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Article

A checklist of halacarid mites (Acari, Halacaridae) associated with echinoderms (Echinodermata)

Tapas Chatterjee

Near Harimandir Road, Dhanbad 826001, Jharkhand, India; E-mails: drtchatterjee@gmail.com, drtchatterjee@yahoo.co.in

ABSTRACT
A compilation of halacarid mite species (Halacaridae) found associated with echinoderms (Echinodermata) has been carried out based on published records. In this paper, we listed 20 halacarid mite species associated with echinoderms altogether. These 20 species belong to 10 genera, viz. *Agaue* (2 species), *Agauopsis* (1 species), *Copidognathus* (5 species), *Enterohalacarus* (1 species), *Halacarellus* (4 species), *Halacaropsis* (1 species), *Halacarus* (2 species), *Rhombognathides* (2 species), *Rhombognathus* (1 species) and *Thalassarachna* (1 species).

KEY WORDS: Association; Halacarida; occasional invader; Prostigmata; Trombidiformes.

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INTRODUCTION

Halacarid mites live in a variety of substrata ranging from fronds, holdfasts, tufts of algae, in and on colonies of sponges, hydrozoans, bryozoans, barnacles, mussels, and polychaetes to sediments, flocculent ooze, coarse and fine sands (Chatterjee and Sarma 1991; Bartsch 2006, 2008). Halacarid mites are recorded from upper altitude areas as well as from deep-sea area (Chatterjee and Durucan 2021; Chatterjee 2021a). Some species are also associated with mangroves (Chatterjee *et al.* 2018). The mites are also known to dwell on the rough and hairy body surfaces of various macrofauna. Recently, a checklist of halacarid mites associated with decapod crustaceans has been given in Chatterjee (2021b). There are also a few parasitic forms or suspected to be parasitic halacarid species (Chatterjee 2020).

In marine environments, many small invertebrates, like copepods (e.g., Humes 1976, 1980, 1981, 1986, 1987; Kim 2003; Korzhavina *et al*. 2019), isopods (e.g., Ross 1983), polychaetes (e.g., Devaney 1967; Uchida 1975; Martin and Britayev 1998; Britayev *et al*. 1999) and amphipods (e.g., McCloskey 1970; Tzvetkova 1975; Vader 1978; Berge *et al*. 2004) have been found associated with echinoderms.

Information on the halacarid fauna associated with echinoderms are scarce and scattered in the literature. The present article compiles a checklist of halacarid mites found associated with echinoderms based on published data in the literature.

METHOD

The present checklist is prepared based on published literatures. The genera, and species within

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genera, are arranged in an alphabetical sequence.

RESULTS

Genus *Agaue* Lohmann, 1889

Agaue chevreuxi (Trouessart, 1889)

Syn.: *Leptopsalis chevreuxi* Trouessart, 1889
Halacarus chevreuxi - Lohmann 1893 (partim)
Halacarus (*Leptopsalis*) *chevreuxi* - Trouessart 1889
Halacarus (*Leptospathis*) *chevreuxi* - Trouessart 1894
Halacarus (*Polymela*) *chevreuxi* - Lohmann 1901

Report associated with echinoderms – This species was reported associated with holothurians (Echinodermata, Holothuroidea) and sea urchin *Strongylocentrotus* sp. (Echinodermata, Echinoidea) from Adriatic Sea (Viets 1939, 1940).

Remarks – This species has been reported in a variety of substrata like subtidal algae, mussels, sediment from northeastern Atlantic, Mediterranean and Black Sea (Trouessart 1889a; Lohmann 1893; Viets 1940; Mari and Morselli 1990; Bartsch 1998, 2009; Durucan 2019a).

Agaue panopae (Lohmann, 1893)

Syn.: *Halacarus panopae* Lohmann, 1893
Halacarus panopae var. *squamifera* Lohmann, 1893
Halacarus panopae var. *setifera* Lohmann, 1893
Halacarus (*Polymela*) *panopae* Lohmann, 1901
Leptospathis panopae - Trouessart 1907

Report associated with echinoderms – This species was reported associated with sea urchin *Strongylocentrotus* sp. (Echinodermata, Echinoidea) from Adriatic Sea (Viets 1940).

Remarks – This species has been reported in various subtidal substrata from Cape Verde Islands, off the Amazonas, Mediterranean Sea (Lohmann 1893; Newell 1984; Durucan 2019a).

Genus *Agauopsis* Viets, 1927

Agauopsis brevipalpus (Trouessart, 1889)

Syn.: *Agaue brevipalpus* Trouessart, 1889
Agaue brevipalpus var. *pontica* Chichkoff, 1907

Report associated with echinoderms – This species was reported associated with holothurians (Echinodermata, Holothuroidea) from Rovigno, Adriatic Sea, Mediterranean Sea (Viets 1940).

Remarks – This species has been reported in a variety of substrata from tidal and subtidal area of northeastern Atlantic, Mediterranean and Black Sea (Trouessart 1889b, c, 1901; Viets 1940; Bartsch 1996a; Durucan and Boyaci 2018; Durucan 2020).

Genus *Copidognathus* Trouessart, 1888

Copidognathus brachystomus Viets, 1940

Report associated with echinoderms – Few specimens of this species were reported associated with holothurians (Echinodermata, Holothuroidea) from Rovigno, Adriatic Sea, Mediterranean Sea (Viets 1940).

Remarks – This species has been reported in a variety of substrata at shallow water from Baltic, Mediterranean and Black Sea (Viets 1940; Morselli 1980; Bartsch 2001; Durucan 2019b, 2020).

Copidognathus flabellifents Bartsch, 2011

Report associated with echinoderms – Gulf of Mexico, Alminos Canyon, 26° 10.87' N, 94° 37.38' W, depth 2743 m; upper 0–2 cm of undisturbed muddy sediment with the spatangoid sea urchin *Snrsiaster griegi* Mortensen, 1950 (Echinodermata, Echinoidea) – Bartsch (2011).

Remarks – This species was also reported from Gulf of Mexico, Alaminos Canyon, 26–27° N, 88–94° W, at 2744–2190 m depth amongst mussel *Batllymodiolus brooksi* (bivalve mollusk) and from Gulf of Mexico, Atwater Valley, 28° N, 88° W, at 2190 m depth amongst *Bathymodious brooksi* and tubeworms *Escarpia lnrninaia, Lamellibrach* sp. — Bartsch (2011).

This species was collected from gas seep areas of the northern Gulf of Mexico. External characters of this species do not reflect at specialization to a life in gas seep areas and the species is most likely also found outside seep communities (Bartsch 2011).

Copidognathus latus Viets, 1927

Report associated with echinoderms – This species was reported from a depth of 20 m, from sediment inhabited by sea cucumbers *Cucumaria* sp. (Echinodermata, Holothuroidea) and brown algae (*Desmarestia* sp.) from Bergen (Rylands Sund), Norway (Viets 1928).

Remarks – This species was reported associated with algae *Fucas Serratus* in the northern Øresund, Denmark (Hagerman 1966).

Copidognathus papillatus Krantz, 1982

Report associated with echinoderms – This species was reported from Gorda Ridge, 43° N, 127° W, 2701 m depth found on the echinoderm *Xyloplax janetae* Mah, 2006 (Echinodermata, Asteroidea) from margin of a hydrothermal vent field with a few polychaeta tubeworms *Ridgeia piscesae* Jones, 1985 (Voight 2005, referred in Bartsch 2011)

Remarks – This species was found from northern and southern Pacific in Abyssal depth mostly reported from hydrothermal vent area (Krantz 1982; Bartsch 1991, 2011).

Copidognathus perforatus Viets, 1940

Report associated with echinoderms – This species was reported associated with holothurians (Echinodermata, Holothuroidea) from Rovigno, Adriatic Sea, Mediterranean Sea (Viets 1940).

Remarks – This species has been reported from various shallow water substrata (Viets 1940).

Genus *Enterohalacarus* Viets, 1938

Enterohalacarus minutipalpis Viets, 1938

Report associated with echinoderms – Viets (1938) reported an intestinal parasitic halacarid species found in the gut of a sea urchin, *Plesiodiadema indicum* (Döderlein, 1900) (Echinodermata,

Echinoidea) at a depth of 430 m off the west coast of Halmahera Island, Strait of Molucca, Sulu Sea, 7° N and 127° E, south of the Philippines.

Remarks – The species is characterised by reduced palps. The genus *Enterohalacarus* consists a single species.

Genus *Halacarellus* Viets, 1927

Halacarellus arnaudi (Newell, 1984)

Syn.: *Thalassarachna arnaudi* Newell, 1984

Report associated with echinoderms – This species was mentioned found from Antarctica, off Graham Land, Terre Adélie in crevices amongst algae and epifauna (washings of ophiuroids, crinoids, echinoids, tunicates) (Bartsch 2021).

Remarks – This species was found living amongest various substrata (Newell 1984; Bartsch 1990, 1993b).

Halacarellus balticus (Lohmann, 1889)

Syn.: *Halacarus balticus* Lohmann, 1889
Halacarus (*Halacarellus*) *balticus* - Viets 1927
Halacarus (*Thalassarachna*) *balticus* - Newell 1947

Report associated with echinoderms – This species was reported among sediments inhabitat by *Cucumaria* sp. (Echinodermata, Holothuroidea) and algae *Desmarestia* sp. from Bergen (Rylands Sund), Norway (Viets 1928).

Remarks – This species was also reported from eastern and western North Atlantic, North Sea, Baltic, Greenland among various tidal and subtidal substrata (Newell 1947; Green and MacQuitty 1987; Bartsch 2009).

Halacarellus flavellus Bartsch, 1993

Report associated with echinoderms – This species was found crawling on a brittle star (Echinodermata, Ophiuroidea) collected from Rottnest Island, Salmon Bay, Australia (Bartsch 1993a).

Remarks – This species was also reported among red algae, Bickley Point, Southwestern Australia (Bartsch 1993a).

Halacarellus vajetus (Bartsch, 1974)

Syn.: *Agaue vajeta* Bartsch, 1974

Report associated with echinoderms – This species was reported from Tanzania, near Tanga in shallow water coral reef, from washings of ophiuroids (Bartsch 1974, 2021).

Genus *Halacaropsis* Bartsch, 1996

Halacaropsis hirsuta (Trouessart, 1884)

Syn.: *Agaue hirsuta* Trouessart, 1889
Agauopsis hirsute - Viets 1927

Report associated with echinoderms – This species was reported found associated with sea urchin *Strongylocentrotus* sp. (Echinodermata, Echinoidea) from Rovigno, Adriatic Sea, Mediterranean Sea (Viets 1940).

Remarks – This species has been reported in various shallow water substrata from southeastern North Atlantic and Mediterranean Sea (Trouessart 1889b, c; André 1941; Viets 1940).

Genus *Halacarus* Gosse, 1855

Halacarus bisulcus Viets, 1927

Report associated with echinoderms – This species was reported among sediments rich in shell and inhabited by *Echinus esculentus* Linnaeus, 1758 (Echinodermata, Echinoidea), *Cucumaria frondosa* (Gunnerus, 1767) (Echinodermata, Holothuroidea) and algae *Delesseria* sp. from Bergen (Herdla Sund), Norway at 10 m depth (Viets 1928).

Remarks – This species was reported from eastern North Atlantic, Mediterranean in subtidal sand, gravels with algae, bryozoans, balanoides, etc. (Viets 1927; Weinstein 1961; Bartsch 1980, 2009; Green and MacQuitty 1987; Durucan 2019a, 2020).

Halacarus otiosus Bartsch, 1993

Report associated with echinoderms – This species was found in washing of crinoids (Echinodermata, Crinoidea) from 250 m depth of Palmer Archipelago (Bartsch 1993b).

Remarks – Bartsch (1993b) commented that this species is believed to live on other organisms and within scrub-like algae.

Genus *Rhombognathides* Viets, 1927

Rhombognathides pascens (Lohmann, 1889)

Syn.: *Aletes pascens* Lohmann, 1889
Rhombognathus pascens - Trouessart 1889
Rhombognathus (*Rhombognathides*) *pascens* - Viets 1927

Report associated with echinoderms – This species was reported among sediments inhabited by *Cucumaria* sp. (Echinodermata, Holothuroidea) and algae *Desmarestia* sp. from Bergen (Rylands Sund), Norway at 20 m depth (Viets 1928); among sediments inhabited by *Echinus esculentus* Linnaeus, 1758 (Echinodermata, Echinoidea), *Cucumaria frondosa* (Gunnerus, 1767) (Echinodermata, Holothuroidea) and algae *Delesseria* sp. from Bergen (Herdla Sund), Norway at 10 m depth (Viets 1928); also reported on the stone and mud floor sea basin inhabiting holothurians *Parastichopus tremulus* (Gunnerus, 1767) [syn.: *Stichopus tremulus* (Gunnerus, 1767)], *Bathyplotes natans* (M. Sars, 1868), *Mesothuria intestinalis* (Ascanius, 1805) (Echinodermata, Holothuroidea) from Bergen, Norway at 400 m depth (Viets 1928).

Remarks – This species was found in eastern and western North Atlantic, Baltic, and Black Sea among intertidal, subtidal algae and other substrata; also found in brackish water (Newell 1947; Green and MacQuitty 1987; Abé 1998; Bartsch 1996b, 2009).

Rhombognathides seahami (Hodge, 1860)

Syn.: *Pachygnathus seahami* (Hodge, 1860)
Aletes seahami - Lohmann 1889
Aletes triunguiculatus Lohmann, 1889
Rhombognathus seahami - Trouessart 1889
Halacarus seahami - Farran 1915
Rhombognathus (*Rhombognathopsis*) *seahami* - Viets 1927
Rhombognathopsis seahami - Viets 1928

Report associated with echinoderms – This species was reported among sediments inhabitat by *Cucumaria* sp. (Echinodermata, Holothuroidea) and algae *Desmarestia* sp. at 20 m depth from Bergen (Rylands Sund), Norway (Viets 1928).

Remarks – This species was found in eastern and western North Atlantic, Arctic, Baltic Sea from tidal and subtidal among algae and other substrata in marine and brackish water (Newell 1947; Green and MacQuitty 1987; Abé 1998; Bartsch 2009).

Genus *Rhombognathus* Trouessart, 1888

Rhombognathus magnirostris Trouessart, 1889

Report associated with echinoderms – This species was reported found associated with sea urchin *Strongylocentrotus* sp. (Echinodermata, Echinoidea) from Rovigno, Adriatic Sea, Mediterranean Sea (Viets 1939, 1940).

Remarks – This species has been reported in various algae, mussels, barnacles and coarse sandy sediments from Mediterranean and Black Sea (Bartsch 1996b; Abé 1998; Durucan 2019a, 2020).

Genus *Thalassarachna* Packard, 1871

Thalassarachna basteri (Johnston, 1836)

Syn.: *Acarus basteri* Johnston, 1836
Halacarus ctenopus Gosse, 1855
Thalassarachna verrilli Packard, 1871
Halacarus spinifer Lohmann, 1889
Halacarus globosus Trouessart, 1889
Halacarus (*Halacarellus*) *basteri* - Viets 1927
Halacarellus basteri var. *septentrionalis* - Gimbel, 1938
Halacarus (*Thalassarachna*) *basteri* - Newell 1947

Report associated with echinoderms – This species was reported among sediments inhabitat by *Cucumaria* sp. (Echinodermata, Holothuroidea) and algae *Desmarestia* sp. from Bergen (Rylands Sund), Norway (Viets 1928); among sediments inhabiting *Echinus esculentus* (Echinodermata, Echinoidea), *Cucumaria frondosa* (Echinodermata, Holothuroidea) and algae *Delesseria* sp. from Bergen (Herdla Sund), Norway (Viets 1928).

Remarks – This species has been reported in various substrata (among sand, hydroids, bryozoans, bivalves, tubes of serpulid polychaetes, algae, etc.) from western, eastern North Atlantic, Baltic and Mediterannean Sea (Newell 1947; Green and MacQuitty 1987; Bartsch 2009).

DISCUSSION

In this paper, we listed 20 species associated with echinoderms, altogether. These 20 species belong to 10 genera, viz. *Agaue* (2 species), *Agauopsis* (1 species), *Copidognathus* (5 species), *Enterohalacarus* (1 species), *Halacarellus* (4 species), *Halacaropsis* (1 species), *Halacarus* (2 species), *Rhombognathides* (2 species), *Rhombognathus* (1 species) and *Thalassarachna* (1 species).

Enterohalacarus minutipalpis reported as an intestinal parasite (endobiotic) found in the gut of a sea urchin, and *Plesiodiadema indicum* at a depth of 430 m off the west coast of Halmahera Island (Viets 1938).

Majority of recorded halacarid mites associated with echinoderms are found from other substrata. *Halacarus otiosus* which was found in washing of crinoids at 250 m depth is also believed to live on other organisms and within scrub-like algae (Bartsch 1993b).

Information on the halacarid fauna associated with echinoderms is very scarce in the literature and in majority of cases samples obtained were insufficient to determine the nature of the relationship between mites and echinoderms which may be occasional invaders in nature.

Ten species of halacarid mites viz. *Agaue chevreuxi, A. panopae*, *Copidognathus flabellifents*, *Enterohalacarus minutipalpis*, *Halacarellus arnaudi*, *Halacarus bisulcus*, *Halacaropsis hirsuta*, *Rhombognathides pascens*, *Rhombognathus magnirostris*, and *Thalassarachna basteri* were reported associated with class Echinoidea; 10 halacarid species viz. *Agaue chevreuxi*, *Agauopsis brevipalpus*, *Copidognathus brachystomus*, *C. latus*, *C. Perforatus*, *Halacarellus balticus*, *Halacarus bisulcus*, *Rhombognathides pascens*, *R. seahami* and *Thalassarachna basteri* were found associated with class Holothuroidea; three species viz. *Halacarellus arnaudi*, *Halacarellus flavellus*, and *H vajetus* were found associated with Ophiuroidea; two species viz. *Halacarellus arnaudi* and *Halacarus otiosus* were found associated with Crinoidea; and one species *Copidognathus papillatus* found associated with Asteroidea.

Proper collection of more echinoderm specimens for epibiotic and endobiotic mites from different areas may result in uncovering many more halacarid mite species and give a better idea about the nature of the association between halacarid mites and echinoderms.

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فهرست کنه‌های دریازی (Acari, Halacaridae) مرتبط با خارپوستان (Echinodermata)

تاپاس چاترجی

جاده نیر هری مندر، هیراپور، زانباد ۸۲۶۰۰٤، جارخند، هند؛ رایانامه‌ها: drtchatterjee@gmail.com، drtchatterjee@yahoo.co.in

چکیده

مجموعه‌ای از گونه‌های کنه‌های دریازی (Halacaridae) مرتبط با خارپوستان (Echinodermata) بر اساس گزارش‌های منتشر شده تهیه شده است. در این مقاله ۲۰ گونه کنهٔ دریازی مرتبط با خارپوستان فهرست شده‌اند. این ۲۰ گونه به ۱۰ جنس یعنی *Agaue* (۲ گونه)، *Agauopsis* (۱ گونه)، *Copidognathus* (۵ گونه)، *Enterohalacarus* (۱ گونه)، *Halacarellus* (٤ گونه)، *Halacaropsis* (۱ گونه)، *Halacarus* (۲ گونه)، *Rhombognathides* (۲ گونه)، *Rhombognathus* (۱ گونه) و *Thalassarachna* (۱ گونه) تعلق دارند.

واژگان کلیدی: ارتباط؛ Halacarida؛ مهاجم اتفاقی؛ Prostigmata ؛ Trombidiformes.

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