

REVIEW ARTICLE

Mediterranean and Black Sea marine halacarids (Halacaridae: Acari): A review

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Abstract

The information of marine halacarid fauna and research history are reviewed using 76 published papers on the Mediterranean and Black Sea region. In total, 105 marine halacarid species belonging to 25 genera have been recorded till now from the region. Additionally, a genus level key to Mediterranean and Black Sea halacarid species is presented.

Keywords: Prostigmata, meiofauna, halacarid mites, species diversity, Mediterranean, Black Sea.

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Introduction

The family Halacaridae is meiobentic and generally live in submerged habitats in a variety of substrata (e.g. on many animal groups, macroalgae and marine phanerogams, sandy deposits, gravels) (Bartsch 2004; 2006; Giere 2009). Most species are predators, but more than two lineages evolved the ability to feed on macroalgae independently (Pepato *et al.* 2018). The family includes marine, brackish and freshwater species occupying areas from littoral to the deep sea (Bartsch 2006). To date more than 1000 species of Halacaridae have been reported globally from tropical to polar regions, and from intertidal to abyssal depths (Bartsch 2009; WoRMS Editorial Board 2020).

Halacarids were discovered by Job Baster (1758), who reported the first marine mite species as “insect marina”. According to Bartsch (2009), this species may be *Lohmannella falcata* (Hodge, 1863). Later on, systematic studies on this family have been carried out by several scientists from many areas. There are,

however, still unstudied or poorly studied regions (e.g. African continent, South-western Atlantic) and habitats (e.g. bathyal, marine caves, bryozoan and cold coral reefs) of the world's oceans and seas (Bartsch 2009).

The aims of this paper are: (1) to provide a list of species recorded from Mediterranean and Black Sea with their habitat informations; (2) to provide a genus level key for Mediterranean and Black Sea marine halacarid mites.

Research History and Species Diversity of Halacarid mites in Black Sea and Mediterranean Sea

Data of 76 studies were compiled and available records from the Mediterranean and Black Sea including the Strait of Gibraltar were checked and their taxonomic status were verified based on Bartsch (2009) and WoRMS Editorial Board (2020) (Figure 1 and Table 1).

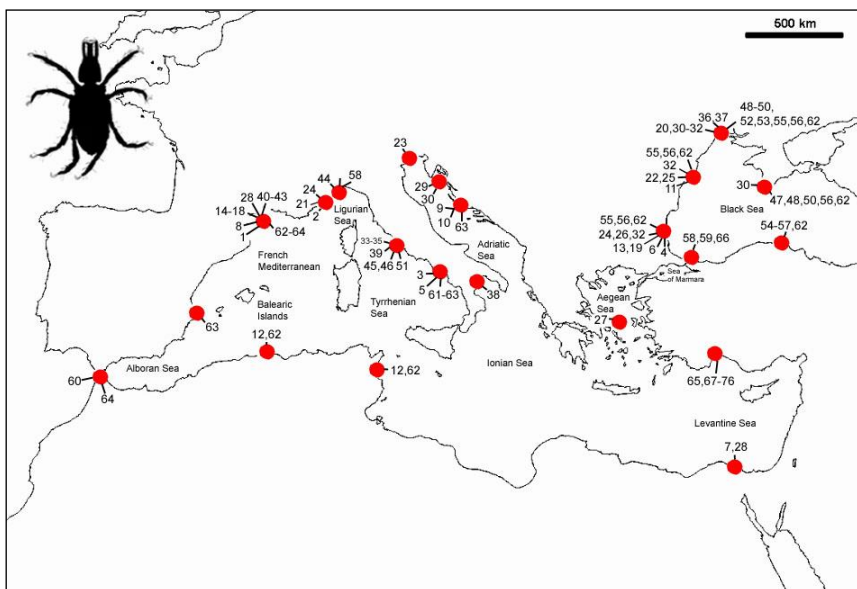


Figure 1. Map showing the known records of marine halacarid in the Mediterranean and Black Sea. Numbers corresponding to localities reported in Table 1 (from 1 to 76).

As shown in Table 1, the first studies on Mediterranean Halacaridae were done by Édouard Louis Trouessart in 1889. Trouessart (1889a-c) described *Agaua chevreuxi*, *Agauopsis brevipalpus*, *A. microhyncha*, *Halacaropsis hirsuta*, *Halacarus levipes* and *Rhombognathus magnirostris* recorded from the French Mediterranean (Perpignon/Banyuls-sur-Mer or from off Marseille) but the species of *H. levipes* was expected to be one of the Mediterranean *Halacarus* species or *Thalassarachna affinis* according to Bartsch (2009). In 1896,

Copidognathus humerosus and *Thalassarachna affinis* described by the same scientist from Marseille, France (Trouessart 1896). After that the first marine halacarid *Copidognathus trouessarti* from Italian coast (Naples) was described by Voinov (1896) from 2 m depths and studies followed by Chichkoff (1907) from the Black Sea and Police (1909) from Naples, Mediterranean Sea.

About two decades later, a second wave of studies was initiated by Karl Viets who described two new species from the Black Sea (Viets 1928), followed by a new species and two new records from Levantine Sea (Alexandria, Egypt) (Viets 1935). Later, Viets greatly contributed to knowledge of halacarid mites of the Adriatic Sea (Croatia, Rovinj and Split) where he described a total of 18 new species (Viets 1939; 1940).

Afterwards, numerous studies were carried out mainly in French and Spanish Mediterranean coasts, Algerian, Italian, Monaco, Moroccan, Strait of Gibraltar, Tunisian, and Black Sea coasts as seen in Table 1.

Finally, the third phase of research performed on Turkish coasts took place with several studies. Three new records were given from the Sea of Marmara (İstanbul) by Bilecenoğlu *et al.* (2013), Kapiris *et al.* (2014) and Durucan and Boyacı (2016). Halacarid mites of the Turkish Levantine Sea were untouched until 2016 (Mytilineou *et al.* 2016), followed by a rapid increase with studies, such as by Stamouli *et al.* (2017), Chartosia *et al.* (2018), Durucan (2018; 2019a-c) and Durucan and Boyacı (2017; 2018a, b).

As of September 2019, 76 papers regarding marine halacarids have been published from the Mediterranean and Black Sea region (Figure 1, Table 1). The names of *species inquirenda* (marked with *) and species need verification (marked with **) are included in Table 1 but excluded in Table 2. According to the papers reviewed, marine halacarids are represented by 105 species belonging to 25 genera in the Mediterranean and Black Sea (Table 2).

Nine halacarid species were excluded from Table 2.

1) *Copidognathus fabricii* (Lohmann, 1889) and *Copidognathus rhodostigma rondus* Bartsch, 1979 (only excluded from the Black Sea) were recorded from the Black Sea (Bulgaria) by Chichkoff (1907), but both mentioned species are indicated as questionable by Bartsch (2009);

2) *Acarochelopodia angelieri* Travé, 1972, *Actacarus illustrans* Newell, 1951 *Anomalohalacarus anomalus* (Trouessart, 1894) were reported from Euboea Island, the Aegean Sea, by Travé (1972), but first mentioned species (*A. angelieri*) was considered *species inquirenda* and not illustrated by Bartsch (2009) and other species (*A. illustrans* and *A. anomalus*) are probably misidentified and need verification by Bartsch (2009);

- 3) *Copidognathus brevirostris* Viets, 1927 and *Thalassarachna hexacantha* (Viets, 1927) were recorded from Bulgaria, the Black Sea, by Valkanov (1955). Both species, however, need verification (Bartsch 2009);
- 4) *Rhombognathus denticulatus*, which was reported by Vorobyeva and Jaroshenko (1979) from Ukraine, the Black Sea, most probably belongs to *Rhombognathus magnirostris*, which is common in the Mediterranean Sea (Bartsch 2009);
- 5) *Halacarellus floridearum* (Lohmann, 1889) was reported from Ukraine, the Black Sea by Vorobyeva and Jaroshenko (1982). The identification was, however, questionable and needs verification (Bartsch 2009).

Seven species are most common species in the Mediterranean and Black Sea region: *Agaua chevreuxi*, *Agauopsis brevipalpus*, *Agauopsis microrhyncha*, *Copidognathus brachystomus*, *Halacaropsis hirsuta*, *Lohmannella falcata* and *Maracarus gracilipes* as seen in Table 1.

Of the 25 genera reported from the Mediterranean and Black Sea, *Copidognathus* is the most species-rich genus (28 species), followed by *Rhombognathus* with 12 species, *Agauopsis* with 9 species, *Anomalohalacarus*, *Halacarellus* and *Halacarus* with 6 species, *Scaptognathus* with 4 species, *Acarochelopedia*, *Actacarus*, *Agaua*, *Isobactrus*, *Lohmannella* and *Thalassarachna* with 3 species, *Acaromantis*, *Coloboceras*, *Maracarus* and *Simognathus* and with 2 species, and all remaining genera with one species (*Atelopsalis*, *Camactognathus*, *Copidognathides*, *Halacaropsis*, *Parhalioxides*, *Pelacarus*, *Plegadognathus*, and *Rhombognathides*) (Table 3). Figure 2 presents the increase of halacarid species records through time in the Mediterranean and Black Sea.

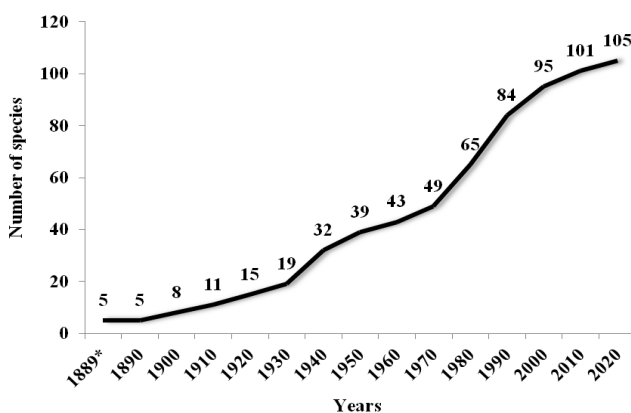


Figure 2. Timeline of the species records in the Mediterranean and Black Sea. The first study indicated with (*)

Table 1. Marine halacarid mites of the Mediterranean and Black Sea with habitat information
(*species inquirenda **need verification)

References	Species	Location (in Figure 1)	Habitat/s and depths
Trouessart (1889a-c)	<i>A. chevreuxi</i> , <i>A. brevipalpus</i> , <i>A. microhyncha</i> , <i>H. hirsuta</i> , <i>R. magnirostris</i>	French Mediterranean (1)	macroalgae
Trouessart (1896)	<i>C. humerosus</i> , <i>T. affinis</i>	French Medit, Marseille (2)	macroalgae
Voinov (1896)	<i>C. trouessarti</i>	Tyrrhenian Sea, Naples, Italy(3)	littoral, Rhodopyhta (Floridae) (2 m)
Chichkoff (1907)	<i>A. brevipalpus</i> , <i>C. brachystomus</i> , <i>C. fabricii</i> ** <i>C. rhodostigma rondus</i> **	Black Sea, Bulgaria (4)	0.5-28 m
Police (1909)	<i>A. spinipes</i> , <i>C. cribosoma</i> , <i>C. magnipalpus</i> , <i>C. sculptus</i> , <i>H. longiunguis</i> , <i>R. sphaerorhynchus</i>	Tyrrhenian Sea, Italy (5)	Rhodopyhta (Floridae), amphioxus sand, subtidal sediment shallow water algae, subtidal sediment, (2-100 m)
Viets (1928)	<i>A. chevreuxi</i> , <i>A. brevipalpus</i> , <i>C. magnipalpus</i> , <i>C. mucronatus</i> , <i>C. ponteuxinus</i> , <i>T. affinis</i>	Black Sea (Bulgaria, Russia, Ukraine) (6)	Rhodopyhta (<i>Phyllophora</i> sp.), amphioxus sand
Viets (1935)	<i>H. hirsuta</i> , <i>H. egyptus</i> , <i>R. magnirostris</i>	Levantine Sea, Egypt (7)	various macroalgae, sand habitats (9-10 m)
André (1939)	<i>C. longiusculus</i>	French Mediterranean (8)	subtidal
Viets (1939)	<i>I. uniscutatus</i> , <i>R. parvulus</i> , <i>R. Peltatus</i> , <i>R. praegracilis</i>	Adriatic Sea, Croatia (9)	various macroalgae and muddy sand (0-1 m)
Viets (1940)	<i>A. adriatica</i> , <i>A. chevreuxi</i> , <i>A. conjuncta</i> , <i>C. dentatus</i> , <i>C. extensus</i> , <i>C. falcifer</i> , <i>C. latisetus</i> , <i>C. perforatus</i> , <i>H. hirsuta</i> , <i>H. rismondoi</i> , <i>H. subtilis</i> , <i>L. steueri</i> , <i>S. adriaticus</i> , <i>C. brachystomus</i> , <i>C. brevipes</i> ,	Adriatic Sea, Croatia (10)	various macroalgae, sand, mud, bryozoan, sponge (0-20 m)
Motas and Soarec (1940)	<i>C. brachystomus</i> , <i>C. rhodostigma</i> ** <i>C. tabellio</i> , <i>C. trouessarti</i> , <i>R. pascens</i> , <i>R. ponticus</i> *, <i>T. affinis</i>	Black Sea, Romania (11)	Phaeophyta (<i>Cystoseira</i> sp.)
Angelier (1954)	<i>A. delameri</i> , <i>A. pygmaeus</i> , <i>A. anomalus</i> , <i>A. brevipalpus</i> , <i>L. falcata</i> , <i>R. praegracilis</i>	Algeria: Oran, Beni-Saf, Djidjelli, ferme Vincent, La Calle, Philippeville. France: Pyrénées-Orientales. Italy: Roma. Spain: Barcelona, Mataro. Tunisia: Gamarth- Plage (12)	littoral sand

Table 1. Continued

Valkanov (1955)	<i>C. breviostris</i> ** <i>C. extensus</i> ** <i>, T. hexacantha</i> **	Black Sea, Bulgaria (13)	-
Laubier (1960)	<i>P. travei</i>	French Mediterranean (14)	associated with a nemertean, subtidal
André (1961)	<i>S. sabularius</i>	French Mediterranean (15)	amphioxus sand (5 m)
Monniot (1961)	<i>S. leiomerus</i>	French Mediterranean (16)	amphioxus sand (5 m)
Weinstein (1961)	<i>H. bisulcus</i>	French Mediterranean (17)	amphioxus sand (20 m)
Monniot (1962)	<i>C. drachi</i>	French Mediterranean (18)	amphioxus sand (20 m)
Marinov (1964)	<i>A. pygmaeus</i> **	Black Sea, Bulgaria (19)	-
Makkaveeva (1966)	<i>T. affinis</i>	Black Sea, Ukraine (20)	Phaeophyta (<i>Cystoseira</i> sp.)
Morselli (1969)	<i>A. conjuncta</i> , <i>A. microhyncha</i> , <i>A. anomalus</i> ** <i>, C. brachystomus</i> , <i>L. falcata</i> , <i>M. gracilipes</i>	Ligurian Sea, Italy (21)	various sized sand (0-12 m)
Konnerth-Ionescu (1970)	<i>A. bacescui</i> , <i>R. pascens</i> , <i>T. affinis</i>	Black Sea, Romania (22)	sand (0-20 m)
Krantz (1970)	<i>A. chevreuxi</i> , <i>A. brevipalpus</i> , <i>A. tricuspis</i> , <i>L. falcata</i> <i>C. brachystomus</i> , <i>Codognathus</i> sp., <i>Rhombognathus</i> sp.	Adriatic Sea, (Italy, Venice) (23)	intertidal mussel beds (<i>M. galloprovincialis</i>)
Morselli (1970)	<i>Acaromantis monnioti</i>	Ligurian Sea, Italy (24)	sand (4,12 m)
Konnerth-Ionescu (1971)	<i>C. magnipalpus</i> , <i>C. mucronatus</i> , <i>R. ponticus</i> *	Black Sea, Romania (25)	sand (0,5, 16 m)
Petrova (1972)	<i>H. phreaticus</i> , <i>H. subterraneus</i>	Black Sea, Bulgaria (26)	interstitial waters
Travé (1972)	<i>A. angelieri</i> * <i>A. squilla</i> , <i>A. illustrans</i> ** <i>, Actacarus</i> sp., <i>A. anomalus</i> ** <i>, Anomalohalacarus</i> sp., <i>C. loricifer</i> , <i>S. sabularius</i>	Aegean Sea, Euboea Island (27)	fine sediment (1 m)
Bartsch (1975)	<i>A. brevipalpus</i> , <i>C. brachystomus</i> , <i>C. brevipes</i> <i>C. magnipalpus</i> , <i>H. hirsuta</i> , <i>R. karlvietsi</i> <i>R. magnirostris</i> , <i>R. notops</i> , <i>R. peltatus</i>	French Mediterranean, Banyuls-sur-Mer, Levantine Sea, Egypt (28)	upper littoral (<i>Mytilus</i> , macroalgae)
Bartsch (1976)	<i>C. stevcici</i>	Adriatic Sea, Croatia (29)	on the eggs of <i>Maja</i> sp.
Petrova (1976)	<i>A. marinovi</i>	Black Sea, Ukraine, Russia (30)	interstitial waters (45-55 cm)
Vorobyeva (1977)	<i>A. pygmaeus</i> **	Black Sea, Ukraine (31)	-
Konnerth-Ionescu (1979)	<i>H. procerus</i>	Black Sea, Bulgaria, Romania, Ukraine (32)	hard substrate (3 m)
Morselli and Mari (1979)	<i>A. bacescui</i> , <i>A. pygmaeus</i> , <i>A. ruffoi</i>	Tyrrhenian Sea, Italy (33)	sand (0-1.5 m)
Morselli (1981)	<i>P. labronicus</i>	Tyrrhenian Sea, Italy (34)	coarse sand (8-10 m)

Table 1. Continued

Morselli and Mari (1981)	<i>A. affinis</i>	Tyrrhenian Sea, Italy (35)	well sorted medium size sand, subtidal
Vorobyeva and Jaroshenko (1979)	<i>R. denticulatus</i> ** <i>T. longipes</i> **	Black Sea, Ukraine (36)	-
Vorobyeva and Jaroshenko (1982)	<i>H. floridearum</i> ** , <i>R. notops</i> **	Black Sea, Ukraine (37)	-
Morselli and Mari (1982)	<i>A. pygmaeus</i> , <i>A. brevipalpus</i> , <i>A. mollis</i> , <i>A. similis</i> , <i>C. tessellatus</i> , <i>C. brachyotomus</i> , <i>C. cribosoma</i> , <i>C. lamelloides</i> , <i>S. hallezi</i>	Ionian Sea, Italy (38)	subtidal sand
Morselli and Mari (1985)	<i>A. bacescui</i> , <i>A. panopae</i> , <i>A. brevipalpus</i> , <i>A. conjuncta</i> , <i>A. microhyncha</i> , <i>C. brevipes</i> , <i>C. cribosoma</i> , <i>C. gibbus</i> , <i>C. longirostris</i> , <i>C. rhodostigma roudus</i> , <i>C. sculptus</i> , <i>H. hirsuta</i> , <i>H. bisulcus</i> , <i>M. gracilipes</i> , <i>P. aculeatus</i> , <i>P. labronicus</i> , <i>S. hallezi</i>	Tyrrhenian Sea, Italy (39)	sand (2,8,16 and 35 m)
Bartsch (1986a)	<i>R. conjunctus</i> , <i>R. parvulus</i> , <i>R. praegracilis</i> , <i>R. paranotops</i>	French Mediterranean (40)	11-45 m
Bartsch (1986b)	<i>L. falcata</i> , <i>L. multisetosa</i> , <i>L. steuerei reducta</i> , <i>S. tridens</i> , <i>S. sabularius</i> , <i>S. hallezi</i> , <i>S. tereninus</i>	French Mediterranean (41)	11-45 m
Bartsch (1986c)	<i>A. pteropes</i>	French Mediterranean (42)	sediment with detritus, <i>P. oceanica</i> meadows (12,37,45 m)
Bartsch (1987)	<i>H. griseus</i>	French Mediterranean (43)	unsorted sediment (11,17 m)
Morselli and Mari (1989)	<i>A. singularis</i>	Ligurian Sea, Italy (44)	sand (7-8 m)
Mari and Morselli (1990)	<i>A. adriatica</i> , <i>A. chevreuxi</i> , <i>A. panopae</i> , <i>C. magnipalpus</i> , <i>H. subtilis</i> , <i>R. praegracilis</i>	Tyrrhenian Sea, Italy (45)	<i>P. oceanica</i> meadows (1-30 m)
Morselli and Mari (1993)	<i>A. adriatica</i> , <i>A. panopae</i> , <i>A. microhyncha</i> , <i>C. magnipalpus</i> , <i>C. quadricostatus</i> , <i>H. rismondoi</i> , <i>R. paratonops</i>	Tyrrhenian Sea, Italy (46)	coralligenous formations of an infralittoral bottom (6-12 m)
Bartsch (1996a)	<i>A. brevipalpus</i> , <i>A. ibssi</i> , <i>A. marinovi</i>	Black Sea, Russia (47)	sandy deposits, macroalgae, colonies of mussels and their epibionts
Bartsch (1996b)	<i>R. pascens</i> , <i>R. karlvietsi</i> , <i>R. magnirostris</i> , <i>R. paranotops</i> , <i>R. peltatus</i> , <i>R. tonops</i>	Black Sea (Russia, Ukraine) (48)	colonies of mussels, various sediments (0-10 m)
Bartsch (1998a)	<i>I. peregrinus</i>	Black Sea, Ukraine (49)	sediment (30-50 cm)

Table 1. Continued

Bartsch (1998b)	<i>A. chevreuxi</i> , <i>H. chersonesus</i> , <i>H. discretus</i> , <i>H. micropectinatus</i> , <i>H. phreaticus</i> , <i>H. procerus</i> , <i>H. subterraneus</i> , <i>M. gracilipes</i> , <i>T. affinis</i> , <i>T. longipes</i>	Black Sea (Ukraine, Russia) (50)	various macroalgae, mussels, various sediments (from supralittoral to 10 m)
Morselli <i>et al.</i> (1998)	<i>A. cuneifera</i> , <i>A. delamarei</i> , <i>A. tarentina</i>	Tyrrhenian Sea, Italy (51)	interstitial waters (30–40 cm, 2 m)
Bartsch (1999a)	<i>C. ampliatus</i>	Black Sea, Ukraine (52)	red macroalgae (<i>Corallina</i> sp.) (0.4 m)
Bartsch (1999b)	<i>A. ponticus</i>	Black Sea, Ukraine (53)	barnacles, upper tidal
Bartsch (2000)	<i>I. ponticus</i>	Black Sea, Turkey (54)	barnacles (<i>Chthamalus</i> sp.)
Bartsch (2001)	<i>C. ampliatus</i> , <i>C. brachystomus</i> , <i>C. brevipes</i> , <i>C. lamelloides</i> , <i>C. magnipalpus</i> , <i>C. mucronatus</i> , <i>C. ponteuxinus</i> , <i>C. setilatus</i> , <i>C. tabellio</i>	Black Sea (Bulgaria, Romania, Turkey, Ukraine) (55)	sand
Bartsch (2004)	<i>A. delamarei</i> , <i>A. bacescui</i> , <i>A. ponticus</i> , <i>A. chevreuxi</i> , <i>A. brevipalpus</i> , <i>A. ibbsi</i> , <i>A. marinovi</i> , <i>A. mollis</i> , <i>A. similis</i> , <i>C. ampliatus</i> , <i>C. brachystomus</i> , <i>C. brevipes</i> , <i>C. lamelloides</i> , <i>C. magnipalpus</i> , <i>C. mucronatus</i> , <i>C. ponteuxinus</i> , <i>C. setilatus</i> , <i>C. tabellio</i> , <i>H. chersonesus</i> <i>H. discretus</i> , <i>H. phreaticus</i> , <i>H. micropectinatus</i> , <i>I. ponticus</i> , <i>L. falcata</i> , <i>M. gracilipes</i> , <i>R. pascens</i> , <i>R. karlvietsi</i> , <i>R. magnirostris</i> , <i>R. paratonops</i> , <i>H. procerus</i> , <i>H. subterraneus</i> , <i>I. peregrinus</i> , <i>R. peltatus</i> , <i>R. tonops</i> , <i>T. affinis</i>	Black Sea (Bulgaria, Romania, Russia, Turkey, Ukraine) (56)	various macroalgae and sand, clumps of mytilids (0–150 m)
Bartsch (2013)	<i>C. tessellatus</i> , <i>C. dissimilis</i> , <i>C. sculptus</i>	Black Sea, Turkey (57)	mixture of shell remains, muddy sand (3,7 m)
Bilecenoğlu <i>et al.</i> (2013)	<i>A. chevreuxi</i>	Sea of Marmara, Istanbul (58)	green algae (<i>Ulva lactuca</i>) (3–4 m)
Kapiris <i>et al.</i> (2014)	<i>T. affinis</i>	Sea of Marmara, Istanbul (59)	macroalgae with sand (2–3 m)
Bartsch (2015a)	<i>C. tessellatus</i> , <i>C. ampliatus</i> , <i>C. magnipalpus</i> , <i>H. hirsuta</i>	Black Sea, Turkey, Strait of Gibraltar, Morocco (60)	-
Bartsch (2015b)	<i>T. basteri</i>	Tyrrhenian Sea, Italy (61)	<i>P. oceanica</i> meadows (6 m)
Bartsch (2015c)	<i>A. brevipalpus</i>	Mediterranean Sea: France, Italy, Monaco, Algeria, Tunisia; Black Sea: Bulgaria, Romania, Ukraine, Crimea, Russia, Turkey (62)	-

Table 1. Continued

Bartsch (2016a)	<i>M. gracilipes</i> , <i>M. minor</i>	Tyrrhenian Sea, Italy; Adriatic Sea, Croatia; French Mediterranean, (Spain and France) (63)	sandy shallow
Bartsch (2016b)	<i>A. adriatica</i> , <i>A. chevreuxi</i> , <i>A. panopae</i>	French Mediterranean, Marseille Morocco, off Tanger (64)	-
Mytilineou <i>et al.</i> (2016)	<i>A. microhyncha</i>	Levantine Sea, Turkey (65)	soft sand (22 m)
Durucan and Boyaci (2016)	<i>H. hirsuta</i>	Sea of Marmara, Istanbul (66)	green algae (<i>Ulva lactuca</i>) (3-4 m)
Stamouli <i>et al.</i> (2017)	<i>A. monnioti</i>	Levantine Sea, Turkey (67)	sand (2-3 m)
Stamouli <i>et al.</i> (2017)	<i>S. adriaticus</i>	Levantine Sea, Turkey (68)	sand (1-2 m)
Durucan and Boyaci (2017)	<i>A. pasifica</i>	Levantine Sea, Turkey (69)	soft sand (30 m)
Durucan (2018)	<i>S. hallezi</i> , <i>S. sabularius</i>	Levantine Sea, Turkey (70)	medium coarse and fine sand (7-25 m)
Chartosia <i>et al.</i> (2018)	<i>L. falcata</i>	Levantine Sea, Turkey (71)	medium coarse sand (7 m)
Durucan and Boyaci (2018a)	<i>A. brevipalpus</i> , <i>A. conjuncta</i> , <i>A. ibssi</i> , <i>A. nonornata</i> , <i>A. pteropes</i>	Levantine Sea, Turkey (72)	various macroalgae, sand deposits, meadows of marine phanerogams, and bivalves (0-30 m)
Durucan and Boyaci (2018b)	<i>A. cuneifera</i> , <i>A. bacescui</i> , <i>A. similis</i>	Levantine Sea, Turkey (73)	interstitial water at 50-70 cm
Durucan (2019a)	<i>A. chevreuxi</i> , <i>A. panopae</i> , <i>H. hirsuta</i> , <i>H. bisulcus</i> , <i>M. gracilipes</i> , <i>R. magnirostris</i> , <i>R. paratonops</i> , <i>T. affinis</i>	Levantine Sea, Turkey (74)	various macroalgae and sand deposits (1.5-12 m)
Durucan (2019b)	<i>C. brachystomus</i> , <i>C. dentatus</i> , <i>C. gibbus</i> , <i>C. lamelloides</i> , <i>C. longirostris</i> , <i>C. loricifer</i> , <i>C. magnipalpus</i> , <i>C. majusculatus</i> , <i>C. oculatus</i> , <i>C. quadricostatus</i> , <i>C. remipes</i> , <i>C. septentrionalis</i> , <i>C. tabellio</i>	Levantine Sea, Turkey (75)	various macroalgae, sand deposits (1-9 m)
Durucan (2019c)	<i>A. bacescui</i> , <i>C. tessellatus</i> , <i>C. drachi</i> , <i>H. rismondoi</i> , <i>R. paratonops</i> , <i>R. parvulus</i>	Levantine Sea, Turkey (76)	brown algae (<i>Cystoseira barbata</i>) and various sized of sand (0,5-12 m)

Table 2. List of marine halacarid species of the Mediterranean and Black Sea
(present + or absence -)

Species	Black Sea	Mediterranean Sea
<i>Acarochelopodia cuneifera</i> Bartsch, 1977	-	+
<i>Acarochelopodia delamarei</i> Angelier, 1954	-	+
<i>Acarochelopodia tarentina</i> Morselli, Mari & Sarto, 1998	-	+
<i>Acaromantis monnioti</i> Morselli, 1970	-	+
<i>Acaromantis squilla</i> Trouessart & Neumann, 1893	-	+
<i>Actacarus bacescui</i> Konnerth-Ionescu, 1970	+	+
<i>Actacarus ponticus</i> Bartsch, 1999	+	-
<i>Actacarus pygmaeus</i> Schulz, 1937	+	+
<i>Agauae adriatica</i> Viets, 1940	-	+
<i>Agauae chevreuxi</i> (Trouessart, 1889)	+	+
<i>Agauae panopae</i> (Lohmann, 1893)	-	+
<i>Agauopsis brevipalpus</i> Trouessart, 1889	+	+
<i>Agauopsis conjuncta</i> Viets, 1940	-	+
<i>Agauopsis ibssi</i> Bartsch, 1996	+	+
<i>Agauopsis marinovi</i> Petrova, 1976	+	-
<i>Agauopsis microrhyncha</i> (Trouessart, 1889)	-	+
<i>Agauopsis nonornata</i> Bartsch, 1999	-	+
<i>Agauopsis pteropes</i> Bartsch, 1986	-	+
<i>Agauopsis spinipes</i> (Police, 1909)	-	+
<i>Agauopsis tricuspis</i> Benard, 1962	-	+
<i>Anomalohalacarus affinis</i> Morselli & Mari, 1981	-	+
<i>Anomalohalacarus mollis</i> Morselli & Mari, 1982	+	+
<i>Anomalohalacarus ruffoi</i> Morselli & Mari, 1979	-	+
<i>Anomalohalacarus similis</i> Bartsch, 1976	+	+
<i>Anomalohalacarus singularis</i> Morselli & Mari, 1989	-	+
<i>Atelopsalis pasifica</i> Bartsch, 1985	-	+
<i>Camactognathus tessellatus</i> (Morselli & Mari, 1982)	+	+
<i>Coloboceras drachi</i> Monniot, 1962	-	+
<i>Coloboceras longiusculus</i> Trouessart, 1889	-	+
<i>Copidognathides ampliatus</i> Bartsch, 1999	+	-
<i>Copidognathus adriaticus</i> Viets, 1940	-	+
<i>Copidognathus brachystomus</i> Viets, 1940	+	+
<i>Copidognathus brevipes</i> Viets, 1940	+	+
<i>Copidognathus cribosoma</i> (Police, 1909)	-	+
<i>Copidognathus dentatus</i> Viets, 1940	-	+
<i>Copidognathus dissimilis</i> Bartsch, 2013	+	+
<i>Copidognathus extensus</i> Viets, 1940	+	+
<i>Copidognathus falcifer</i> Viets, 1940	-	+
<i>Copidognathus gibbus</i> (Trouessart, 1889)	-	+
<i>Copidognathus humerosus</i> (Trouessart, 1896)	-	+
<i>Copidognathus lamelloides</i> Bartsch, 2000	+	+
<i>Copidognathus latisetus</i> Viets, 1940	-	+
<i>Copidognathus longirostris</i> (Trouessart, 1896)	-	+
<i>Copidognathus loricifer</i> André, 1946	-	+
<i>Copidognathus magnipalpus</i> (Police, 1909)	+	+
<i>Copidognathus majusculatus</i> (Trouessart, 1894)	-	+

Table 2. Continued

<i>Copidognathus mucronatus</i> Viets, 1928	+	-
<i>Copidognathus oculatus</i> (Hodge, 1863)	-	+
<i>Copidognathus perforatus</i> Viets, 1940	-	+
<i>Copidognathus ponteuxinus</i> Viets, 1928	+	-
<i>Copidognathus quadricostatus</i> (Trouessart, 1894)	-	+
<i>Copidognathus rhodostigma rondus</i> Bartsch, 1979	-	+
<i>Copidognathus remipes</i> (Trouessart, 1894)	-	+
<i>Copidognathus sculptus</i> (Police, 1909)	+	+
<i>Copidognathus septentrionalis</i> (Halbert, 1915)	-	+
<i>Copidognathus setilatus</i> Bartsch, 2001	+	-
<i>Copidognathus stevcici</i> Bartsch, 1976	-	+
<i>Copidognathus tabellio</i> (Trouessart, 1894)	+	+
<i>Copidognathus trouessarti</i> (Voinov, 1896)	-	+
<i>Halacarellus chersonesus</i> Bartsch, 1998	+	-
<i>Halacarellus discretus</i> Bartsch, 1998	+	-
<i>Halacarellus micropectinatus</i> Bartsch, 1972	+	-
<i>Halacarellus phreaticus</i> Petrova, 1972	+	-
<i>Halacarellus procerus</i> (Viets, 1927)	+	-
<i>Halacarellus subterraneus</i> Schulz, 1933	+	-
<i>Halacaropsis hirsuta</i> (Trouessart, 1889)	-	+
<i>Halacarus aegyptus</i> Viets, 1935	-	+
<i>Halacarus bisulcus</i> Viets, 1927	-	+
<i>Halacarus griseus</i> Bartsch, 1987	-	+
<i>Halacarus longiunguis</i> Police, 1909	-	+
<i>Halacarus rismondoi</i> Viets, 1940	-	+
<i>Halacarus subtilis</i> Viets, 1940	-	+
<i>Isobactrus peregrinus</i> Bartsch, 1998	+	-
<i>Isobactrus ponticus</i> Bartsch, 2000	+	-
<i>Isobactrus uniscutatus</i> (Viets, 1939)	-	+
<i>Lohmannella falcata</i> (Hodge, 1863)	+	+
<i>Lohmannella multisetosa</i> Bartsch, 1986	+	+
<i>Lohmannella steueri reducta</i> Bartsch, 1986	-	+
<i>Maracarus gracilipes</i> (Trouessart, 1889)	+	+
<i>Maracarus minor</i> (Bartsch, 1977)	-	+
<i>Parhalixodes travei</i> Laubier, 1960	-	+
<i>Pelacarus aculeatus</i> (Trouessart, 1896)	-	+
<i>Plegadognathus labronicus</i> Morselli, 1981	-	+
<i>Rhombognathides pascens</i> (Lohmann, 1889)	+	-
<i>Rhombognathus conjunctus</i> Bartsch, 1986	-	+
<i>Rhombognathus karlvietsi</i> Bartsch, 1975	+	+
<i>Rhombognathus magnirostris</i> Trouessart, 1889	+	+
<i>Rhombognathus notops</i> (Gosse, 1855)	-	+
<i>Rhombognathus paranotops</i> Bartsch, 1986	+	+
<i>Rhombognathus parvulus</i> Viets, 1939	-	+
<i>Rhombognathus peltatus</i> Viets, 1939	+	+
<i>Rhombognathus praegracilis</i> Viets, 1939	-	+
<i>Rhombognathus sphaerorhynchus</i> Police, 1909	-	+
<i>Rhombognathus tonops</i> Bartsch, 1996	+	-
<i>Scaptognathus hallezi</i> Trouessart, 1894	-	+

Table 2. Continued

<i>Scaptognathus sabularius</i> André, 1961	-	+
<i>Scaptognathus tereninus</i> Bartsch, 1986	-	+
<i>Scaptognathus tridens</i> Trouessart, 1889	-	+
<i>Simognathus adriaticus</i> Viets, 1940	-	+
<i>Simognathus leiomerus</i> Trouessart, 1894	-	+
<i>Thalassarachna affinis</i> (Trouessart, 1896)	+	+
<i>Thalassarachna basteri</i> (Johnston, 1836)	-	+
<i>Thalassarachna longipes</i> (Trouessart, 1888)	+	-

Table 3. Number of marine halacarid species recorded from Mediterranean and Black Sea

Genus	Black Sea	Mediterranean Sea
<i>Acarochelopodia</i>	0	3
<i>Acaromantis</i>	0	2
<i>Actacarus</i>	3	2
<i>Agauae</i>	1	3
<i>Agauopsis</i>	3	8
<i>Anomalohalacarus</i>	2	5
<i>Atelopsalis</i>	0	1
<i>Camactognathus</i>	1	1
<i>Coloboceras</i>	0	2
<i>Copidognathides</i>	1	0
<i>Copidognathus</i>	11	25
<i>Halacarellus</i>	6	0
<i>Halacaropsis</i>	0	1
<i>Halacarus</i>	0	6
<i>Isobactrus</i>	2	1
<i>Lohmannella</i>	1	3
<i>Maracarus</i>	1	2
<i>Parhalixodes</i>	0	1
<i>Pelacarus</i>	0	1
<i>Plegadognathus</i>	0	1
<i>Rhombognathides</i>	1	0
<i>Rhombognathus</i>	5	9
<i>Scaptognathus</i>	0	4
<i>Simognathus</i>	0	2
<i>Thalassarachna</i>	2	2

Discussion

In comparison to the world marine halacarid fauna, halacarid diversity in the Mediterranean and Black Sea represent approximately 11% of known halacarid species globally. At the moment, there are no records of halacarid mites from the coasts of Cyprus, Israel, Lebanon, Libya, Malta, and Syria in the Mediterranean and Georgia in the Black Sea.

In summary, many studies have been done throughout the Mediterranean and Black Sea. However, additional field and taxonomic works are needed in different habitats. As a very few species are known from deep waters in the region, the large majority of deep-sea halacarids have not yet been discovered. This paper compiled all existing species data regarding marine halacarid mites along the coast of Mediterranean and Black Sea regions and provide a database for future studies.

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Akdeniz ve Karadeniz halacaridleri (Halacaridae: Acari): Bir derleme

Öz

Bu derleme çalışmasında, Akdeniz ve Karadeniz’de deniz halacaridleriyle ilgili bugüne kadar yapılan 76 çalışma incelenmiştir. Çalışma sonucunda, bölgede 25 cinse ait 105 deniz halacaridi türünün olduğu tespit edilmiştir. Ayrıca, Akdeniz ve Karadeniz halakaridleri cins seviyesinde bir anahtarda sunulmuştur.

Anahtar kelimeler: Prostigmata, meiofauna, halacarid akarları, tür çeşitliliği, Akdeniz, Karadeniz

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ANNEX

Key to the Mediterranean and Black Sea marine halacarid genera (modified from Bartsch, 2006)

- 1a. AE bears epimeral vesicles.....2
- 1b. AE bears a pair of epimeral pores or epimeral organs are lacking.....4
- 2a. Palps lateral to gnathosoma, three-segmented. Leg I enlarged. Tibia I with pair of ventral spines in middle and pair of ventral setae near distal end of that segment.*Atelopsalis*
- 2b. Palps dorsal to gnathosoma.....3
- 3a. Palps two-segmented, tarsus I with a single claw *Acaromantis*
- 3b. Palps three-segmented, tarsus I with a median and two lateral claws.....*Simognathus*
- 4a. Palps inserted dorsally5
- 4b. Palps inserted laterally.....6
- 5a. Rostrum spatula-shaped or wide and lamellar, apex truncate..*Scaptognathus*
- 5b. Rostrum slender and parallel-sided.....*Lohmannella*
- 6a. Palps three segmented.....7
- 6b. Palps three or four segmented. Gnathosoma and legs are short. Rostrum shorter than wide. Two of the three ventral setae of tibiae I and II distinctly bipectinate.....*Copidognathides*
- 6c. Palps four segmented.....8
- 7a. Idiosoma with more than 7 dorsal idiosomatic setae (pair of adanal setae excluded).....*Rhombognathides*
- 7b. Idiosoma with less than 7 dorsal idiosomatic setae (pair of adanal setae excluded). Leg I without prominent spiniform process.....*Coloboceras*
- 8a. PD divided..... *Anomalohalacarus*
- 8b. PD is not divided.....9
- 9a. Idiosoma and leg I with cerotegumental lamellae..... *Agauae*
- 9b. Idiosoma and leg I without cerotegumental lamellae.....10
- 10a. Gnathosoma not visible in dorsal aspect..... *Isobactrus*
- 10b. Gnathosoma visible in dorsal aspect.....11
- 11a. Leg I enlarged and very slender tarsus ending with a single small claw..... *Acarochelopodia*
- 11b. Leg I not enlarged and not very slender ending with a single small claw.....12
- 12a. Rostrum with arrow-shaped (barbed) tip..... *Parhalixodes*

12b. Rostrum without arrow-shaped (barbed) tip.....	13
13a. Ventral plates fused (fused in all Mediterranean species)...	<i>Rhombognathus</i>
13b. Ventral plates not fused.....	14
14a. Ocular plates reduced (less than 20 µm in length).....	<i>Actacarus</i>
14b. Ocular plate nor reduced (more than 20 µm in length).....	15
15a. Palpal segment 3 with seta/e.....	16
15b. Palpal segment 3 without seta/e.....	20
16a. Median claws of tarsi I to IV distinct, stout.....	<i>Halacaropsis</i>
16b. Median claws of tarsi I to IV minute, small.....	17
17a. Tarsus I with 3 dorsal setae.....	18
17b. Tarsus I with more than 3 dorsal setae	<i>Thalassarachna</i>
18a. Tarsi III and IV without ventral setae.....	<i>Agauopsis</i>
18b. Tarsi III and IV with ventral setae.....	19
19a. Female GA mostly with crescent sclerotized areas.....	<i>Halacarus</i>
19b. Female GA without crescent sclerotized areas.....	<i>Halacarellus</i>
20a. Tarsus I with one ventral seta.....	<i>Camactognathus</i>
20b. Tarsus I with two or more ventral setae.....	21
21a. Tibia I with 2 ventral setae.....	<i>Pelacarus</i>
21b. Tibia I with 3 ventral setae.....	<i>Copidognathus</i>
21c. Tibia I with 4 ventral setae.....	22
22a. PD with raised areolae which include cup-like foveae.....	<i>Plegadognathus</i>
22b. PD with punctate areolae but major parts uniformly ornamented, often reticulated.....	<i>Maracarus</i>