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Article

A checklist of halacarid and pontarachnid mites (Acari: Halacaridae and Pontarachnidae) found in seagrass habitats

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ABSTRACT
A compilation of marine halacarid and pontarachnid mites (Halacaridae and Pontarachnidae) found among seagrasses has been carried out based on published records. In this paper, we listed 92 halacarid and 8 pontarachnid mite species in seagrass habitats. These 92 halacarid species belong to 18 genera viz. *Agaue* (7 species), *Agauopsis* (10 species), *Atelopsalis* (1 species), *Australacarus* (1 species), *Bradyagaue* (1 species), *Copidognathus* (32 species), *Halacarellus* (3 species), *Halacaropsis* (2 species), *Halacarus* (5 species), *Isobactrus* (2 species), *Lohmannella* (2 species), *Maracarus* (1 species), *Pelacarus* (1 species), *Rhombognathides* (3 species), *Rhombognathus* (11 species), *Scaptognathus* (2 species), *Simognathus* (4 species), and *Thalassarachna* (4 species). Eight pontarachnid species belonging to two genera viz. *Litarachna* (4 species), and *Pontarachna* (4 species) are found in seagrass habitats. The real diversity and distribution of mites in seagrass habitats is far from being complete and future investigations may reveal further new taxa present in this environment.

KEY WORDS: Hydrachnidia; marine mites; meiofauna; Phanerogamae; Prostigmata; Trombidiformes.

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INTRODUCTION

In seagrass ecosystems, epifaunal biodiversity plays a critical role in the food web and chain (Hemminga and Duarte 2000; Duffy 2006). Seagrass vegetation can stabilize the sediment, enhance organic matter accumulation, and thus increase the availability of food (Baden *et al*. 2010) and provide shelter for numerous organisms. Liao *et al*. (2015, 2016) studied samples obtained from patches of seagrass bed and adjacent unvegetated sediments for meiofauna and found that abundance and diversity of crustaceans and nematodes were substantially higher where seagrass grew than in unvegetated sediments. Among the meiofauna groups, the nematodes exhibit the highest relative abundance in different sediment layers and seagrass species along the tidal gradient, followed by harpacticoids (De Troch *et al*. 2008); the rest of the meiofauna groups occurred in low relative abundances and were mostly limited to the oxygenated, upper sediment layer (De Troch *et al*. 2008). However, in some studies harpacticoid copepods were numerically dominant meiofauna over nematodes in different habitats of seagrass meadow (Mascart *et al*. 2013). Meiofaunal studies in

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seagrass habitats were made by several authors e.g., Hopper and Meyers (1967a, b), Nagle (1968), Tietjen (1969), Dennis (1981), Lewis and Hollingworth (1982), Novak (1982), Kikuchi (1980), Bell *et al*. (1984), Hicks (1986), Hall and Bell (1993), Ansari and Parulekar (1994), De Troch *et al*. (2001, 2008), Liao *et al*. (2015, 2016), Leduc and Probert (2011), Mascart *et al*. (2013), Rizqydiani *et al*. (2018). Recent studies reported a perpetual worldwide decline in seagrass abundance due to several natural and anthropogenic stressors (Orth *et al*. 2006; Waycott *et al*. 2009; Short *et al*. 2011; Ramesh *et al*. 2019).

The family Halacaridae includes more than 1000 marine and about 60 freshwater species all over the world (Bartsch 2009). The family is one of the broadest altitudinal ranges among animals, inhabiting from the abyssal depths to alpine snow melting streams and high altitude lakes (Roger *et al.* 2020). Halacarid mites are found from high altitudes more than 900 m above sea level to deep-sea more than 1000 m depth (Chatterjee 2021a; Chatterjee and Durucan 2021).

Marine mites of family Halacaridae attained their zenith of speciation and biodiversity in the marine environments. They are found from fronds, holdfasts, tufts of algae, in and on colonies of sponges, hydrozoans, bryozoans, barnacles, mussels, polychaetes, etc. to sediments, flocculent ooze, coarse and fine sands, etc. (Chatterjee and Sarma 1991; Bartsch 2006, 2008, 2009). Checklist of halacarid mites found associated with decapod crustaceans, echinoderms, sponges and ascidians were given in Chatterjee (2021b, c, d, 2022). Some species are associated with mangroves (Chatterjee *et al*. 2018). There are a few parasitic forms or suspected-to-be parasitic species (Chatterjee 2020).

The water mite family Pontarachnidae Koenike, 1910, belongs to the superfamily Hygrobatoidea (Viets 1987; Smit and Alberti 2010) and is recognized as the only family of the Hydrachnidia occurring in the marine environment. Pontarachnid mites have been reported from 0.5 m to the depth of almost 70 m (Pešić *et al*. 2012a, 2014; Durucan *et al.* 2018); although most of the known species live in the marine littoral zone (Smit 2003; Pešić *et al*. 2012b; Chatterjee *et al*. 2018, 2019). Some pontarachnids are also found associated with mangroves (Pešić *et al*. 2013; Chatterjee 2015; Chatterjee *et al*. 2018). A few pontarachnids that have been described from freshwaters occur in estuaries or locations near the sea (Smit 2009). Two species from South Korea have been shown to posess typical features of interstitial dwelling species such as reduced ocular pigment and elongated body (Pešić 2013).

The present paper provides a checklist and ecological remarks of halacarid and pontarachnid mites found in seagrass habitats.

MATERIAL AND METHODS

Records presented in this paper are all based on published literature up to July 2021. Ambiguous reports or reports of undetermined species and preprint of unaccepted papers are not included in this checklist. Higher systematic categories (suborders and cohorts) are arranged in the order given by Krantz and Walter (2009), families and species are listed in alphabetical order. For synonyms of halacarid species see Bartsch (2009).

Classifications and common name of seagrasses among which halacarid and pontarachnid mites have been found are summarized in Table 1. Classification of seagrasses follows Short *et al*. (2011, 2016).

The division of marine provinces used in this manuscript follows Bartsch (2009), which has been modified from Hedgpeth (1957), Lüning (1985) and Briggs (1995). The marine provinces are: ANE, Atlantic Ocean, North-East; ANT, Antarctica and sub-Antarctic region; ANW, Atlantic Ocean, North-West; ARC, Arctic region; ASE, Atlantic Ocean, South-East; ASW, Atlantic Ocean, South-West; ATE, Atlantic Ocean, Tropical East; ATW, Atlantic Ocean, Tropical West; ISE, Indian Ocean, South-East; ISW, Indian Ocean, South-West; ITE, Indian Ocean, Tropical East; ITW, Indian Ocean, Tropical West; MDB, Mediterranean Sea , Black Sea, Caspian Sea and Aral Sea; PNE, Pacific Ocean,

North-East; PNW, Pacific Ocean, North-West; PSE, Pacific Ocean, South-East; PSW, Pacific Ocean, South-West; PTE, Pacific Ocean, Tropical East; PTW, Pacific Ocean, Tropical West.

Seagrasses distribution shown in map follows Harris (2012) which has been taken from UNEP-GRID Arendal.

Table 1. Classifications and common name of seagrasses among which halacarid and pontarachnid mites have been found.

Seagrass family	Seagrass species	Common name, if any
Cymodoeaceae	*Amphibolis antarctica* (Labillardière) Sonder & Ascherson ex Ascherson, 1868	Wire weed; Sea nymph
	Amphibolis spp.	-
	Cymodocea nodosa (Ucria) Ascherson, 1870	Little Neptune grass
	Halodule uninervis (Forsskål) Ascherson in Boissier, 1882	Narrow leaf seagrass
	Halodule wrightii Ascherson, 1868	Shoal weed; Shoal grass
	Syringodium isoetifolium (Ascherson) Dandy, 1939	Noodle seagrass
	Syringodium sp.	-
	Thalassodendron sp.	-
Hydrocharitaceae	*Halophila minor* (Zollinger) Hartog, 1957	Tape grass
	Halophila ovalis (R. Brown) Hooker f., 1858	Paddle weed; spoon grass; dugong grass
	Halophila stipulacea (Forsskål) Ascherson, 1867	-
	Thalassia hemprichii (Ehrenberg) Ascherson, 1871	Sickle seagrass; Pacific turtlegrass
	Thalassia testudinum K.D.Koenig, 1805	Turtle-grass
Posidoniaceae	*Posidonia oceanica* (Linnaeus) Delile,1813	Neptune grass; Mediterranean tapeweed
	Posidonia spp.	-
Zosteraceae	*Phyllospadix iwatensis* Makino, 1931	-
	Phyllospadix sp.	-
	Zostera marina Linnaeus, 1753	Eel grass; Seawrack
	Zostera spp.	-

RESULTS

Halacarid mites found in seagrasses habitats
Suborder Prostigmata
Family Halacaridae Murray, 1877
Genus *Agaue* Lohmann, 1889

Agaue abyssorum (Trouessart, 1896)

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) as *Agaue* cf. *abyssorum* (Martínez *et al*. 2021).

Remarks – This species was reported from Bay of Biscay at 400 m and 1410 m depths (Trouessart 1896).

Agaue adriatica Viets, 1940

Report found in seagrass habitats – This species was reported among meadows of *Posidonia oceanica* from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990).

Remarks – This species was also reported from Tyrrhenian Sea, (Mediterranean Sea) among mud, sand and sponges (Mari and Morselli 1990). Bartsch (2009) commented that from northern

France, Trouessart (1898) described a variety of *Halacarus* (*Leptospathis*) *chevreuxi* (syn.: *Agaue chevreuxi*) with large lamellae which was regarded as *A. adriatica* by Mari and Morselli (1990).

Agaue brevipes Bartsch, 1999

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999a). This was also reported among seagrass *Posidonia* sp. from Esperance, Duke of Orleans Bay (Bartsch 2007a).

Remarks – This species was also reported among algae *Scaberia agardhii* at 11 m depth from Esperance Bay (Bartsch 2007a).

Agaue chevreuxi (Trouessart, 1889)

Report found in seagrass habitats – This species was reported among seagrass and also in mixed habitat containing *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp. from Rovinj (Rovigno), Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1940). This species was also reported among meadows of *Posidonia oceanica* from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) and also from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) (Mari and Morselli 1990; Durucan 2021a).

Remarks – This species has been reported in a variety of substrata like subtidal algae, mussels, sponge, and sediment from northeastern Atlantic, Mediterranean Sea, and Black Sea (Trouessart 1889a; Lohmann 1893; Viets 1940; Bartsch 1998, 2009, 2016a).

Agaue circellaris Bartsch 1999

Report found in seagrass habitats – This species was reported in subtidal seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999a).

Agaue panopae (Lohmann, 1893)

Report found in seagrass habitats – This species was reported among *Zostera* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940); among meadows of *Posidonia oceanica* from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990); among *P. oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species has been reported in various substrata from North Atlantic Ocean and Mediterranean Sea (Lohmann 1893; Viets 1940; Morselli and Mari 1985, 1993; Bartsch 2016a)

Agaue tenuipes Bartsch 1999

Report found in seagrass habitats – This species was reported in seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999a).

Genus *Agauopsis* Viets, 1927

Agauopsis australiensis Bartsch, 1996

Report found in seagrass habitats – This species was reported from Nancy Cove, among seagrass *Amphibolis* sp. with epiflora and fauna; from Little Armstrong Bay among seagrass

Amphibolis sp.; also found among *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1996a, 1999a).

Remarks – This species was reported among *Amphiroa* sp. and other corallines; from Fish Hook Bay, Cape Vlamingh, Australia among red algae *Liagora* sp. (Bartsch 1996a).

Agauopsis brevipalpus (Trouessart, 1889)

Report found in seagrass habitats – This species was reported among seagrass and also in mixed habitat containing *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp. from Rovinj (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940); among *Posidonia* sp., *Zostera* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940); from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990); among *Posidonia oceanica* from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) (Durucan 2021a); among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

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

Agauopsis conjuncta Viets, 1941

Report found in seagrass habitats – This species was reported among seagrass *Zostera* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940). This was also reported among seagrass *Cymodocea nodosa* from Kaş, Antalya (Levantine Sea, Mediterranean Sea) (Durucan and Boyaci 2018); among *Posidonia oceanica* from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) (Durucan 2021a).

Remarks – This species was first described by Viets (1940) from the various habitats which was collected from the Adriatic Sea (Croatia - Rovinj and Split). Later, this was recorded from Tyrrhenian Sea (Livorno) by Morselli and Mari (1985).

Agauopsis curvata Krantz, 1973

Report found in seagrass habitats – Some specimens of this species were reported among eel grasses (Zosteraceae) from Oregon (northeastern Pacific) (Krantz 1973).

Remarks – This species was mostly reported on colony of *Mytilus californianus* from Oregon (Krantz 1973); this species was also reported from various other substrata like anchor substrate of *Laminaria* from Oregon (Krantz 1973). This was also reported from California amongst mussel and barnacle beds, and intertidal algae (MacQuitty 1984).

Agauopsis microrhyncha (Trouessart, 1889)

Report found in seagrass habitats – This species was reported among seagrass *Zostera* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940); from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990); among *Posidonia oceanica* from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) (Durucan 2021a). This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported from eastern Atlantic Ocean, Mediterranean Sea among various tidal and subtidal substrata – algae and sand (Trouessart 1889a, c; Morselli 1969; André 1941; Mytilineou *et al*. 2016; Durucan and Boyaci 2018).

Agauopsis miliaris Bartsch, 2005

Report found in seagrass habitats –This species was reported from Western Australia, Lucky Bay among *Posidonia* sp. (Bartsch 2005).

Remarks – This was also found among algae from rocks (Bartsch 2005).

Agauopsis minor (Trouessart, 1894)

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021)

Remarks – This species reported among algae, hydrozoans, sponges, and sediments from North-Atlantic Ocean (Trouessart 1894; Bartsch 2001).

Agauopsis mokari Otto, 1994

Report found in seagrass habitats – This species was reported from Western Australia, Duke of Orleans Bay, among seagrasses *Posidonia* sp. and *Amphibolis* sp. (Bartsch 2005).

Remarks – This was first described among intertidal coralline algae and algae *Padina pavonica* from New South Wales, Guerilla Bay, Australia (Otto 1994).

Agauopsis nonornata Bartsch, 1999

Report found in seagrass habitats – This species was reported among detritus rich sediment with *Posidonia oceanica* (12 m) at Bilem Beach from Antalya, Mediterranean Sea (Durucan and Boyaci 2018).

Remarks – This species was first reported as *Agauopsis ornata* in interstitial sand from tropical East Pacific, Galapagos Islands, mainly in the lower slope area of the beaches of the islands Fernandina, Tower, James, Santa Cruz and Barrington (Bartsch 1977; Bartsch and Schmidt 1978). Bartsch (1999d) described as a new species based on materials from Galapagos and also from Caribbean region, in shallow water on the east coast of Panama.

Agauopsis pteropes Bartsch, 1986

Report found in seagrass habitats – This was reported among detritus rich sediment with *Posidonia oceanica* at 12 m depth from Bilem Beach from Antalya, Mediterranean Sea (Durucan and Boyaci 2018).

Remarks – This species was reported from Mediterranean and Canary Island among fine to coarse sediment (Bartsch 1986a, 2009).

Genus *Atelopsalis* Trouessart, 1896

Atelopsalis pacifica Bartsch, 1985

Report found in seagrass habitats – This species was reported from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) among detritus rich sediment with *Posidonia oceanica* at 8 m depth (Durucan 2021a).

Remarks – This species was reported from Mactan Islands, Philippines (Pacific Ocean) at 15 m depth shallow subtidal region (Bartsch 1985); this was also reported Chatam Island, Port Blair,

Andaman Islands, Bay of Bengal (Indian Ocean) at intertidal associated with red algae *Jania rebens* (Sarma and Chatterjee 1993). Durucan and Boyaci (2017) reported this from Levantine Sea, Turkey in soft sand at 30 m depth.

Genus *Australacarus* Bartsch, 1987

Australacarus pustulatus Bartsch 1993

Report found in seagrass habitats – The species extracted from coarse sediment, rich on debris from seagrasses taken near Rottnest Island, southwestern Australia (Bartsch 1993a).

Remarks – This species was reported only during its first discovery.

Genus *Bradyagaue* Newell, 1971

Bradyagaue scutella Bartsch, 1992

Report found in seagrass habitats – This species was reported from Western Australia, Rottnest Island, Bickley Bay, amongst epifauna and epiflora on the seagrass *Amphibolis antarctica* at 1–2 m depth (Bartsch 1992, 1999a).

Genus *Copidognathus* Trouessart, 1888

Copidognathus ampliatus Bartsch, 1994

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* overgrown with epiflora and epifauna from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1994a).

Copidognathus angusticeps Bartsch, 2007

Report found in seagrass habitats – This species was reported from Western Australia, Esperance, Duke of Orleans Bay, among seagrass *Amphibolis* sp. with epiflora and fauna (Bartsch 2007b).

Copidognathus australensis (Lohmann, 1909)

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999a).

Remarks – Lohmann (1909) discovered *Copidognathus australensis* (Lohmann 1909) from southwestern Australia with a very short description. Bartsch (1999a) redesrcribed this species collected from Rottnest Island, southwestern Australia. This was also found among algae on rocks (Bartsch 1999b) and sediments among intertidal algae *Jania rubens* from Chatham Island, Andaman Islands, India (Chatterjee and Guru 2013).

Copidognathus bistriatus Bartsch 1994

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1994a, 1999a).

Remarks – This species was also found associated with coralline algae and colonies of polychaetes on rock surface from Western Australia (Bartsch 1994a).

Copidognathus brachystomus Viets, 1940

Report found in seagrass habitats – This species reported in mixed habitat containing seagrass *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp.) from Rovinj (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940).

Remarks – This species was reported in variey of substrata from noertheastern Atlantic and Mediterranean Sea (Viets 1940; Morselli 1980; Bartsch 2001, 2009).

Copidognathus caelatus Bartsch, 1994

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1994a).

Remarks – This species was also found associated with red algae *Amphiroa* sp. and other coralline algae on rock surface from Bickley point, Rottnest Island, Western Australia (Bartsch 1994a).

Copidognathus culoatus Bartsch, 1999

Report found in seagrass habitats – This species was reported in seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999c).

Copidognathus dentatus Viets, 1940

Report found in seagrass habitats – This species was reported in seagrass from Adriatic Sea (Viets 1940).

Remarks – This was also found in intertidal and subtidal zone on stone and algae (Viets 1940; Green and MacQuitty 1987).

Copidognathus fabricii (Lohmann, 1889)

Report found in seagrass habitats – Lohmann (1889, 1893) reported this species among seagrass (*Zostera* sp.) from Baltic Sea. This species was reported among mixed habitat containing seagrass *Zostera* sp. and algae *Chorda filum*, *Laminaria* sp. from Bergen, Norway (Viets 1927a); reported among *Zostera* sediments from Bergen, Norway (Viets 1928); in sediments of *Zostera* meadows from Brittany coast (Bartsch 1978).

Remarks – This species is inhabitant of lower tidal and subtidal substrata - sandy deposits, algae and colonial organisms (Bartsch 2020).

Copidognathus faubeli Bartsch, 1986

Report found in seagrass habitats – This species was reported among the seagrasses *Thalassia hemprichii* from the Pujada Bay, the Philippines (Chatterjee and De Troch 2003).

Remarks – This species was first described from Philippines (Bartsch 1986b). This was also reported among the thalli of algae *Halimeda opuntia* from Mus Island, Nicobar Island (Chatterjee 1999).

Copidognathus gazii Chatterjee & De Troch, 2000

Report found in seagrass habitats – This species was reported among the seagrass *Thalassia hemprichii* from Gazi Bay, Kenya (Chatterjee and De Troch 2000).

Copidognathus ivanomorsellii Chatterjee & De Troch, 2003

Report found in seagrass habitats – This species was also reported among *Thalassia hemprichii* from the Pujada Bay, the Philippines (Chatterjee and De Troch 2003).

Copidognathus kenyae Chatterjee & De Troch 2000

Report found in seagrass habitats – This species was reported among the seagrasses *Thalassia hemprichii* and *Halophila stipulacea* from Gazi Bay, Kenya (Chatterjee and De Troch 2000).

Copidognathus lamelloides Bartsch, 2000

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was found in shallow water substrata – sand, algae (Bartsch 2000, 2001)

Copidognathus latisetus Viets, 1940

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported from Rovigno, Adriatic Sea among sand (Viets 1940)

Copidognathus levigatus Bartsch, 1999

Report found in seagrass habitats – This species was reported among seagrass *Posidonia* from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1999c).

Copidognathus magnipalpus (Police, 1909)

Report found in seagrass habitats – This species was reported among seagrass and also in mixed habitat containing *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp. from Rovinj, (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940). This was reported from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) on seagrass *Posidonia oceanica* (Mari and Morselli 1990). This was also found among seagrasses *Thalassia hemprichii*, *Halophila stipulacea*, *Syringodium isoetifolium* from Gazi Bay (Kenya) (Chatterjee and De Troch 2000). This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported among various substrata (Durucan 2019b).

Copidognathus multiporus Bartsch, 1994

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1994a).

Copidognathus oculatus (Hodge, 1863)

Report found in seagrass habitats – This species was reported among seagrass and algae

(Lohmann 1889). This species was reported from mixed habitat containing seagrass *Zostera* sp. and algae *Chorda filum*, *Laminaria* sp. from Bergen, Norway (Viets 1927a). This species was reported in seagrass *Zostera* sediments from Britany coast (Bartsch 1978). This species was also reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported among various substrata (Durucan 2019b).

Copidognathus ornatus Bartsch, 1981

Report found in seagrass habitat – This species was reported in mixed habitat with coral sand, coral sticks and seagrass *Thalassodendron* sp. from Zélée-Bank Mozambique Channel (Bartsch 1981).

Remarks – This species was reported among sand and coral rubble from Long Island, Great Barrier Reef, Australia (Otto 2001).

Copidognathus perforatus Viets, 1940

Report found in seagrass habitats – This was repoted among *Zostera* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940). This species was also reported among seagrass from Adriatic Sea (Viets 1940).

Remarks – This species was also found among algae, mud, echinoderms, and sponges from Adriatic Sea (Viets 1940).

Copidognathus philippinensis Chatterjee & De Troch, 2003

Report found in seagrass habitats – This species was also reported among the seagrasses *Thalassia hemprichii*, *Halodule uninervis* from the Pujada Bay, the Philippines (Chatterjee and De Troch 2003).

Copidognathus pontellus Bartsch, 1981

Report found in seagrass habitat – This species was reported in mixed habitat with coral sand, coral sticks and seagrass *Thalassodendron* sp. at 18–24 m depth from Zélée-Bank Mozambique Channel (Bartsch 1981).

Copidognathus pujadus Chatterjee & De Troch, 2003

Report found in seagrass habitats – This species was also reported among the seagrasses *Halodule uninervis*, *Halophila minor* and *Thalassia hemprichii* from the Pujada Bay, the Philippines (Chatterjee and De Troch 2003).

Copidognathus pumicatus Bartsch, 1999

Report found in seagrass habitats – This species was reported associated with seagrass *Amphibolis* sp. from Little Armstrong Bay, Rottnest Island, Western Australia (Bartsch 1999c).

Copidognathus quadricostatus (Trouessart, 1894)

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*.

2021).

Remarks – This species was reported in sand, sediments, bryozoans (Bartsch 1997; Durucan 2019b).

Copidognathus remipes (Trouessart, 1894)

Report found in seagrass habitats – This species was reported among *Posidonia* sp. from Split, Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1939, 1940); among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021). This was also reported from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) among detritus rich sediment with *Posidonia oceanica* at 8 m depth (Durucan 2021b).

Remarks – This species was reported from lower intertidal to subtidal zones on sediments, algae, and barnacles, etc., also found in brackish water (Green and MacQuitty 1987; Durucan 2019a).

Copidognathus reticulatus (Trouessart, 1893)

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was found amongst coarse sediments, calcareous algae from northeastern Atlantic and Arctic region (Green and MacQuitty 1987).

Copidognathus rhodostigma (Gosse, 1855)

Report found in seagrass habitats – This species was reported among *Zostera* sp. from Baltic Sea (Lohmann 1893).

Remarks – This species often found on sediment rich in organic debris from northeastern Atlantic Sea, North Sea, Baltic Sea, Mediterranean Sea (Bartsch 2009).

Copidognathus uniscutatus Bartsch, 1984

Report found in seagrass habitats – This species was reported Punta Allen, Quintana Roo (Yucatán Peninsula, Mexico), among *Thalassia testudinum* seagrass plants (Chatterjee and De Troch 2001). This species was also reported among seagrasses *Thalassia hemprichii*, *Syringodium isoetifolium*, *Halodule uninervis* and *Halophila minor* from the Pujada Bay, the Philippines (Chatterjee and De Troch 2003).

Remarks – This was originally reported from Mactam Island, off Cebu, Philippines at intertidal to 15 m depth (Bartsch 1984).

Copidognathus wadjemupis Bartsch, 1999

Report found in seagrass habitats – This species was reported in seagrass *Amphibolis* sp. from Bickley point, Rottnest Island, Western Australia (Bartsch 1994a, 1999b).

Copidognathus yucatanensis Chatterjee & De Troch, 2001

Report found in seagrass habitats – This species was reported Punta Allen, Quintana Roo (Yucatán Peninsula, Mexico), among *Thalassia testudinum* seagrass meadows (Chatterjee and De Troch 2001).

Genus *Halacarellus* Viets, 1927

Halacarellus balticus (Lohmann, 1889)

Report found in seagrass habitats – This species was reported from *Zostera* sp. from Bergen, Norway (Viets 1927a, b, 1928).

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

Halacarellus floridearum (Lohmann, 1889)

Report found in seagrass habitats – This species was reported [reported as *Halacarus* (*Halacarellus*) *bergensis*] among *Zostera* from Bergen, Norway (Viets 1927a, 1928).

Remarks – This was reported from subtidal sediments and algae (Bartsch 2021).

Halacarellus rottnestensis Bartsch, 1999

Report found in seagrass habitats – This species was reported from Esperance, Duke of Orleans Bay among sea grass *Amphibolis* sp. (Bartsch 1999a, 2007a).

Genus *Halacaropsis* Bartsch, 1996

Halacaropsis capuzina Bartsch, 1996

Report found in seagrass habitats – This species was reported in seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, Western Australia (Bartsch 1999a, 2007a).

Remarks – This species also present amongst scrub-like corallines covering rocks and demosponges (Bartsch 2007a).

Halacaropsis hirsuta (Trouessart, 1889)

Report found in seagrass habitats – This species was reported in seagrass *Zostera* sp. from Rovinj and Split Croatia (Adriatic Sea, Mediterranean Sea) (Viets 1940).

Remarks – This was found in various shallow water substrata (Bartsch 2009).

Genus *Halacarus* Gosse, 1855

Halacarus flavellus Bartsch, 1993

Report found in seagrass habitats – This species was reported from Western Australia Esperance, Duke of Orleans Bay, on seagrasses *Amphibolis* sp. and *Posidonia* sp. (Bartsch 1993c, 2007a).

Remarks – This species was found among algae (Bartsch 2007a).

Halacarus fuscatus Bartsch, 1993

Report found in seagrass habitats – This species was reported among seagrass *Amphibolis* sp. from Bickley Bay, Rottnest Island, and Duke of Orleans Bay, Western Australia (Bartsch (1993c,

1999b, 2007a).

Remarks – This species was extracted from an epiflora growing on seagrass, algal fronds and sponges (Bartsch 1999b, 2007a).

Halacarus magniporus Krantz, 1973

Report found in seagrass habitats – This species was reported from California, North Salmon creek, north of San Simeon on seagrass *Phyllospadix* sp. roots (MacQuitty 1984).

Remarks – This species was reported from Oregon in *Mytilus californicus* bed (Krantz 1973). This was also repoted from California among mixed algae, on rocks oyster shell (MacQuitty 1984).

Halacarus membraneus Bartsch, 1981

Report found in seagrass habitats – This species was reported in mixed habitat with coral sand, coral sticks and seagrass *Thalassodendron* sp. at 18–24 m depth from Zélée-Bank, Mozambique Channel (Bartsch 1981).

Halacarus subtilis Viets, 1940

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Naples, Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990).

Remarks – This was also reported among mud and sponges (Viets 1940).

Genus *Isobactrus* Newell, 1947

Isobactrus ponapensis Abé, 1996

Report found in seagrass habitats – This species was reported among seagrass *Thalasia hemprichii* from Micronesia, Ponape Island (Abé 1996, 1998).

Remarks – This was also reported among algae, coarse coral sandy sediments (Abé 1996, 1998).

Isobactrus setosus (Lohmann, 1889)

Report found in seagrass habitats – This species was reported associated among seagrass *Zostera marina* and *Zostera* sp. from northeastern Atlantic (Viets 1927a; Abé 1998).

Remarks – This species was reported in intertidal and subtidal zone among algae, mussels, barnacles, etc. (Abé 1998); also present in brackish water (Bartsch 2009).

Genus *Lohmannella* Trouessart, 1901

Lohmannella falcata (Hodge, 1863)

Report found in seagrass habitats – This species (cited as *Leptognathus marinus*) was reported among seagrass and algae from the Baltic Sea (Lohmann 1889); among *Zostera* sp. from the Baltic Sea (Lohmann 1893); among mixed habitat containing seagrass *Zostera* and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a); among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – It was reported from various lower tidal and subtidal substrata, often found amongst colonies of hydrozoa (Bartsch 2020).

Lohmannella norvegica Viets, 1927

Report found in seagrass habitats – This species was reported from mixed habitat containing seagrass *Zostera* and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a).

Remarks – This was reported from subtidal substrata among algae (Viets 1928, Bartsch 2020).

Genus *Maracarus* Bartsch 2016

Maracarus gracilipes (Trouessart, 1889)

Report found in seagrass habitats – This species was reported in mixed habitat containing seagrass *Zostera* sp. and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a); among seagrass from Rovinj (Adriatic Sea, Mediterranean Sea) (Viets 1940). This was reported in sediments of *Zostera* meadows from Britanny coast (Bartsch 1978); among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was found amongst sediment and various algal substrata from Northeastern Atlantic Ocean, Mediterranean Sea and Black Sea (Viets 1956; Bartsch 1985, 2004, 2009, 2016b).

Genus *Pelacarus* Bartsch, 1986

Pelacarus aculeatus (Trouessart, 1896)

Report found in seagrass habitats – This species was reported among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported in sand from Tyrrhenian Sea, Italy (Morselli and Mari 1985).

Genus *Rhombognathides* Viets, 1927

Rhombognathides pascens (Lohmann, 1889)

Report found in seagrass habitats – This species was reported among seagrass and algae from the Baltic Sea (Lohmann 1889); among *Zostera* meadows from Bergen, Norway (Viets 1927a, b, 1928); also reported in sediments of *Zostera* meadows from coast of Brittany (Bartsch 1978).

Remarks – This species was found in eastern and western Northatlantic (from the Azores to northern Norway), Baltic, Black Sea amongst subtidal algae and also found in brackish water (Lohmann 1889; Viets 1927a; Newell 1947; Bartsch 1972, 2009; Green and MacQuitty 1987; Abé 1998).

Rhombognathides seahami (Hodge, 1860)

Report found in seagrass habitats – This species was reported from *Zostera* sp. from Bergen, Norway (Viets 1927a, 1928). This species was reported in sediments of *Zostera* meadows from coast of Brittany (Bartsch 1978).

Remarks – This species was found in Novaja Semlja, Murmansk, Greenland, eastern and western North Atlantic, and Baltic Sea from tidal and subtidal substrata, mainly among algae in marine and brackish water (Hodge 1860; Viets 1927a; Newell 1947; Bartsch 1972; Green and MacQuitty 1987; Abé 1998; Bartsch 2009).

Rhombognathides spinipes (Viets, 1933)

Report found in seagrass habitats – This species was reported among *Zostera* sp. from Baltic Sea (Lohmann 1893).

Remarks – This species was reported among various algae, hydrozoans, barnacles etc. In estuarine area, also in salt marshes (Green and MacQuitty 1987; Abé 1998).

Genus *Rhombognathus* Trouessart, 1888

Rhombognathus cebuus Bartsch, 1983

Report found in seagrass habitats – This species was found among sediment of seagrass *Thalassia* sp. and algae *Padina* and *Diadema* zones from Mactan Island, Philippines (Bartsch 1983).

Remarks – This species was collected in mixed zone with seagrass and algae.

Rhombognathus compressus Abé, 1996

Report found in seagrass habitats – The species was reported among seagrass *Phyllospadix iwatensis* from Hokkaido, Japan (Abé 1996, 1998).

Remarks – This species was reported among various algae from Japan (Abé 1996, 1998).

Rhombognathus dissociatus Abé, 1990

Report found in seagrass habitats – The species was reported among *Zostera marina* from Hokkaido, Japan (Abé 1996, 1998).

Remarks – This species was reported among various algae from Japan (Abé 1990, 1996, 1998).

Rhombognathus ezoensis Abé, 1990

Report found in seagrass habitats – The species was reported among *Zostera marina* and *Phyllospadix iwatensis* from Hokkaido, Japan (Abé 1996, 1998).

Remarks – This species was reported among various algae from Japan (Abé 1990, 1998).

Rhombognathus magnirostris Trouessart, 1889

Report found in seagrass habitats – This species was reported in seagrass habitat from Adriatic Sea (Viets 1940); among mixed habitat containing seagrass *Zostera* and algae *Chorda filum*, *Laminaria* from Bergen (Viets 1927a).

Remarks – This species was reported among various algae from North Atlantic Ocean, Mediterranean Sea and Black Sea (Newell and André 1959; Bartsch 1975, 1996b).

Rhombognathus notops (Gosse, 1855)

Report found in seagrass habitats – This species was reported among sediments of seagrass *Zostera marina* and *Zostera* sp. from northeastern Atlantic (Bartsch 1978; Abé 1998).

Remarks – This is common species amongst tidal and subtidal algae northeastern Atlantic (Green and MacQuitty 1987; Abé 1998).

Rhombognathus paranotops Bartsch, 1986

Report found in seagrass habitats – This species was found among algae dredged from *Zostera* sp. meadow at 2–3 m depth of the Kazachya Bay (Bartsch 1996b). This was also reported from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) among detritus rich sediment with *Posidonia oceanica* at 8 m depth (Durucan 2021a).

Remarks – This was reported among bushy algae, clusters of small mussels and sandy deposite (Bartsch 1975, 1986c, 1996b; Morselli and Mari 1993).

Rhombognathus praegracilis Viets, 1939

Report found in seagrass habitats – This species was also reported among seagrass *Posidonia oceanica* meadows from Italy (Tyrrhenian Sea, Mediterranean Sea) (Mari and Morselli 1990) and from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This was found in macroalgae and sand (Bartsch 1986c).

Rhombognathus procerus Bartsch, 1975

Report found in seagrass habitats – This species was also reported among *Posidonia oceanica* from Cala del Cuartel, in Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This was found among algae from French coast (Bartsch 1975; Abé 1998).

Rhombognathus scutulatus Bartsch, 1983

Report found in seagrass habitats – This species was also reported among seagrass *Amphibolis* sp. from Rottnest Island, Australia (Bartsch 1993b, 1999b). This species was also reported among seagrasses *Thalassia hemprichii*, *Halophila ovalis*, *H. stipulacea*, *Halodule wrightii*, *Syringodium isoetifolium* from Gazi Bay, Kenya (Chatterjee and De Troch 2000).

Remarks – This species was reported among various algae from Indo-Pacific regions. Detail habitats and distribution given in Chatterjee and Nanajkar (2019).

Rhombognathus tonops Bartsch, 1996

Report found in seagrass habitats – This species was found among algae dredged from a seagrass meadow at 2–3 m depth of the Bay of Sevastopol (Bartsch 1996b).

Remarks – This species was reported among various algae and coarse sediments (Bartsch 1996b).

Genus *Scaptognathus* Trouessart, 1889

Scaptognathus punctatus Bartsch, 1981

Report found in seagrass habitats – This species was reported in mixed habitat with coral sand, coral sticks and seagrass *Thalassodendron* sp. at 18–24 m depth from Zélée-Bank Mozambique Channel (Bartsch 1981).

Remarks – This species was reported also from 110–440 m depth (Bartsch 1982).

Scaptognathus sabularius André, 1961

Report found in seagrass habitats – This species was reported from French Mediterranean Sea (Pyrénées-Orientales), 10–15 m sandy habitats near *Posidonia* sp. (André 1961).

Remarks – This was reported in medium-coarse sand from Turkey (Durucan 2018).

Genus *Simognathus* Trouessart, 1889

Simognathus adriaticus Viets, 1940

Report found in seagrass habitats – This species was reported from Bozcaada, Çanakkale (Aegean Sea, Mediterranean Sea) among detritus rich sediment with *Posidonia oceanica* at 8 m depth (Durucan 2021a).

Remarks – This species was reported among algae e.g., *Fucus* sp., *Acetabularia* sp., *Enteromorpha* sp. (Viets 1940).

Simognathus maculatus Bartsch, 1994

Report found in seagrass habitats – This species was reported from Rottnest Island, Bickley Point, southern Australia among *Amphibolis antarctica* densly covered with epifauna and epiflora and also from Little Armstrong Bay, southern Australia among *Posidonia* sp. (Bartsch 1994b).

Remarks – This species was reported on corals *Pocillopora* sp. and red algae *Liagora* sp. from rocky platform (Bartsch 1994b).

Simognathus minutus (Hodge, 1863)

Report found in seagrass habitats – This species was reported in mixed habitat containing seagrass *Zostera* and algae *Chorda filum*, *Laminaria* sp. from Bergen, Norway (Viets 1927a): among *Posidonia oceanica* from Cala del Cuartel, Santa Pola, southeastern Spain (Alboran Sea, Mediterranean Sea) (Martínez *et al*. 2021).

Remarks – This species was reported from various shallow water substrata (Bartsch 1974, 2009).

Simognathus tropicalis Chatterjee & De Troch, 2000

Report found in seagrass habitats – This species was reported from Gazi Bay, Kenya, among the seagrass species *Syringodium isoetifolium* seagrass (Chatterjee and De Troch 2000).

Genus *Thalassarachna* Packard, 1871

Thalassarachna basteri (Johnston, 1836)

Report found in seagrass habitats – This species (cited as *Halacarus spinifer*) was reported among seagrass and algae (Lohmann 1889); among seagrass *Zostera* from Bergen, Norway (Viets 1927a, b, 1928); in sediments of *Zostera* meadows from coast of Brittany (Bartsch 1978); among seagrass *Posidonia oceanica* meadows at 6 m depth from Italy (Tyrrhenian Sea, Mediterranean Sea) (Bartsch 2015).

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 Mediterranean Sea (Newell 1947; Green and MacQuitty 1987; Bartsch 2009).

Thalassarachna hexacantha (Viets, 1927)

Report found in seagrass habitats – This species (cited as *Halacarus hexacanthus* and *Halacarus hexacanthus reducta*) from mixed habitat containing seagrass *Zostera* sp. and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a).

Remarks – This species found amongst shallow water algae (Bartsch 2020).

Thalassarachna longipes (Trouessart, 1888)

Report found in seagrass habitats – This species was reported among mixed habitat containing seagrass *Zostera* sp. and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a).

Remarks – This species was found among algae; spider crab *Libinia emarginata* (Bartsch 1979, 2020; Chatterjee 2021b).

Thalassarachna striata (Lohmann, 1889)

Report found in seagrass habitats – This species was reported among mixed habitat containing *Zostera* sp. and algae *Chorda filum*, *Laminaria* from Bergen, Norway (Viets 1927a).

Remarks – This species was found among lower tidal and subtidal algae and their hapteres (Bartsch 2020).

Pontarachnid mites found in seagrasses habitats
Family Pontarachnidae Koenike, 1910
Genus *Litarachna* Walter, 1925

Litarachna cawthorni Wiles, Chatterjee & De Troch, 2002

Report found in seagrass habitats – This species was reported from Kenya, Gazi Bay among sea grasses (Wiles *et al*. 2002).

Litarachna communis Walter, 1925

Report found in seagrass habitats – This species was reported among seagrass from Adriatic Sea (Viets 1940); from Rovinj, Croatia (northern Adriatic Sea, Mediterranean Sea) among algae and *Posidonia* seagrass (Viets 1941); from Punta Vico (Lacco Ameno of Ischia), Italy among *Posidonia oceanica* (Mari and Morselli 1983, 1990); from Marmara Sea, Turkey—among *Zostera marina* (Artüz and Pešić 2016); among *P. oceanica* from Spain (Stern *et al*. 2019).

Remarks – This species was reported from Mediterranean Sea (Croatia, France, Italy, Montenegro, and Turkey), Black Sea (Russia) among algae and other substrata (Chatterjee *et al*. 2019). Artüz and Pešić (2016) reported intersexuality in *Litarachna communis* from the western coast of the Sea of Marmara among *Zostera marina* sea grass.

Litarachna duboscqi Walter, 1925

Report found in seagrass habitats – This species was reported among seagrass and also in mixed habitat containing *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp. from Rovinj (Adriatic Sea, Meditrannean Sea) (Viets 1939, 1940).

Remarks – This species is widely distributed in Mediterranean Sea (Adriatic Sea and Aegean Sea), Black Sea among various substrata (Chatterjee *et al*. 2019). Pešić (1990) reported in Kapiris *et al*. (2014) the phenomenon of intersexuality in *Litarachna duboscqi* collected from the Adriatic Sea.

Litarachna halei (Womersley, 1937)

Report found in seagrass habitats – This species was reported on *Amphibolis* sp., from Bickley Point, Rottnest Island (Smit 2003).

Remarks – This species was also reported from Sellick's Beach Australia, in algae *Sargassum* (Womersley 1937; Smit 2003). This species was reported from South Australia lives both in benthic habitats as well as in association with scyphozoan jelly fishes (Smit and Alberti 2010).

Genus *Pontarachna* Philippi, 1840

Pontarachna aenariensis Mari & Morselli, 1983

Report found in seagrass habitats – This species was reported from Punta Vico—Lacco Ameno of Ischia, Italy among *Posidonia oceanica* (Mari and Morselli 1983, 1990).

Remarks – This species was most numerous between 3 and 5 m depth, and was not found below 6 m (Mari and Morselli 1983). Durucan (2021b) reported this species from Izmir - Urla-Karantina Island, Turkey, Aegean Sea among oyster, bivalve mollusc *Pinctada radiata* (Leach, 1814) (reported as *Pinctata radiata*) (alternate representation as *Pictada imbricata radiata*).

Pontarachna australis Smit, 2003

Report found in seagrass habitats – This species was reported from Mindanao Island, Philippines, north-eastern coast of Pujada Bay among *Thalassia hemprichii* (Pešić *et al*. 2009).

Remarks – This species was also reported from Australia, Watering Cove, Burrup Peninsula, Western Australia (Smit, 2003); from He-Ping-Dao, NE Taiwan, intertidal, among coralline algae (Pešić *et al*. 2008) and Mahatma Gandhi National Park (Marine Park), Wandoor, Port Blair, South Andaman, Andaman Islands, India among sediments of macroalgae *Padina* sp. (Pešić *et al*. 2009).

Pontarachna capensis Lohmann, 1909

Report found in seagrass habitats – This species was reported in *Syringodium* seagrass beds near Kunduchi, from the littoral water of Tanzania (Konnerth-Ionescu 1977).

Remarks – This species was reported in various habitats e.g., sands, stones, among coral *Acropora palmate*, amongs bivalves *Tridacna* sp., crustacean *Mysis* sp., colony of ascidians *Botryllus* sp. from Tanzania and South Africa (Lohmann 1909; Walter 1925; Konnerth-Ionescu 1977).

Pontarachna punctulum Phillippi, 1840

Report found in seagrass habitats – This species was reported found among seagrass and also in mixed habitat containing *Zostera* sp. and algae *Fucus* sp., *Sargassum* sp. from Rovinj (Adriatic Sea, Medioterannean Sea) (Viets 1939, 1940). This was reported from coast of Tuscany, Italy among sea grass meadows of *Posidonia oceanica*, colonized a rocky bottom at 8 m to 25 m depth (Bedini *et al.* 2011); from Punta Vico—Lacco Ameno of Ischia, among *Posidonia oceanica* sea grass (Mari and Morselli 1983). Thayer *et al.* (1984) listed this species in the epiphytic fauna of sea grass *Zostera marina* from North Carolina to Nova Scotia. This was collected from Spain (Stern *et al*. 2019) among sea grass *Posidonia oceanica*.

Remarks – This has been commonly found in Mediterranean area (Chatterjee *et al*. 2019, Pešić *et al*. 2019). There are also some records from the Black Sea, USA and Canada (Chatterjee *et al.* 2019). Durucan (2021b) reported this species from Izmir - Urla-Karantina Island, Turkey, Aegean Sea among oyster, bivalve mollusc *Pinctada radiata* (Leach, 1814).

DISCUSSION

Seagrass meadows provide various microhabitats e.g., macroalgal mats, rubble cavities, sand patches with sparse seagrass, anemone gardens, hard substratum, sponges mixed with seagrass (Bell *et al*. 1984). In this paper, we listed 92 halacarid and eight pontarachnid mite species in seagrass habitats. These 92 halacarid species belong to 18 genera viz. *Agaue* (7 species), *Agauopsis* (10 species), *Atelopsalis* (1 species), *Australacarus* (1 species), *Bradyagaue* (1 species), *Copidognathus* (31 species), *Halacarellus* (3 species), *Halacaropsis* (2 species), *Halacarus* (5 species), *Isobactrus* (2 species), *Lohmannella* (2 species), *Maracarus* (1 species), *Pelacarus* (1 species), *Rhombognathides* (3 species), *Rhombognathus* (11 species), *Scaptognathus* (2 species), *Simognathus* (4 species), and *Thalassarachna* (4 species). Most of halacarid mites are recovered from other habitats or mixed habitats; some are known from their first discovery. It is reasonable to suppose that some species are not dependent on the seagrass itself but on the epiflora and epifauna covering the leaves (Bartsch 1999a).

The Pontarachnidae is the only family of Hydrachnidia that is adapted to marine waters. This family is represented by two genera, *Pontarachna* Philippi, 1840 and *Litarachna* Walter, 1925 that mainly inhabit marine littoral zones in tropical and subtropical areas (Chatterjee *et al*. 2019). Smit (2016) commented that pontarachnids are easily collected among seagrasses in the Mediterranean and may be this is the habitat in which they live in the seas of eastern Australia. So far, four species of *Litarachna* (*L. cawthorni, L. communis, L. duboscqi* and *L. halei*) and four species of *Pontarachna* (*P. aenariensis, P. australis, P. capensis* and *P. punctulum*) are known to be associated with seagrass. Most of these pontarachnid species are also found in other habitats (e.g. sands, stones, among algae, corals, bivalves, crustaceans). *Litarachna cawthorni* was reported only for its first discovery.

Table 2 provides species names of halacarid and pontarachnid mites found in seagrass habitats from different marine provinces of the world. The number of species (halacarid and pontarachnid mites) present from seagrass habitats in each marine province is shown in Figure 1. Most halacarid species (35 species) found in seagrass habitats were reported from MDB, followed by 25 species known from the ANE, 24 species in ISE and 9 halacarid species in ITW. The richness of halacarid mites from seagrass habitats in different marine province is more likely related to the intensity of faunistic surveys with the appropriate collecting methods for mites and adequate report of substrate, than to presence or absence of seagrasses.

Several seagrasses viz. *Amphibolis antarctica*, *Amphibolis* spp., *Cymodocea nodosa*, *Halodule uninervis*, *Halodule wrightii*, *Halophila minor*, *Halophila stipulacea*, *Phyllospadix* sp., *Phyllospadix iwatensis*, *Posidonia oceanica*, *Posidonia* spp., *Syringodium isoetifolium*, *Thalassia hemprichii*, *Thalassia* sp., *Thalassia testudinum*, *Thalassodendron* sp., *Zostera marina* and *Zostera* spp. were found where marine mites (halacarid and pontarachnid) were reported (Table 1). However, in some cases seagrass genus name was also not mentioned in the reports. Studies of seagrasses for halacarid and pontarachnid mites were found in four major seagrass families viz. Cymodoeaceae, Hydrocharitaceae, Posidoniaceae, Zosteraceae (Tables 1, 3). Other seagrass families e.g. Ruppiaceae, Zannichelliaceae were not studied for marine mites.

Seagrass habitats have declined in recent years and several species are threatened due to multiple natural and anthropogenic stressors (Waycott *et al*. 2009; Short *et al*. 2011). Anthropogenic activities play an important role in the loss of seagrass due to the impact of coastal development on seagrass ecosystems, including eutrophication and habitat loss due to dredging, anchoring and coastal infrastructure (Orth *et al*. 2006; Ralph *et al*. 2006; Waycott 2009; Salinas 2020).

Species numbers of halacarid and pontarachnid mites clearly correlate with sampling effort from a particular area. Marine mite species from vast areas of seagrass meadows are yet to be investigated, for example, in India, the total seagrass cover is estimated to be 517 km^2 (Geevarghese *et al*. 2017) with 14 reported species (Ramesh *et al*. 2019) which remains unexplored for marine mites. The real diversity and distribution of seagrass mites is far from being complete and future investigations may

reveal further new taxa being present in this environment that is deeply affected by anthropogenic activities.

Table 2. Halacarid and pontarachnid mites reported from seagrass habitats in different marine provinces of the world.

Area	Species
ANE, Atlantic Ocean, North-East	*Copidognathus fabricii*
	Copidognathus lamelloides
	Copidognathus magnipalpus
	Copidognathus oculatus
	Copidognathus rhodostigma
	Halacarellus balticus
	Halacarellus floridearum
	Halacarellus rottnestensis
	Halacaropsis capuzina
	Isobactrus setosus
	Lohmannella falcata
	Lohmannella norvegica
	Maracarus gracilipes
	Pelacarus aculeatus
	Rhombognathides pascens
	Rhombognathides seahami
	Rhombognathides spinipes
	Rhombognathus magnirostris
	Rhombognathus notops
	Rhombognathus praegracilis
	Simognathus minutus
	Thalassarachna basteri
	Thalassarachna hexacantha
	Thalassarachna longipes
	Thalassarachna striata
ANT, Antarctica and sub-Antarctic	-
ANW, Atlantic Ocean, North-West	*Pontarachna punctulum*
ARC, Arctic region	-
ASE, Atlantic Ocean, South-East	-
ASW, Atlantic Ocean, South-West	-
ATE, Atlantic Ocean,Tropical East	-
ATW, Atlantic Ocean,Tropical West	*Copidognathus uniscutatus*
	Copidognathus yucatanensis
ISE, Indian Ocean, South-East	*Agaue brevipes*
	Agaue circellaris
	Agaue tenuipes
	Agauopsis australiensis
	Agauopsis miliaris
	Agauopsis mokari
	Australacarus pustulatus
	Bradyagaue scutella
	Copidognathus ampliatus
	Copidognathus angusticeps
	Copidognathus australensis
	Copidognathus bistriatus
	Copidognathus caelatus
	Copidognathus culoatus

Table 2. Continued.

Area	Species
ISE, Indian Ocean, South-East	*Copidognathus levigatus*
	Copidognathus multiporus
	Copidognathus pumicatus
	Copidognathus wadjemupis
	Halacarellus rottnestensis
	Halacaropsis capuzina
	Halacarus flavellus
	Halacarus fuscatus
	Rhombognathus scutulatus
	Simognathus maculatus
	Litarachna halei
ISW, Indian Ocean,South-West	-
ITE, Indian Ocean, Tropical East	-
ITW, Indian Ocean, Tropical West	*Copidognathus gazii*
	Copidognathus kenyae
	Copidognathus magnipalpus
	Copidognathus ornatus
	Copidognathus pontellus
	Halacarus membraneus
	Rhombognathus scutulatus
	Scaptognathus punctatus
	Simognathus tropicalis
	Litarachna cawthorni
	Pontarachna capensis
MDB, Mediterranean Sea, Black Sea, Caspian Sea and Aral Sea	*Agaue abyssorum*
	Agaue adriatica
	Agaue chevreuxi
	Agaue panopae
	Agauopsis brevipalpus
	Agauopsis conjuncta
	Agauopsis microrhyncha
	Agauopsis minor
	Agauopsis nonornata
	Agauopsis pteropes
	Atelopsalis pacifica
	Copidognathus brachystomus
	Copidognathus dentatus
	Copidognathus lamelloides
	Copidognathus latisetus
	Copidognathus magnipalpus
	Copidognathus oculatus
	Copidognathus perforatus
	Copidognathus quadricostatus
	Copidognathus remipes
	Copidognathus reticulatus
	Halacaropsis hirsuta
	Halacarus subtilis
	Lohmannella falcata
	Maracarus gracilipes
	Pelacarus aculeatus
	Rhombognathus magnirostris
	Rhombognathus paranotops

Table 2. Continued.

Area	Species
MDB, Mediterranean Sea, Black Sea, Caspian Sea and Aral Sea	*Rhombognathus praegracilis*
	Rhombognathus procerus
	Rhombognathus tonops
	Scaptognathus sabularius
	Simognathus adriaticus
	Simognathus minutus
	Thalassarachna basteri
	Litarachna communis
	Litarachna duboscqi
	Pontarachna aenariensis
	Pontarachna punctulum
PNE, Pacific Ocean, North-East	*Agauopsis curvata*
	Halacarus magniporus
PNW, Pacific Ocean, North-West	*Rhombognathus compressus*
	Rhombognathus dissociatus
	Rhombognathus ezoensis
PSE, Pacific Ocean, South-East	-
PSW, Pacific Ocean, South-West	-
PTE, Pacific Ocean, Tropical East	-
PTW, Pacific Ocean, Tropical West	*Copidognathus faubeli*
	Copidognathus ivanomorsellii
	Copidognathus philippinensis
	Copidognathus pujadus
	Copidognathus uniscutatus
	Isobactrus ponapensis
	Rhombognathus cebuus
	Pontarachna australis

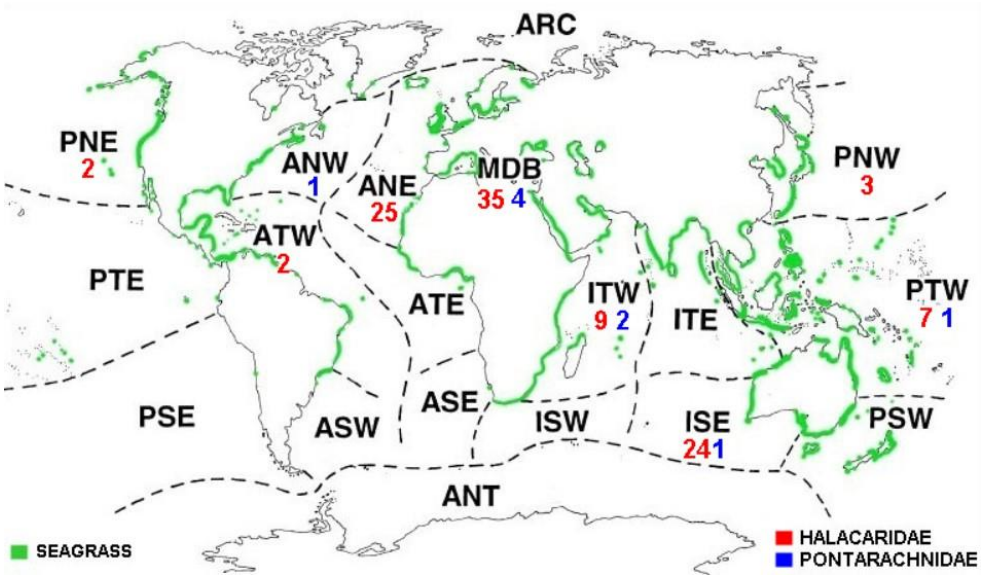

Figure 1. Number of halacarid and pontarchnid species reported from seagrass habitats in each marine provinces of the world.

Table 3. Halacarid and pontarachnid species reported in different seagrass families.

Halacarid and pontarachnid species	Seagrass families						Reported from other habitats/ mixed habitat
	Cymodoeaceae	Hydrocharitaceae	Posidoniaceae	Zosteraceae	Any other families	Family/Genus/ Species of seagrass not mentioned	
Family Halacaridae							
Agaue abyssorum	-	-	+	-	-	-	+
Agaue adriatica	-	-	+	-	-	-	+
Agaue brevipes	+	-	+	-	-	-	+
Agaue chevreuxi	-	-	+	+	-	+	+
Agaue circellaris	+	-	-	-	-	-	-
Agaue panopae	-	-	+	+	-	-	+
Agaue tenuipes	+	-	-	-	-	-	-
Agauopsis australiensis	+	-	-	-	-	-	+
Agauopsis brevipalpus	-	-	+	+	-	+	+
Agauopsis conjuncta	+	-	+	+	-	-	+
Agauopsis curvatus	-	-	-	+	-	-	+
Agauopsis microrhyncha	-	-	+	+	-	-	+
Agauopsis miliaris	-	-	+	-	-	-	+
Agauopsis minor	-	-	+	-	-	-	+
Agauopsis mokari	+	-	+	-	-	-	+
Agauopsis nonornata	-	-	+	-	-	-	+
Agauopsis pteropes	-	-	+	-	-	-	+
Atelopsalis pacifica	-	-	+	-	-	-	+
Australacarus pustulatus	-	-	-	-	-	+	-
Bradyagaue scutella	+	-	-	-	-	-	-
Copidognathus ampliatus	+	-	-	-	-	-	-
Copidognathus angusticeps	+	-	-	-	-	-	-
Copidognathus australensis	+	-	-	-	-	-	+
Copidognathus bistriatus	+	-	-	-	-	-	+
Copidognathus brachystomus	-	-	-	+	-	-	+
Copidognathus caelatus	+	-	-	-	-	-	+
Copidognathus culoatus	+	-	-	-	-	-	-
Copidognathus dentatus	-	-	-	-	-	+	+
Copidognathus fabricii	-	-	-	+	-	-	+
Copidognathus faubeli	-	+	-	-	-	-	+
Copidognathus gazii	-	+	-	-	-	-	-
Copidognathus ivanomorsellii	-	+	-	-	-	-	-
Copidognathus kenyae	-	+	-	-	-	-	-
Copidognathus lamelloides	-	-	+	-	-	-	+
Copidognathus latisetus	-	-	+	-	-	-	+
Copidognathus levigatus	-	-	+	-	-	-	-
Copidognathus magnipalpus	+	+	+	+	-	+	+
Copidognathus multiporus	+	-	-	-	-	-	-
Copidognathus oculatus	-	-	+	+	-	+	+
Copidognathus ornatus	-	+	-	-	-	-	-
Copidognathus perforatus	-	-	-	+	-	+	+
Copidognathus philippinensis	+	+	-	-	-	-	-
Copidognathus pontellus	+	-	-	-	-	-	+
Copidognathus pujadus	+	+	-	-	-	-	-
Copidognathus pumicatus	+	-	-	-	-	-	-
Copidognathus quadricostatus	-	-	+	-	-	-	+
Copidognathus remipes	-	-	+	-	-	-	+

Table 3. Continued.

Halacarid and pontarachnid species	Seagrass families						Reported from other habitats/ mixed habitat
	Cymodoeaceae	Hydrocharitaceae	Posidoniaceae	Zosteraceae	Any other families	Family/Genus /Species of seagrass not mentioned	
Family Halacaridae							
Copidognathus reticulatus	-	-	+	-	-	-	+
Copidognathus rhodostigma	-	-	-	+	-	-	+
Copidognathus uniscutatus	+	+	-	-	-	-	+
Copidognathus wadjemupis	+	-	-	-	-	-	-
Copidognathus yucatanensis	-	+	-	-	-	-	-
Halacarellus balticus	-	-	-	+	-	-	+
Halacarellus floridearum	-	-	-	+	-	-	+
Halacarellus rottnestensis	+	-	-	-	-	-	-
Halacaropsis capuzina	+	-	-	-	-	-	+
Halacaropsis hirsuta	-	-	-	+	-	-	+
Halacarus flavellus	+	-	+	-	-	-	+
Halacarus fuscatus	+	-	-	-	-	-	+
Halacarus magniporus	-	-	-	+	-	-	+
Halacarus membraneus	+	-	-	-	-	-	+
Halacarus subtilis	-	-	+	-	-	-	+
Isobactrus ponapensis	-	+	-	-	-	-	+
Isobactrus setosus	-	-	-	+	-	-	+
Lohmannella falcata	-	-	+	+	-	+	+
Lohmannella norvegica	-	-	-	+	-	-	+
Maracarus gracilipes	-	-	+	+	-	-	+
Pelacarus aculeatus	-	-	+	-	-	-	+
Rhombognathides pascens	-	-	-	+	-	+	+
Rhombognathides seahami	-	-	-	+	-	-	+
Rhombognathides spinipes	-	-	-	+	-	-	+
Rhombognathus cebuus	-	+	-	-	-	-	+
Rhombognathus compressus	-	-	-	+	-	-	+
Rhombognathus dissociatus	-	-	-	+	-	-	+
Rhombognathus ezoensis	-	-	-	+	-	-	+
Rhombognathus magnirostris	-	-	-	+	-	+	+
Rhombognathus notops	-	-	-	+	-	-	+
Rhombognathus paranotops	-	-	+	+	-	-	+
Rhombognathus praegracilis	-	-	+	-	-	-	+
Rhombognathus procerus	-	-	+	-	-	-	+
Rhombognathus scutulatus	+	+	-	-	-	-	+
Rhombognathus tonops	-	-	-	-	-	+	+
Scaptognathus punctatus	+	-	-	-	-	-	+
Scaptognathus sabularius	-	-	+	-	-	-	+
Rhombognathus praegracilis	-	-	+	-	-	-	+
Rhombognathus procerus	-	-	+	-	-	-	+
Rhombognathus scutulatus	+	+	-	-	-	-	+
Rhombognathus tonops	-	-	-	-	-	+	+
Scaptognathus punctatus	+	-	-	-	-	-	+
Scaptognathus sabularius	-	-	+	-	-	-	+
Rhombognathus praegracilis	-	-	+	-	-	-	+
Simognathus adriaticus	-	-	+	-	-	-	+
Simognathus maculates	+	-	+	-	-	-	+
Simognathus minutus	-	-	+	+	-	-	+
Simognathus tropicalis	+	-	-	-	-	-	-

Table 3. Continued.

Halacarid and pontarachnid species	Seagrass families						Reported from other habitats/ mixed habitat
	Cymodoeaceae	Hydrocharitaceae	Posidoniaceae	Zosteraceae	Any other families	Family/Genus /Species of seagrass not mentioned	
Family Halacaridae							
Thalassarachna basteri	-	-	+	+	-	+	+
Thalassarachna hexacantha	-	-	-	+	-	-	+
Thalassarachna longipes	-	-	-	+	-	-	+
Thalassarachna striata	-	-	-	+	-	-	+
Family Pontarachnidae							
Litarachna cawthorni	-	-	-	-	-	+	-
Litarachna communis	-	-	+	+	-	+	+
Litarachna duboscqi	-	-	-	+	-	+	+
Litarachna halei	+	-	-	-	-	-	+
Pontarachna aenariensis	-	-	+	-	-	-	+
Pontarachna australis	-	+	-	-	-	-	+
Pontarachna capensis	+	-	-	-	-	-	+
Pontarachna punctulum	-	-	+	+	-	+	+

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فهرست کنه‌های هالاکارید و پونتاراکنید (Acari: Halacaridae and Pontarachnidae) یافت شده در زیستگاه‌های علف‌های دریایی

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چکیده

مجموعه‌ای از کنه‌های هالاکارید و پونتاراکنید دریایی (Halacaridae و Pontarachnidae) یافت شده در میان علف‌های دریایی بر اساس گزارش‌های منتشر شده انجام شده است. در این مقاله، ۹۲ گونه کنهٔ هالاکارید و ۸ گونه کنهٔ پونتاراکنید در زیستگاه‌های علف‌های دریایی فهرست شده‌اند. این ۹۱ گونه هالاکارید به ۱۸ جنس تعلق دارند یعنی *Agaue* (۷ گونه)، *Agauopsis* (۱۰ گونه)، *Atelopsalis* (۱ گونه)، *Australacarus* (۱ گونه)، *Bradyagaue* (۱ گونه)، *Copidognathus* (۳۲ گونه)، *Halacarellus* (۳ گونه)، *Halacaropsis* (۲ گونه)، *Halacarus* (۵ گونه)، *Isobactrus* (۲ گونه)، *Lohmannella* (۲ گونه)، *Maracarus* (۱ گونه)، *Pelacarus* (۱ گونه)، *Rhombognathides* (۳ گونه)، *Rhombognathus* (۱۱ گونه)، *Scaptognathus* (۲ گونه)، *Simognathus* (٤ گونه) و *Thalassarachna* (٤ گونه). هشت گونه پونتاراکنید متعلق به دو جنس یعنی *Litarachna* (٤ گونه) و *Pontarachna* (٤ گونه) در زیستگاه‌های علف‌های دریایی یافت می شوند. تنوع و پراکنش واقعی کنه‌ها در زیستگاه‌های علف‌دریایی کامل نیست و پژوهش‌های آینده ممکن است آرایه‌های جدید بیشتری را در این محیط نشان دهد.

واژگان کلیدی: کنه‌های آبزی؛ کنه‌های دریازی؛ meiofauna؛ Phanerogamae؛ پیش‌استیگمایان؛ Trombidiformes.

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