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Article

Two new genera, *Limnohalacarus* and *Soldanellonyx* (Acari: Halacaridae) in freshwater halacarid mites with additional new records from Turkey

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ABSTRACT
This study is based on freshwater halacarid mites collected from two different provinces (Isparta and Muğla) of Turkey. *Limnohalacarus wackeri* (Walter, 1914) and *Soldanellonyx monardi* Walter, 1919 are reported for the first time for Turkish freshwater halacarid fauna. Additionally, both nymphal stages of *Halacarellus hyrcanus* (Viets, 1928) and deutonymph of *Porohalacarus alpinus* (Thor, 1910) are also recorded for the first time for Lake Eğirdir, Isparta. Each species is illustrated, briefly diagnosed with notes and shown on a map of Turkey depicting all recorded freshwater halacarid species to this date.

KEY WORDS: Biogeography; Halacaroidea; new records; nymphs; taxonomy.

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INTRODUCTION

Halacarid mites are microscopic invertebrates (also referred to as meiofauna). They live in all aquatic habitats (marine, brackish and freshwater) and include species ranging from 180 to 700 µm, more than 1000 of which are marine and more than 60 species have been found from freshwaters or brackish waters like saline lakes and estuaries; some species are also described from all over the world (Chatterjee and Chang 2005; Bartsch 2006, 2009, 2018; Durucan 2019b). All halacarid mites have probably evolved in brackish or sea water according to Bartsch (2001). The first marine halacarid mite (*Thalassarachna basteri*) was described by Johnston in 1836. The first freshwater halacarid mite (*Leptognathus violaceus*) was described by Kramer in 1879 (Bartsch 2007, 2008). Freshwater halacarid mites can be found in both subterranean and surface waters. They live in springs, wells, the hyporheic zone of rivers and flocculant ooze of lakes, in artificial filters, sandy deposits, amongst colonial organisms, gill chambers, mosses and vascular plants, in humic as well as in brackish coastal waters (Bartsch 2007, 2008). The freshwater halacarid species differs from marine forms by enlarged epimeral pores and/or the presence of external genital acetabula. The external genital acetabula and the epimeral pores both have osmoregulatory functions (Bartsch 1995).

In the present study, a total of 36 halacarid mite specimens were identified from two different localities of Turkey (Lake Eğirdir, Isparta and Çiftlik, Fethiye, Muğla): *Halacarellus hyrcanus* (Viets, 1928), *Limnohalacarus wackeri* (Walter, 1914), *Porohalacarus alpinus* (Thor, 1910) and *Soldanellonyx monardi* Walter, 1919. Among them *L. wackeri* and *S. monardi* are new to the Turkish freshwater halacarid fauna. Furthermore, the author found more than 200 *Copidognathus tectiporus* specimens which were previously recorded and illustrated in Durucan (2018a) at all life stages from Lake Eğirdir (Isparta).

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MATERIALS AND METHODS

The specimens studied were collected from two different sampling sites on September 2019 (Figs. 1, 2). Immediately after collection, sediments and stones retained in the set of sieves (63 µm, 500 µm, 1 mm) were sorted under binocular microscope (Nikon SMZ 10). Mites were then cleared in lactic acid and mounted in Hoyer's medium. Drawings were made using a camera lucida microscope (Nikon Eclipse E400). The specimens were kept in the author's personal collection in Antalya. All measurements are given in micrometers (µm). Terminology and abbreviations follow Bartsch (2006).

List of abbreviations

AD	anterior dorsal plate	gs	genital sclerite
AE	anterior epimeral plate	OC	ocular plate (s)
co	costae	P-1 to P-4	first to fourth segments of palp
cor	corneae	pc	pore canaliculus
ds-1 to ds-6	dorsal setae on idiosoma	PD	posterior dorsal plate
DN	deutonymph	PE	posterior epimeral plate (s)
GA	genitoanal plate	pgs	perigenital seta
gac	genital acetabula	PN	protonymph
glp-1 to glp-5	gland pore/s	sgs	subgenital seta

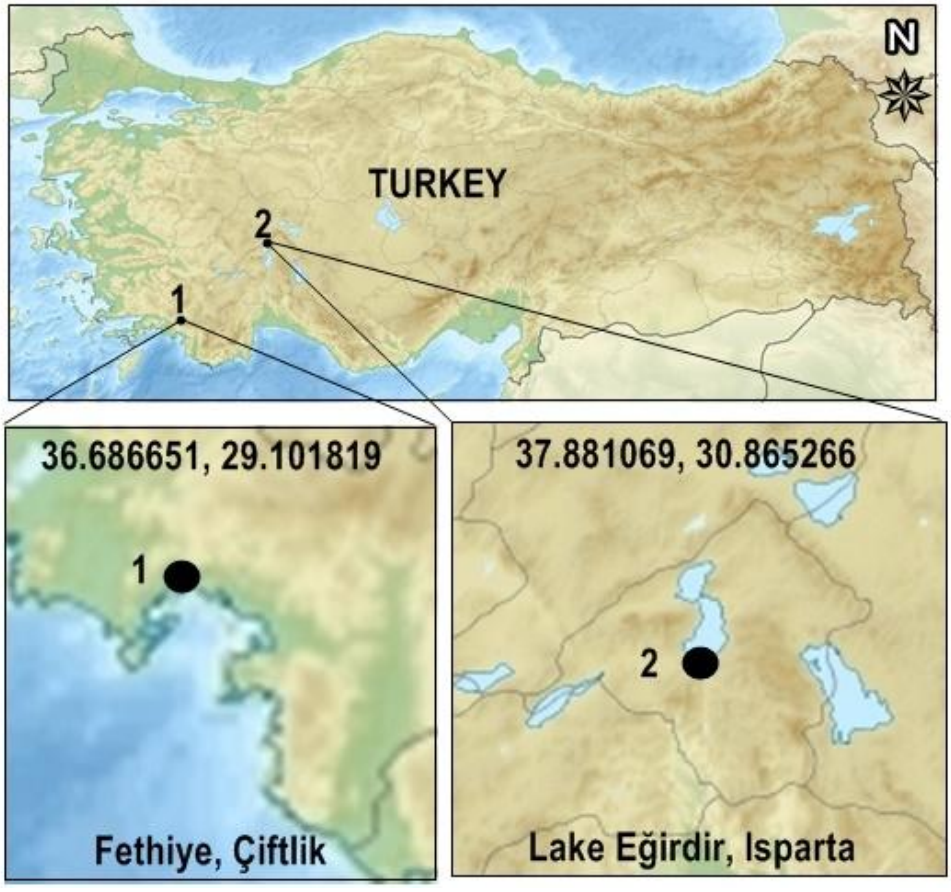

Figure 1. Map of the study areas showing the sampling stations.

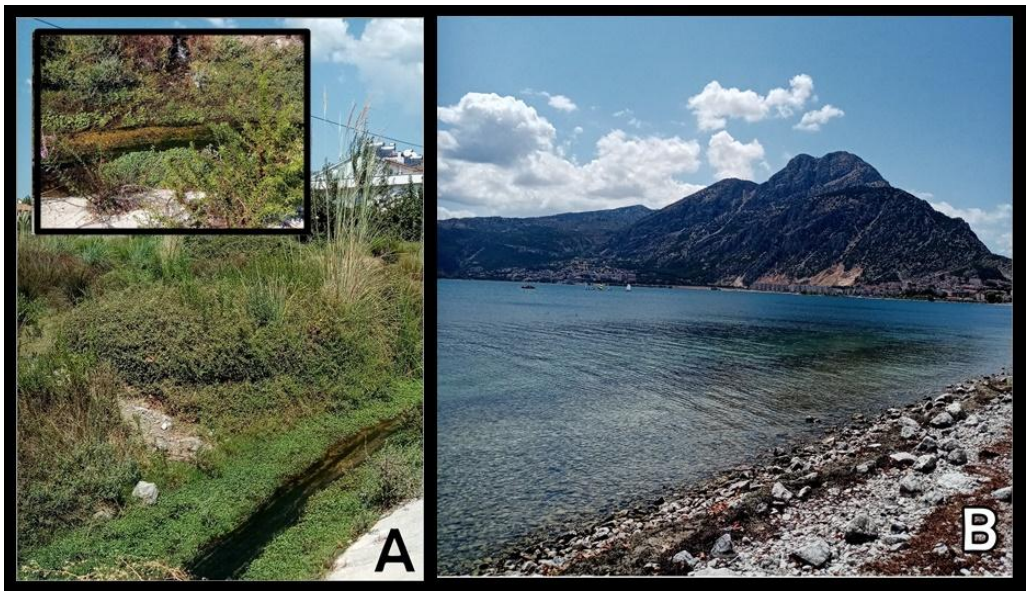

Figure 2. Sampling locations: A. Çiftlik, Fethiye; B. Lake Eğirdir, Isparta.

RESULTS

In the present study, 36 specimens were identified from four different freshwater halacarid genera. The diagnosis of the species are presented in alphabetical genus order.

Systematics

Family Halacaridae Murray, 1877

Genus *Halacarellus* Viets, 1927

Halacarellus hyrcanus (Viets, 1928) (Figs. 3A-E)

Material examined

15 deutonymphs, 16 protonymphs, Lake Eğirdir-Isparta, on sediments and stones, 19 August 2019, coll. F. Durucan.

Morphology and notes

Idiosoma of deutonymphs between 400–410 long, 270–278 wide. AD, OC and PD reticulated. AD 100–103 long, 110–112 wide. OC 65–67 long, 55–57 wide. PD 225–228 long, 164–167 wide (Fig. 3A). AE with 3 pairs of ventral setae. AE 93–95 long, 212–215 wide. PE with 1 dorsal, 2 ventral setae. PE 135–138 long, 75–78 wide. GA with 2 pairs of pgs and 2 pairs of large genital acetabula. GA 160–165 long, 150–155 wide (Fig. 3B). Gnathosoma 110–114 long, 73–75 wide. P-1, 12; P-2, 40; P-3, 17; P-4, 13 (Fig. 3C). Genu I with large ventral seta and 2 smaller ventromedial setae. Tibia I with 2 pairs of ventral setae (Figs. 3D). Idiosoma of protonymphs are between 280–300 long, 200–210 wide. GA with one pair of large genital acetabula. GA of protonymph almost as long as wide (114). Each genital acetabula size is 20. (Fig. 3E). *Halacarellus hyrcanus* has previously recorded in both sexes from running water on 15th May 2016 in from Kargi Stream, Fethiye by Durucan and Boyacı (2019). In this study, both nymphal stages (proto- and deutonymph) of the species have been recorded from standing water on 19th August 2019.

Distribution

Halacarellus hyrcanus was found from Caspian Sea, Baku-Azerbaijan by Viets (1928) for the

first time and afterwards recorded from Rhine (France, Germany, Netherlands), Bulgaria (Lake Varna), Romania (Danube delta, Sfintul Gheorghe, Plavisevita, Sulina) (Bartsch 1998, 2004, 2009). Juveniles were reported from Wales (Bartsch 2001). Turkey (Kargi Stream, Fethiye, Muğla) (Durucan and Boyacı 2019) **Present record:** Lake Eğirdir (Isparta).

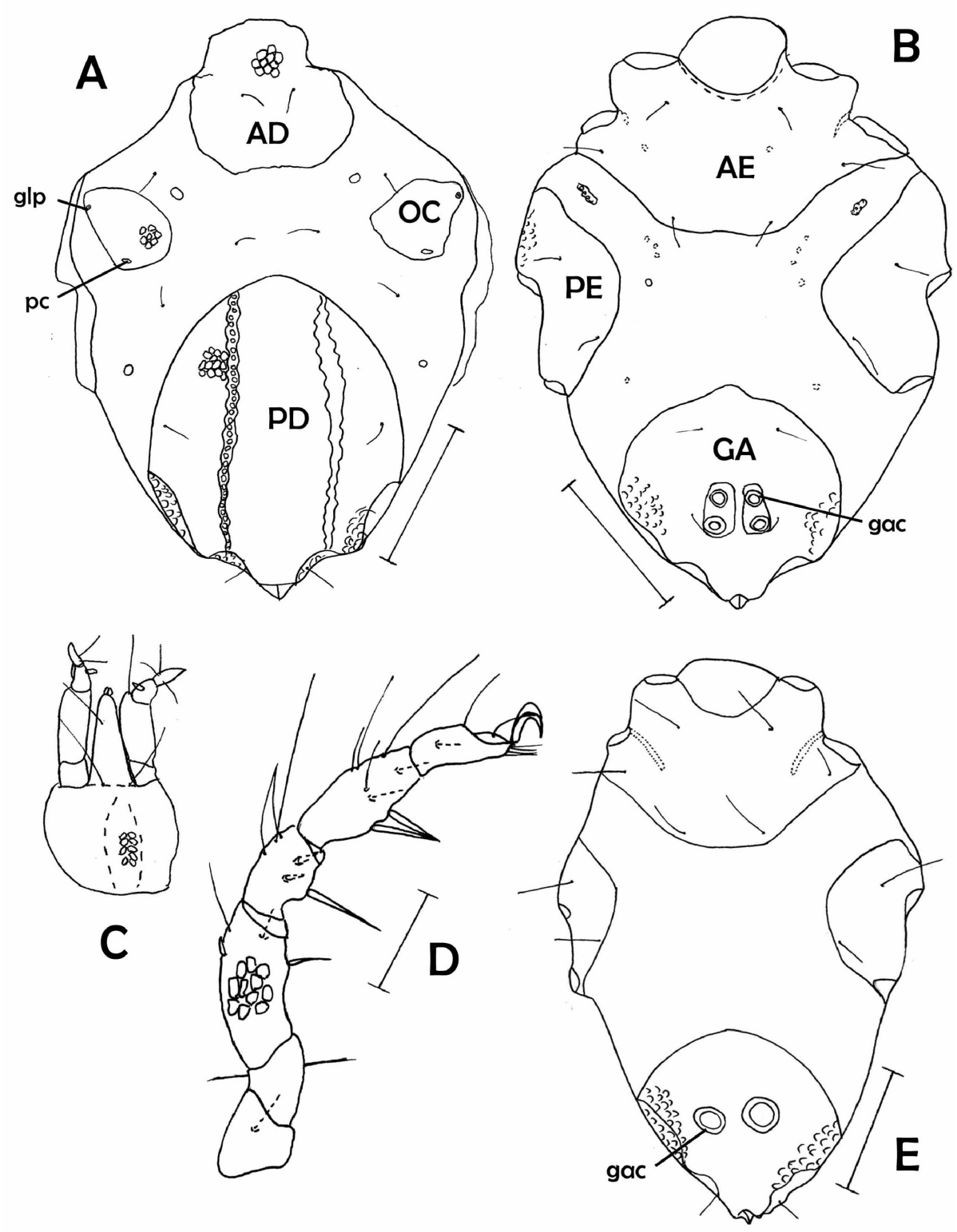

Figure 3. *Halacarellus hyrcanus* (Viets, 1928) (deutonymph) – A. Idiosoma, dorsal view; B. Idiosoma, ventral view; C. Gnathosoma, ventral view; D. Leg I, medial view; E. *H. hyrcanus* (protonymph) – E idiosoma, ventral view. Scale bars: A–C 100 µm, D–E 50 µm.

Genus *Limnohalacarus* Walter, 1917

Limnohalacarus wackeri (Walter, 1914) (Figs. 4A–F, 5)

Material examined

1 ♂, standing water, on sediments and stones, Lake Eğirdir-Isparta, 19 August 2019, coll. F. Durucan.

Morphology and notes

Idiosoma 390 long, 263 wide. AD 82 long, 100 wide. OC divided transversely with cornea and eye pigment. Anterior ocular plate is wider than long. OC 37 long, 61 wide. Post ocular plate slender, triangular 42 long, 25 wide. Pore canaliculi in the distal part of the OC. Setae ds-1 on AD, ds-2 striated in integument, ds-3 on PD. Dorsum with five pairs of gland pores (Fig. 4A). AE with 3 pairs of ventral setae. AE 110 long, 230 wide. PE with one seta dorsally, one laterally. PE 135 long, 63 wide. PD 300 long, 153 wide, 1.9 times longer than wide and anteriorly rounded. GA 217 long, 175 wide. The specimen has 50 pairs of perigenital setae and 7 pairs of genital acetabula (Fig. 4B). Dorsal plates AD, OC and PD reticulated (Fig. 4C). Gnathosoma 93 long, 75 wide, length:width ratio 1.24. First pair of maxillary setae in. Second palp is broadly, basal spur. Palps with four segments, attached dorsally. P-1, 8, short. P-2, 45, enlarged. P-3, 20 and P-4, 35. P-2 with one short and one long seta. P-3 has a spine ventromedially. P-4 with six setae and a large spine (Figs. 4D & E). Leg-I chaetotaxy from trochanter to tarsus: 1, 4, 4, 7, 8, 7. Claws on tarsus I with pectines (Fig. 4F). As mentioned by Bartsch (2006) egg-shaped internal concrement (ic) has observed in the author's species as shown in Figure 5.

This is the first report of this genus and species from Turkey. The morphological characteristics and habitat preferences of the specimens reported here accord with the previous descriptions given by Bartsch (1989, 2001).

Distribution

The genus has a worldwide distribution. At present the genus *Limnohalacarus* contains 13 described species. *Limnohalacarus wackeri* is recorded from northern European and Asian waters, from southern Finland and Kamchatka (Bartsch 2001, 2018). **Present record:** Lake Eğirdir (Isparta).

Genus *Porohalacarus* Thor, 1922

Porohalacarus alpinus (Thor, 1910) (Figs. 6G, H)

Material examined

1 protonymph, slow running water canal, on sediments and stones, Fethiye, Çiftlik, 14 September 2019, coll. F. Durucan.

Morphology and notes

Idiosoma 185 long, 110 wide. Idiosoma slender. Dark spots of eye pigment underneath AD and OC. AD 55 long, 58 wide. OC 25 long, 13 wide. PD 125 long, 70 wide. GA 40 long, 23 wide (Figs. 6G, H). The protonymph specimens are similar to deutonymph and adult ones. The adult and deutonymph of *P. alpinus* previously recorded from standing waters of three different provinces of Turkey by Durucan and Boyacı (2019).

Distribution

The species was described based on only one female for the first time from Norway by Thor in

1910 and afterwards recorded from Europe (from Finland and Iceland to Italy), Black Sea (Turkey) North Africa, North America (United States and Canada), Australia and New Zealand (Bartsch 2009); Madagascar (Bartsch 2018) Turkey: Mehmet Manavoğlu Park (Antalya), Lake Eğirdir (Isparta), Lake Işıklı (Denizli) (Durucan and Boyacı 2019). **Present record:** Fethiye, Çiftlik (Muğla).

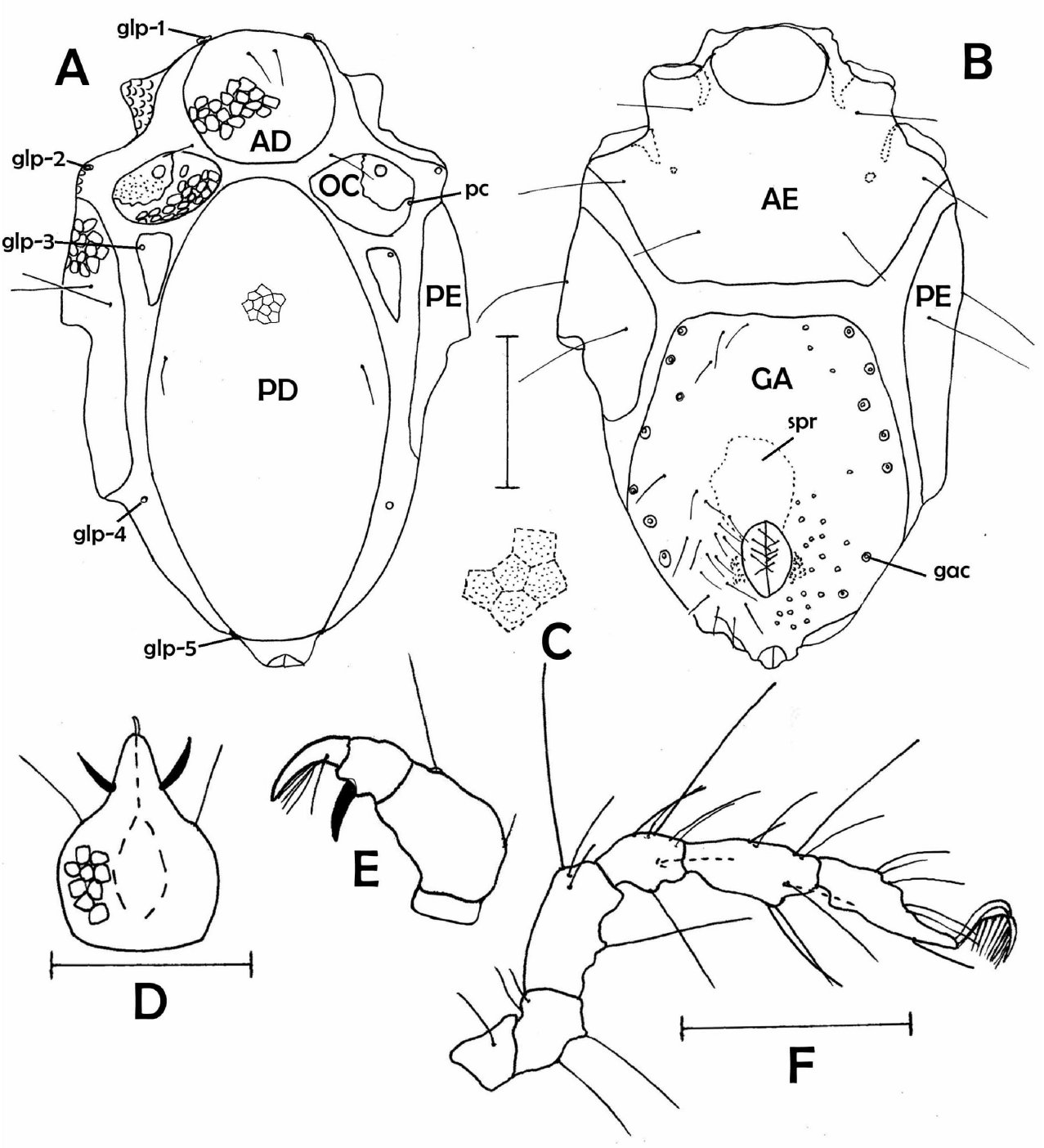

Figure 4. *Limnohalacarus wackeri* (Walter, 1914) (male) – A. Idiosoma, dorsal view; B idiosoma, ventral view; C. reticulation on the plates; D. Gnathosoma, ventral view; E. Palp, lateral view; F. Leg I, medial view. Scale bars: 100 µm.

Figure 5. *Limnohalacarus wackeri* (Walter, 1914) (male) – ic = internal concrement.

Genus *Soldanellonyx* Walter, 1917

Soldanellonyx monardi Walter, 1919 (Figs. 6A–F)

Material examined

2 ♀♀, 1 deutonymph, slow running water canal, on sediments and stones, Fethiye, Çiftlik, 14 September 2019, coll. F. Durucan.

Morphology and notes

Idiosoma of females 375 long, 265 wide. Idiosoma length:width ratio 1.4. Idiosoma colours are light brown. Dorsal plates with faint reticulation. Anterior margin of AD almost truncated. AD 100 long, 90 wide. OC 63 long, 50 wide without corneae. PD 200 long, 113 wide. Dorsum with five pairs of gland pores and five pairs of short dorsal idiosomatic setae. AE with 3 pairs of ventral setae (Fig. 6A). AE 117 long, 212 wide. PE 162 long, 67 wide. GA 114 long, 125 wide and with five pairs of setae (Fig. 6B). Gnathosoma 125 long, 114 wide. Chelicera 125 long. Palp lengths from P1 to P4; 12, 50, 25, 32. Second palpal segment with basal spur and distal seta. Third segment with spine (Figs. 6C, D). Leg segments short. Leg-I chaetotaxy from basifemur to tarsus (solenidia, famuli and

parambulacral setae excluded): 3, 5, 6, 7, 5. Claws in leg I umbrella-shaped (Fig. 6E). Idiosoma of deutonymph 300 long, 180 wide. GA of deutonymph as long as wide (75) (Fig. 6F). This is the first report of this genus from Turkey. The morphological characteristics and habitat preferences of the specimens reported here accord with the previous descriptions given by Bartsch (2001, 2008).

Distribution

The genus *Soldanellonyx* has a worldwide distribution. At present the genus *Soldanellonyx* contains 9 described species (Bartsch 2018). *Soldanellonyx monardi* is recorded from many localities from continental Europe (from north to south), England, Scotland, Ireland, Tunisia, Kenya, Japan, Australia, New Zealand, Hawaiian Islands, Oahu Island, North and South America (Bartsch 2008). **Present record:** Fethiye, Çiftlik (Muğla).

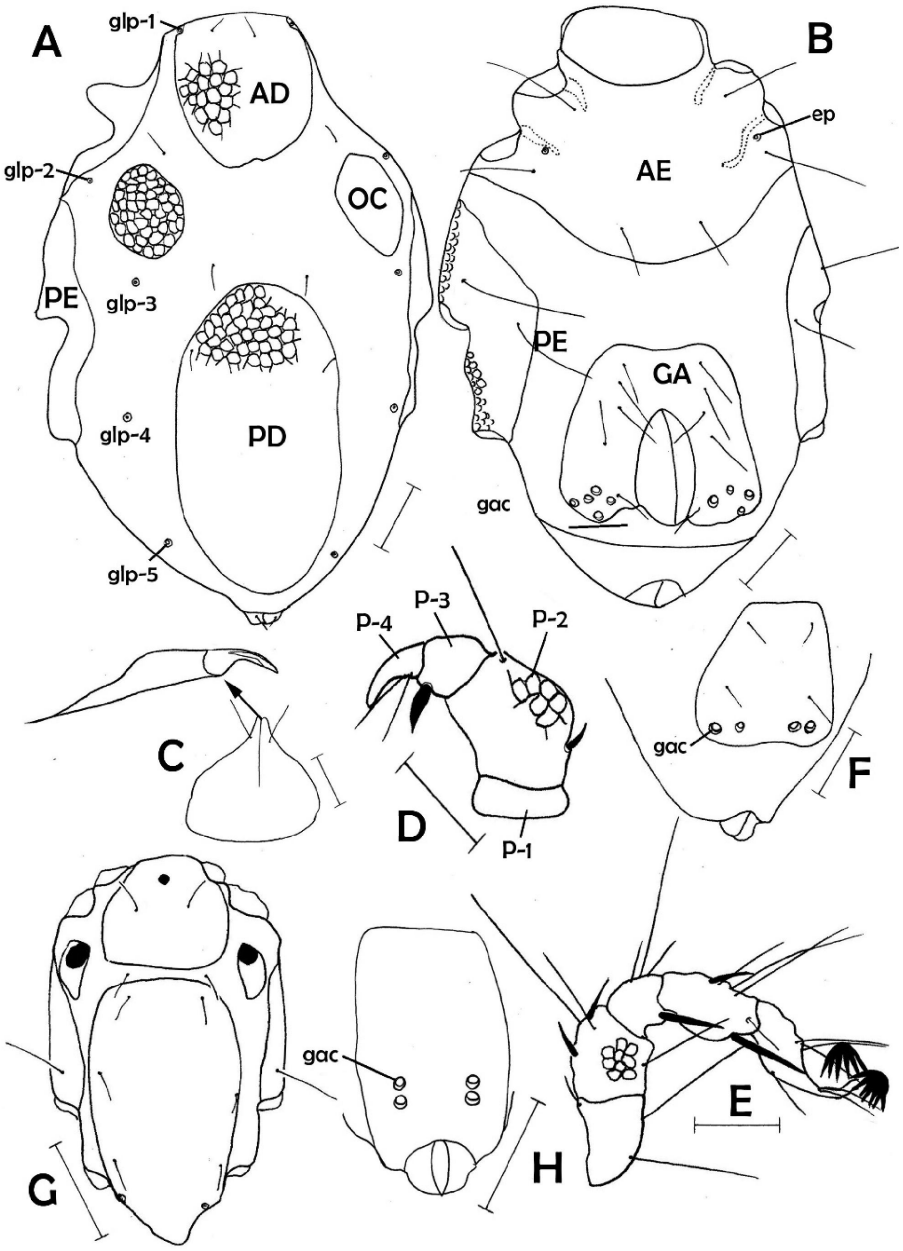

Figure 6. *Soldanellonyx monardi* Walter, 1919 (female) – A. idiosoma, dorsal view; B. idiosoma, ventral view; C. gnathosoma, ventral view and chelicera, lateral view; D. palp, medial view; E. leg I, lateral view; F. Genitoanal plate, deutonymph; G–H. *Porohalacarus alpinus* (Thor, 1910), deutonymph; G. idiosoma, dorsal view; H. Genitoanal plate. Scale bars: 50 µm.

DISCUSSION

The freshwater representatives of the predominantly marine family Halacaridae are poorly known whilst more than 40 of marine halacarid mites have been recorded in Turkey (Durucan 2018b; 2019a, b, c). According to the latest checklist of Erman *et al.* (2019), 335 species of water mites (Acari: Hydrachnidia) are recorded from Turkey but only three freshwater halacarid mites (Acari: Halacaridae) have hitherto been recorded from inland waters of Turkey (Durucan 2018a; Durucan and Boyacı 2019). Including this study, total number of known freshwater halacarid mite species increases from 3 to 5 as shown in Figure 7. Further studies aimed to improve our knowledge of Turkish freshwater halacarid mites should focus on unexplored areas and habitats in Turkey.

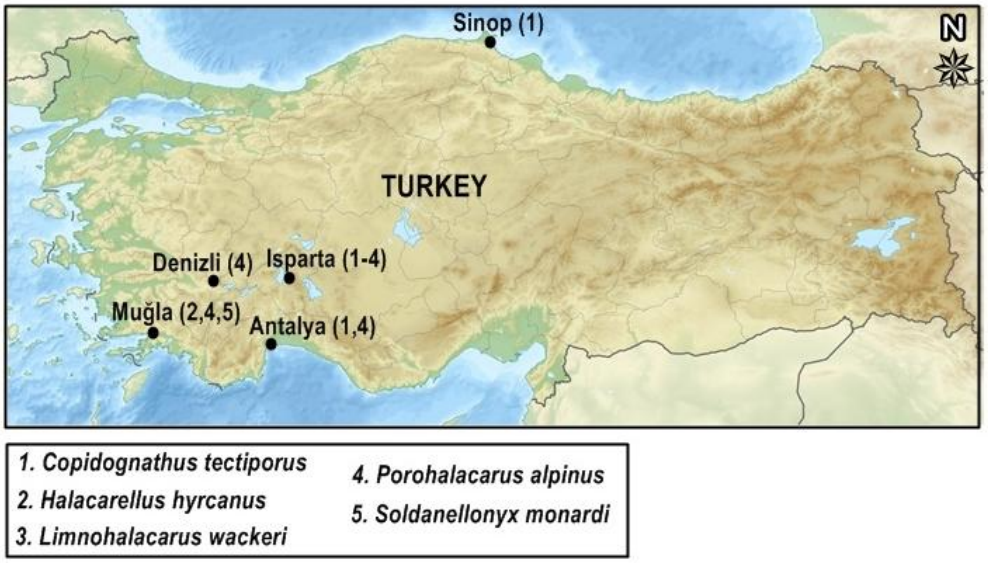

Figure 7. Map of all recorded freshwater halacarid species in Turkey.

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REFERENCES

Bartsch, I. (1989) Süßwasserbewohnende Halacariden und ihre Einordnung in das System der Halacaroidea (Acari). *Acarologia*, 30: 217–239.

Bartsch, I. (1995) *Lobohalacarus subterraneus* n. sp., a freshwater halacarid (Acari: Halacaridae) from New Zealand. *New Zealand Journal of Zoology*, 22: 209–212.

Bartsch, I. (1998) Halacarinae (Acari, Halacaroidea) from the northwestern Black Sea: A review. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 95: 143–178.

Bartsch, I. (2001) Black Sea Copidognathinae (Arachnida, Acari, Halacaridae): A review. *Mitteilungen aus dem Museum für Naturkunde in Berlin, Zoologische Reihe*, 77: 247–275.

Bartsch, I. (2004) The Black Sea halacarid fauna (Halacaridae, Acari): faunal comparison with the Mediterranean, eastern North Atlantic, North Sea, and Baltic and reflection on its origin. *Museum für Naturkunde in Berlin*, *Zoologische Reihe*, 80(2): 143–158.

Bartsch, I. (2006) Acari: Halacaroidea. *In*: Gerecke R. (Ed.), Süßwasserfauna von Mitteleuropa 7/2-1, *Chelicerata: Araneae, Acari I*. Elsevier, Spektrum, Heidelberg, pp. 113–157.

Bartsch, I. (2007) The freshwater mite *Porolohmannella violacea* (Kramer, 1879) (Acari: Halacaridae), description of juveniles and females and notes on development and distribution. *Bonner zoologische Beitrage*, 55: 47–59.

Bartsch, I. (2008) Global diversity of halacarid mites (Halacaridae: Acari: Arachnida) in freshwater. *Hydrobiologia*, 95: 317–322.

Bartsch, I. (2009) Checklist of marine and freshwater halacarid mite genera and species (Halacaridae: Acari) with notes on synonyms, habitats, distribution and descriptions of the taxa. *Zootaxa*, 1998: 1–170.

Bartsch, I. (2018) Freshwater halacarid mites (Acari: Halacaridae) from Madagascar-new records, keys and notes on distribution and biology. *Bonn zoological Bulletin*, 67(2): 79–99.

Chatterjee, T. & Chang, C.Y. (2005) A new species of *Limnohalacarus* (Acari: Halacaridae) from India. *Bulletin Institut Royal des Sciences Naturelles de Belgique, Entomologie*, 75: 23–27.

Durucan, F. (2018a) First record of *Copidognathus tectiporus* Viets, 1935 (Halacaridae, Acari) from the Lake Eğirdir, Isparta, Turkey. *Acta Biologica Turcica*, 31(1): 1–5.

Durucan, F. (2018b) New record of the genus *Scaptognathus* (Acari: Halacaridae) from Antalya with a checklist of marine halacarid mites of Turkey. *Turkish Journal of Zoology*, 42(4): 499–507.

Durucan, F. (2019a) New halacarid records from Antalya, Turkey (Acari, Halacaridae). *Munis Entomology & Zoology*, 14(1): 270–282.

Durucan, F. (2019b) New records of *Copidognathus* (Acari: Halacaridae) from Antalya, Turkey. *Persian Journal of Acarology*, 8(3): 189–210.

Durucan, F. (2019c) New records of halacarid mites (Acari: Halacaridae) from the Levantine coast of Turkey. *Ege Journal of Fisheries and Aquatic Sciences*, 36(4): 329–336. DOI: 10.12714/egejfas.36.4.03

Durucan, F. & Boyacı, Y.Ö. (2019) Contribution to the knowledge of freshwater halacarid mites (Acari: Halacaridae) from Turkey. *Acta Aquatica Turcica*, 15(3): 318–324.

Erman, O., Gülle, P., Özkan, M., Candoğan, H. & Boyacı, Y.Ö. (2019) Checklist of the water mites (Acari: Hydrachnidia) of Turkey: First supplement. *Zootaxa*, 4686(3): 376–396.

Johnston, G. (1836) Illustrations in British zoology. *Magazine of Natural History*, 9(63): 353–357.

Kramer, P. (1879) Ueber die Milbengattungen *Leptognathus* Hodge, *Raphignathus* Dug., *Caligonus* Koch und die neue Gattung *Cryptognathus*. *Archiv für Naturgeschichte*, 45: 142–157.

Thor, S. (1910) Die erste norwegische Süßwasserform der Halacariden. *Zoologischer Anzeiger*, 36: 348–351.

Viets, K. (1928) Wassermilben aus dem Schwarzen Meer, dem Kaspischen Meer und dem Aral-See. *Abhandlungen Naturwissenschaftlicher Verein zu Bremen*, 27: 47–80.

Walter, C. (1914) Notizen über die Süßwasserformen der Halacariden nebst Beschreibung einer neuen Art. *Archiv für Hydrobiologie*, 9: 279–285

Walter, C. (1919) Schweizerische Süßwasserformen der Halacariden. *Revue de Suisse Zoologie*, 27: 235–242.

دو جنس جدید *Limnohalacarus* و *Soldanellonyx* (Acari: Halacaridae) در کنه‌های هالاکارید آب شیرین همراه با گزارش‌های جدید از ترکیه

فورکان دوروکان

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چکیده

در این بررسی، کنه‌های هالاکارید آب شیرین از دو استان گوناگون (ایسپارتا و موغلا) ترکیه جمع‌آوری شدند. گونه‌های *Limnohalacarus wackeri* (Walter, 1914) و *Soldanellonyx monardi* Walter, 1919 برای نخستین بار برای فون کنه‌های هالاکارید آب شیرین ترکیه گزارش می‌شوند. افزون بر این، مراحل پورگی *Halacarellus hyrcanus* (Viets, 1928) و پورهٔ سن دوم *Porohalacarus alpinus* (Thor, 1910) برای نخستین بار از دریاچهٔ اغیردیر، اسپارتا نیز گزارش می‌شوند. هر گونه ترسیم شده و ویژگی‌های مشخصه همراه با یادداشت‌هایی آورده شده و همهٔ گونه‌های هالاکارید آب شیرین روی نقشهٔ ترکیه نشان داده شدند.

واژگان کلیدی: جغرافیای زیستی؛ Halacaroidea ؛ گزارش‌های جدید؛ پوره‌ها؛ آرایه‌شناسی.

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