family Pseudotachidiidae, with some reservation) (Fig. 2, A, B), collected from the subtidal region off the Veraval coast (latitude 20°54'41.10'' N, longitude 70°20'36.10'' E), Gujarat, India, at water depth 23 m (collected by Sabyasachi Sautya).

Description

Suctorian ciliate with a thin-walled, elongated lorica, without folds, oval in cross-section, with a slight apical widening. Lorica aperture narrow, slit-like, almost straight. Actinophores were indrawn in the observed specimens. The cell body attached to the bottom of the lorica. The tentacles clavate, they can retract during fixation; located in two bundles on flattened actinophores that can withdraw during fixation. The stalk short, dense, with weak transverse striation, slightly curved, provided with a small basal disk in connections between stalk and lorica. The macronucleus is ellipsoid, positioned along the longitudinal axis of the body.

Measurements (in μm, based on 4 individuals)

Lorica length 77–109; lorica width in the middle part 22–35; lorica aperture width 37–40; macronucleus length 14–34; macronucleus width 8–12; stalk length 11–30; stalk diameter 3–6; tentacle length 5-24.

Remarks

Acineta nitocrae was first described as epibiont on the copepod *Nitokra hibernica hibernica* (Brady, 1880) (cited as *Nitocra hibernica*) (family Ameiridae Boeck, 1865) from flood-land lake near Dnieper River (Kiev, Ukraine) by Dovgal (1984). Later, this species was reported on *Nitokra hibernica hibernica* (cited as *Nitocra hibernica* and *N. incerta*), *Nitokra lacustris lacustris* (Schmankevitsch, 1875) (cited as *Nitocra lacustris*), *Nitokra* sp. (cited as *Nitocra* sp.), and also on *Canthocamptus* (*Canthocamptus*) *staphylinus* (Jurine, 1820) (family Canthocamptidae G.O. Sars, 1906) from Ukraine (Kiev Reservoir, flood plain lake near Kiev city, Lake Nobel, Kremenchung Reservoir, lower Dnieper River, Dnieper-Bug Estuary, Danube River delta) (Dovgal, 1994, 2013; Grigorovich et al., 2001; Rybka and Yuryshynets, 2018); and on *Nitokra hibernica hibernica* (cited as *Nitocra hibernica* and *N. incerta*) from the Lake Saint Clair (Middle Sister Island) and Detroit River in Canada (Grigorovich et al., 2001). Recently, this species was reported on *Nitokra* sp. from Amsterdam, The Netherlands (Yalçın et al., 2021).

In the present case, the specimens were obtained as epibionts on a harpacticoid copepod (family Pseudotachidiidae, assigned with reservation) from marine water on the west coast of India. Individuals found on the Indian coast appeared to be indistinguishable in morphology and measurements from the representatives of the species from Europe and North America. This is the first record of this species from the Indian coast.

A. nitocrae lives as an epizooic on or near the caudal rami (furca) of the harpacticoid copepod hosts (Kipp, 2023). In the present study, this species was also found attached to the furca of the host.

The preferable water temperature for this species is 4–11 °C, and densities greatly decline at higher temperatures, 19–23 °C (Kipp, 2023). In the present investigation, near-bottom water temperature was 25.1 °C, and in the entire harpacticoid population, only one host organism was infested with ten individuals of *A. nitocrae*.

According to published data, *A. nitocrae* can tolerate salinity fluctuations from 0.1 to 5‰ in the Dnieper-Bug Estuary (Grigorovich et al., 2001)

or possibly higher (Kipp, 2023). Grigorovich et al. (2001) pointed out that ocean salinity tolerance is unknown for this species. The present occurrence of the species at salinity 34.4 ‰ at water depth 23 m in the subtidal region of the Indian coast suggests that *A. nitocrae* can tolerate a wide range of salinity and, possibly, shows its potential euryhaline nature. However, the obtained material is too scarce (just 10 ciliates on just one individual of the harpacticoid copepods) and, therefore, the idea about its possible euryhalinity is so far tentative and needs further investigation and approval.

Meanwhile, a number of publications confirm that euryhalinity is common among representatives of the genus *Acineta*. For example, the species *A. compressa* Claparède et Lachmann, 1859, *A. euchaetae* Sewell, 1951, *A. karamani* Hadži, 1940, *A. sulcata* Dons, 1927, and *A. tuberosa* Ehrenberg, 1834 were observed both in marine and freshwaters (Dovgal, 2002a, 2013; Dovgal et al., 2008; Sahu et al., 2017; Chatterjee et al., 2021a).

Hence, our current results are promising since they are likely expanding the knowledge of salinity tolerance by *A. nitocrae*, thus shedding more light on the ecology of this epibiont ciliate species.

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