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The ground beetle tribe Trechini in Israel and adjacent regions

(Coleoptera, Carabidae)

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Based on the study of approximately 700 specimens, we give an overview of the systematics and taxonomy, distribution, dispersal power, and habitat preference of the ground beetles belonging to the tribe Trechini in Israel. We provide an identification key to all Trechini species in Israel (and the adjacent regions in Lebanon, Syria, Jordan and Egypt), supported by photographs of species with verifiable records. *Trechus dayanae* spec. nov., a member of the *Trechus austriacus* group, is described from the Golan Heights and Mount Hermon. The new species is similar to *Trechus pamphylicus* but can be distinguished by its colour, microsculpture, length of antennae, shape of pronotum, and characteristics of the aedeagus. Type material of *Trechus labruleriei* and *Trechus libanenis* was studied and photographed. The species rank of *T. labruleriei* (stat. nov.) is re-established. At least five species of Trechini occur in Israel *(Perileptus stierlini*, *Trechus crucifer*, *T. quadristriatus*, *T. dayanae* spec. nov., and *T. saulcyanus)*; for three further species *(Perileptus areolatus*, *Trechoblemus micros*, *Trechus labruleriei)* we are not aware of any verifiable records, but past, or current, occurrence of the species is possible; the published record of *Trechus libanensis* from Israel was, beyond a doubt, a misidentification.

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Introduction

Trechini is one of the largest ground beetle tribes on Earth, comprising circa 3000 described species. Its nominate genus, *Trechus* Clairville, 1806, which contains more than 800 described species, shows the enormous diversity of the trechine ground beetles (Casale & Laneyrie 1982, Moravec et al. 2003, Lorenz 2005). Most members of the tribe show a restricted distribution range, occurring in mountainous, and especially in subterranean and high-altitude, habitats. This tribe even includes those species which occur at the highest altitudes at which ground beetles are found (about 5600 m a.s.l., Schmidt 2009). These ecological and evolutionary constraints have led to an extraordinarily high degree of endemism (Holdhaus 1954, Moravec et al. 2003).

Some decades ago endemism as exemplified by the numerous trechine beetles played an important role in historical biogeography (e. g. endemism as an indicator for glacial refugia: Holdhaus 1954). After a period of a lack of interest in distribution patterns of endemic species, in recent years studies on endemics have celebrated a revival due to the important role they play in macroecology, phylogeography and conservation biology (e. g. Ohlemüller et al. 2008, see for ground beetles: Christman et al. 2005, Culver et al. 2006, Schuldt & Assmann 2009, Faille et al. 2010). In particular, the strong correlation between the distribution patterns of endemics and overall biodiversity highlight the importance of endemism for the identification of biodiversity hotspots and contemporary approaches to identifying responsibilities for the protection of biodiversity (cf. Myers et al. 2000, see for ground beetles: Schuldt & Assmann 2010).

As such a large number of trechine ground beetles are endemic species, they have the potential to be an important indicator taxon for biodiversity (cf. Schuldt & Assmann 2011). However, if they are to serve as such, a systematic and faunistic inventory is needed, also of hitherto less well-studied regions. In the Palaearctic, these regions include the countries of the Levant, among them Israel (Schuldt et al. 2009). Only few trechine taxa are known from the summer-dry region of the Mediterranean area (cf. Moravec et al. 2003); the semi-desert and desert region of the Middle East seems to be extremely poor in species (cf. Britton 1948, Pawłowski 1979, Felix 2009). However, unusual collecting methods such as litter sieving and pitfall trapping in endogeic and subterranean habitats have recently been the source of some new records (including a new species). Therefore the time seems to be ripe for a faunistic and taxonomic overview of Israel's Trechini species. In addition to taxonomic and faunistic information we also provide as a service for non-taxonomists an identification key with photographs. Short descriptions of the power of dispersal, habitat selection, reproduction seasonality, and distribution range for each species should help to stimulate further carabidological studies in the studied region.

Material and methods

Collections, distribution records

This study is based on the examination of specimens collected during (i) the authors' field trips to Israel, Jordan and Egypt, (ii) ecological and conservation biological surveys (e. g. Buse et al. 2008, Timm et al. 2008, Timm et al. 2009, Buse et al. 2010), and/or (iii) specimens stored in entomological collections (incl. historical collections). We studied approximately 700 trechine individuals from Israel, Jordan, Lebanon and Syria. Individuals of all species of the *Trechus austriacus* Dejean, 1831 group known from the Levant were examined, including holotypes with the exception of *T. polonorum* Pawłowski, 1979, *T. maceki* Deuve, 1992, and *T. crucifer* Piochard de la Brûlerie, 1876.

The material is stored in the following collections:

- CAB Working collection Assmann, Bleckede, Germany (part of the Zoological State Collection Munich, ZSM, Germany)
- CBL Working collection Buse, Landau, Germany
- CHD Working collection Hetzel, Darmstadt, Germany
- COK Collection Orbach, Kiryat Tiv'on, Israel (will be transferred to TAU, Israel)
- CSW Collection Starke, Warendorf, Germany (will be transferred to Westfälisches Landesmuseum Münster, Germany)
- CWB Working collection Wrase, Berlin, Germany (part of the Zoological State Collection Munich, ZSM, Germany)
- TAU National Collections of Natural History, Tel Aviv University, Tel Aviv, Israel
- NHMP Entomology Department, National History Museum Paris (Muséum National d'Histoire Naturelle Paris), Paris, France
- ZSM Zoological State Collection Munich (Zoologische Staatssammlung München), Munich, Germany

Where possible the nomenclature follows the last Palaearctic catalogue or the world list of ground beetles (Löbl & Smetana 2003, Lorenz 2005).

Measurements and photography

Total body length (BL) is measured from the tip of the mandibles to the apex of the right elytron as the maximum linear distance; the width of the head (HW) as the maximum linear distance across the head, including the compound eyes; the length of the pronotum (PL) from the anterior to the posterior margin along the midline; the length of the elytra (EL) from the basal margin to the apex of the right elytron as the maximum linear distance; the width of the pronotum (PW) and elytra

(EW) at their broadest point; the width of the pronotal base (PBaW) between the tip of the hind angles at insertion of seta.

These measurements, made at magnifications between 32× and 60×, using an ocular micrometer in a Leica MZ 95 stereobinocular microscope, were combined as ratios as follows:
PW/PL: width/length of pronotum,
PW/PBaW: width of pronotum/width of the pronotal base, and
EW/EL: length/width of elytra.

Microsculpture was examined at a magnification of 100×. Dissections were made using standard techniques; genitalia were preserved in "Lompe mixture" (Lompe 1989) or Euparal on acetate labels, and pinned beneath the specimens from which they had been removed. The photographs were taken with an Olympus E-330 digital camera in combination with a Leitz MZ 95 or with a Zeiss Discovery V20 in combination with a Power Shot G9 camera. To achieve sufficient depth of focus, up to 40 planes were captured; these were copied to separate layers, and the out of focus planes are masked by a stacking programme (Combine Z5).

Dispersal power

We dissected up to 20 individuals per species to determine hind wing development (brachyptery and macroptery; e. g. Desender 1989a). Where records from light trap or flight interception trap surveys have been published (e. g. Chikatunov et al. 2006, Müller at al. 2006, Buse et al. 2010, including unpublished by-catches) these are mentioned. Presumably, being caught in light or flight interception traps implies the ability to fly and contradictions between the published catches and brachyptery are discussed.

Habitat selection

Information about the habitats of the species is taken from the ecological surveys (traps but also hand picking) and/or the literature (e. g. Chikatunov et al. 2004, Timm et al. 2008, 2009). The nomenclature of the habitats follows Danin (1988) and the cited literature.

Phenology

For some species we summarize the seasonality of the catches (larger series in the collections and/or automatic trap catches) and – if possible – the reproduction cycle. Any records of newly hatched beetles (e. g. with soft exoskeleton) are also mentioned.

Distribution data

The distribution data for the species' ranges are taken from the Palaearctic Catalogue of ground beetles (Moravec et al. 2003), further literature (e. g. Pawłowski 1979, Moravec & Zieris 1998), and, especially for Israel, the largely unpublished data from museum collections (especially TAU). The characterization of the distribution range within Israel follows several publications on geographical and climate regions (Jaffe 1988, Klein 1988, Yom-Tov & Tchernov 1988). However, we use "Mediterranean climate region" instead of "temperate climate region" (for the areas where the climate is subject to strong Mediterranean influence) to avoid confusion with other literature about climate zones (cf. Jaffe 1988).

Results

Identification key to the Trechini species from Israel and adjacent regions of Egypt, Jordan, Lebanon and Syria

The following identification key incorporates all trechine species known from Israel. The Trechini fauna of the Near East is only poorly studied. As we cannot exclude the possibility that some species known from adjacent regions in Lebanon, Syria and Jordan also occur in Israel, they are included in the key. Not incorporated are *Trechus maceki* Deuve, 1992, and *Duvalius phoenicinus* Vigna Taglianti, 1973, which are endemic species of restricted regions in Syria and Lebanon, respectively (Deuve 1992, Vigna-Taglianti 1973). Species without verifiable records from Israel are given in parentheses.

Species from the Levant can be easily identified as members of the Trechini tribe by one of the two following combinations of features: (1) Occurrence of a "*Trechus* groove", i. e. the sutural stria of elytron recurrs at the apex along the outer margin, in combination with a well-developed terminal palpomere of maxillary palps (Figs 24 and 130 in Lindroth 1985f). (2) Eyes with small hairs (50× magnification) in combination with narrow terminal palpomere of maxillary palps (Fig. 128 in Lindroth 1985f). Moreover, trechine beetles are small (less than 6 mm in the Levant) and their habitus is characteristic. The photographs presented here (Figs 1-4) provide further help in identification.

1 Eyes with small hairs (suggested magnification >60×). Terminal palpomere of maxillary palp narrow. Sutural stria of elytron not recurrent at apex. Elytra parallel-sided. Small, BL <2.7 mm. 2

– Eyes without hairs. Terminal palpomere of maxillary palp well developed. Sutural stria of elytron recurrent at apex along outer margin (so-called "*Trechus* groove", as in many Tachyina species). Elytra at least slightly rounded. Longer, BL >2.7 mm. 3

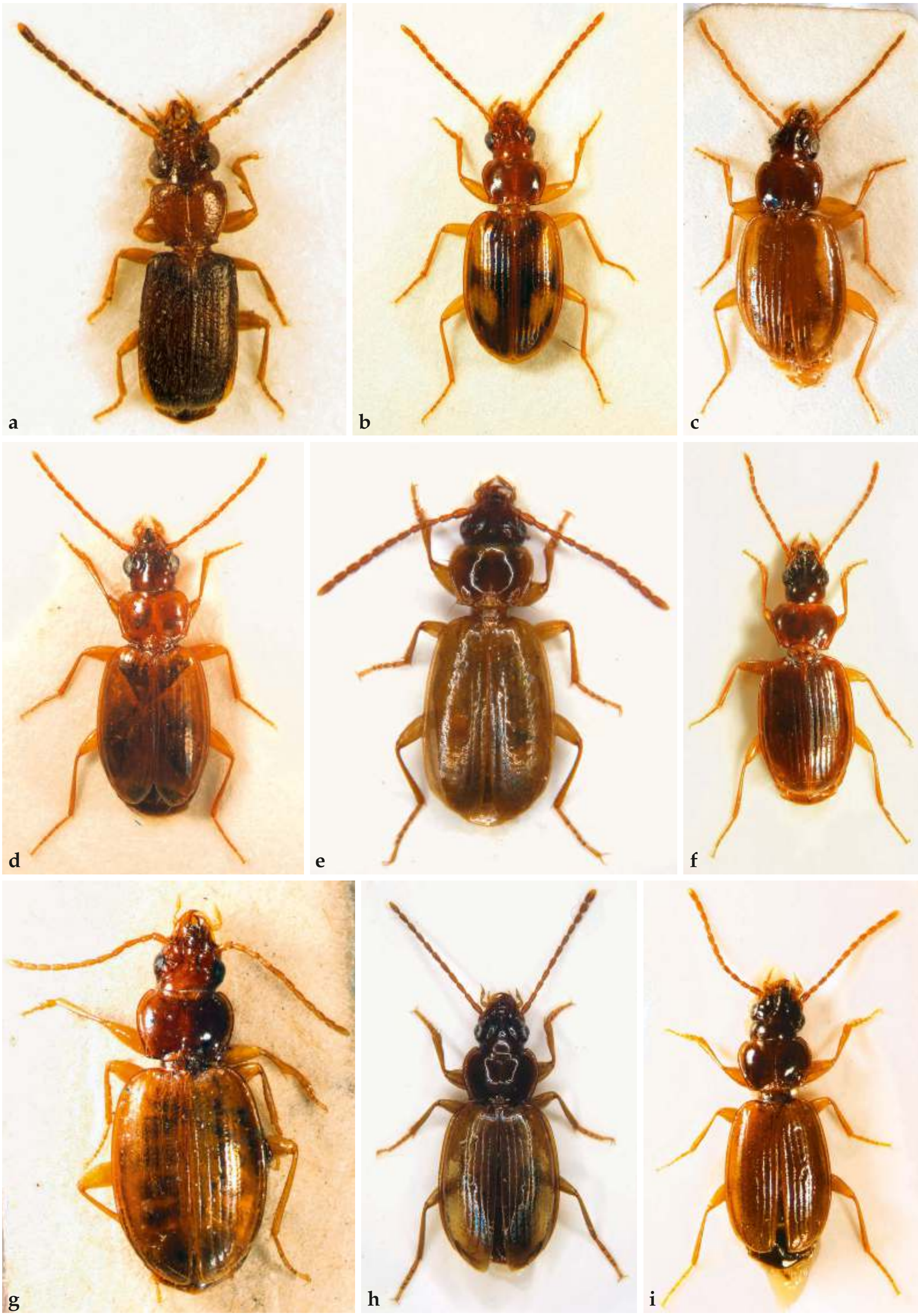
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Fig. 2. *Trechus dayanae* spec. nov., male (Paratype: Israel, Golan Heights, Merom Golan).

Fig. 3. *Trechus dayanae* spec. nov., female (Paratype: Israel, Golan Heights, Merom Golan).

2 Longer, BL 2.3–2.6 mm. Wider. Eyes smaller. Dark brown to piceous, base of antennae, mouthparts, legs and a longitudinal spot on each elytral disc pale. .... (1. *Perileptus areolatus* (Creutzer, 1799))

– Smaller, BL 1.9–2.3 mm. More slender. Eyes larger. Body red-brown to pale brown, basal antennomeres, mouthparts and legs pale, head, elytra and apical antennomeres sometimes darker (Fig. 1a). .... 2. *Perileptus stierlini* Putzeys, 1870

3 Elytra and pronotum with fine, depressed pubescence. Eyes reduced. Recurrent elytral sutural stria (so-called *Trechus* stria) at apex joining with 3rd stria. Testaceous to brownish, usually centre of head and a diffuse longitudinal dark spot on each elytron darker, appendices somewhat brightened. BL 4–4.5 mm. .... (3. *Trechoblemus micros* (Herbst, 1784))

– Elytra and pronotum glabrous, except for dorsal punctures. 4

◁ **Fig. 1.** Habitus of **a.** *Perileptus stierlini* (Israel, Sea of Galilee); **b.** *Trechus crucifer* (Israel, Ya'ar Bar'am); **c.** *Trechus asiaticus* (Turkey, Kocain-Magarasif/Bucak); **d.** *Trechus quadristriatus* (Israel, Hermon); **e.** *Trechus libanensis* (Lebanon, between Aïnâta and Bcharré, 2500 m); **f.** *Trechus saulcyanus* (Israel, Upper Galilee, Nahal Bezet); **g.** *Trechus labruleriei* (Type: <Balghar Dagh>, <Caraman.>, <J. Sahlb.>, <Type>, <Museum Paris / Coll. R. Jeannel, 1931>, <la Bruleriei / n. sp.>); **h.** *Trechus labruleriei* (Turkey, Beyşehir-Gölu, 1200 m); and **i.** *Trechus pamphylicus* (Antakya, Iskenderon).

4 Elytra pale, with both basal or marginal and preapical spot, usually separated by a transverse dark fascia. 5

– Elytra without spots, pale to dark brown, sometimes brightened at the margin and along the suture. 6

5 Small, BL 2.8–3.7 mm. Humeral elytral spot (located near the shoulder) smaller, restricted to the front half, preapical spot larger. Head slender and pronotum relatively small, hind angles of pronotum pronounced. Surface with microsculpture, only slightly iridescent. Punctation of elytral striae strong, inner intervals convex. Reddish-brown to dark brown, basal antennomeres, legs and mouthparts pale, often yellow (Fig. 1b). Aedeagus (Fig. 4a). .... 4. *Trechus crucifer* Piochard de la Brûlerie, 1876

– Larger, BL 4.0–5.2 mm. Marginal elytral spot large and as a rule long, reaching from the shoulder to the apical third; preapical spot small and rounded. Head and pronotum relatively large, hind angles of pronotum small. Microsculpture finer, surface has an iridescent shine. Punctation of elytral striae weaker, intervals flat (Fig. 1c). .... (5. *Trechus asiaticus* Jeannel, 1927)

6 At least 5 striae recognizable on the elytra. 7

– Only 3 inner striae easily recognizable, the 4th weaker, the 5th not recognizable; BL ~3.7 mm; brachypterous. Described from Bikfaia (Libanon), no further records known. .... (6. *Trechus polonorum* Pawłowski, 1979)

7 Pronotum with rounded posterior angles, somewhat blunt, base laterally oblique. Aedeagus well characterized (Fig. 4b). Elytral striae weekly punctated, intervals flat. Body yellow to brownish, head and basis of elytra often darkened (Fig. 1d). BL 3.0–4.7 mm. .... 7. *Trechus quadristriatus* (Schrank, 1781) (syn. *syriacus* Putzeys, 1870)

– Base of pronotum straight or laterally slightly oblique, posterior angles of pronotum right (Figs 2a–d). Shape of aedeagus and copulatory piece(s) different (Figs 6c–g). 8

8 Aedeagus long, slender, apex curved (Figs 6c,d). Brownish. BL ~3.5 mm (Figs 1e, 4c,d). .... (8. *Trechus libanensis* Piochard de la Brûlerie, 1876)

– Aedeagus shorter (Figs 4e–g). 9

9 Copulatory piece of aedeagus long, approximately half of total aedeagus length (Fig. 4g). Further information: see description (Figs 2, 3). BL 2.8–3.5 mm. .... 9. *Trechus dayanae* spec. nov.

– Copulatory piece of apex shorter (Figs 4e,f). 10

10 Apex of aedeagus acuminate; copulatory piece of aedeagus with pointed apex (Fig. 4e); Eyes convex. Elytra with prominent shoulders, sides less convex, striae weakly impressed and intervals flatter. Head and pronotum with clearly visible microsculpture (suggested magnification: 60×), elytra with very fine, transverse meshes (causing distinct iridescence). Body brownish (sometimes piceous), basal antennomeres, mouthparts, legs and sometimes margins of pronotum and elytra brightened (Fig. 1f). BL 3.5–4 mm. .... 10. *Trechus saulcyanus* Csiki, 1928 (syn. *saulcyi* Jeannel, 1921)

– Apex of aedeagus rounded; copulatory piece of aedeagus with rounded apex (Fig. 4f); Eyes subconvex. Shoulders strongly rounded, sides of the elytra more or less convex. Microsculpture weaker, especially on frons, iridescence of elytra weaker. Body yellow-brownish, head and pronotum often darkened (Figs 1g,h). BL 3.8–5.0 mm. ... (11. *Trechus labruleriei* Jeannel, 1921)

Remarks on the species

1. *Perileptus areolatus* (Creutzer, 1799)

Dispersal power: Macropterous, flight active.

Habitat selection: Inhabitant of river and stream banks, especially those with gravel and stones, rarely on clay or sand.

Phenology: Reproduction in Central Europe from spring to summer, summer larvae.

Distribution range: From Europe and North Africa to Iran and Saudi-Arabia, also in Turkey, Cyprus, and Syria (Moravec et al. 2003, Austin et al. 2008) but not in Egypt (Alfieri 1976).

Distribution in Israel: Listed for Israel (e.g. Bodenheimer 1937, Moravec et al. 2003, Chikatunov et al. 2006) but no verifiable record in TAU. The species probably occurred in Galilee, Samaria, Judean Mountains and Golan Heights in the past and may still occur there (e.g. Nahal Kziv). In spite of painstaking efforts, we are not able to cite a population from Israel. The destruction of most streams and rivers in Israel during recent decades may be the reason for the species' possible decline or extinction.

2. *Perileptus stierlini* Putzeys, 1870

Dispersal power: Macropterous, flight active.

Habitat selection: Close to water, especially running water, mainly in open and semi-open habitats (e.g. banks of streams and rivers, Fig. 9), sometimes very abundant (several dozens of individuals per m^2), often accompanied by *Apristus jaechi* Kirschenhofer, 1988, *Abacetus quadripustulatus* Peyron, 1858 and/or *Bembidion atlanticum* s.l. Wollaston, 1854.

Phenology: Abundant in late autumn (after first rainfall), winter and spring; some individuals also during summer.

Distribution range: Known only from Egypt (Sinai) and Israel (Peyerimhoff 1907, Nitzu 1997, Moravec et al. 2003) but highly probable that it also occurs at least in Syria and Jordan.

Distribution in Israel: Exclusively along the Rift Valley from Galilee (Jordan River, Sea of Galilee) to Dead Sea Area (e.g. Nature Reserve En Gedi).

3. ***Trechoblemus micros*** **(Herbst, 1784)**

Dispersal power: Macropterous, flight active.

Habitat selection: A subterranean species in moist habitats (e. g. on banks of streams and rivers, in wet meadows), in humid cellars and bunkers. Many specimens were caught in burrows of small mammals.

Phenology: Reproduction in Europe during summer and autumn, winter larvae (Lindroth 1945).

Distribution range: From Europe to eastern Siberia and southwards to Turkey. Not known from adjacent countries.

Distribution in Israel: Listed by Chikatunov et al. (2006) for Israel but no verifiable record in TAU. One old record (labelled: Jerusalem, Reitter) appears to refer to Israel but mislabeling cannot be excluded. Another individual (labeled: <ISRAEL: / Nahal Neqarot / 19.III.1999 / I. Yarom & / V. Kravchenko>, <*Trechoblemus* / *micros* / det V. Chikatunov 1999>) refers to *Psammodromius noctivagus* Peyerimhoff, 1927 (which is the first record of this species for Israel).

4. ***Trechus crucifer*** **Piochard de la Brûlerie, 1876**

Dispersal power: Macropterous, flight active.

Habitat selection: Woodlands (e. g. Fig. 10), near fresh water, cave entrances, cellars.

Phenology: Tenerals from February to May but also during late autumn and summer, probably mainly an autumn breeder with winter larvae.

Distribution range: From Bulgaria, some Greek Islands, and Turkey to the Levant (Israel, Lebanon, Syria and Jordan), including Cyprus (Moravec et al. 2003, Austin et al. 2008).

Distribution in Israel: Widespread and abundant, from Upper Galilee and Mount Hermon (up to about 2000 m a.s.l.) southwards to Northern Negev (Be'er Sheva, Habsor Road).

5. ***Trechus asiaticus*** **Jeannel, 1927**

Dispersal power: Hindwings dimorphic, most specimens macropterous.

Habitat selection: Woodlands, moist open land, near fresh water, cave entrances.

Phenology: unknown.

Distribution range: Asia Minor, southwards up to Lebanon (Jabal Lubnan).

Distribution in Israel: No record from Israel.

7. ***Trechus quadristriatus*** **(Schrank, 1781)**

Dispersal power: Hindwings dimorphic (in the Middle East predominantly winged specimens).

Habitat selection: Eurytopic species in meadows, arable land and woodlands, sometimes abundant. From about 200 m b.s.l. (Sea of Galilee) to about 2100 m a.s.l. (subalpine altitudes of Mount Hermon).

Distribution range: Widely distributed in Europe and Asia, introduced in North America. In the Levant: Egypt (Nile Delta), Israel, Jordan, Lebanon, Syria, also in Cyprus (Alfieri 1976, Austin et al. 2008, Moravec et al. 2003).

Distribution in Israel: Widely distributed, especially in the north. Probably not south of the Dead Sea Region and Central Negev.

8. ***Trechus libanensis*** **Piochard de la Brûlerie, 1876**

Dispersal power: Brachypterous. Habitat selection: Subalpine and alpine altitudes, at the edge of snow fields.

Phenology: unknown, most specimens collected in spring and early summer.

Distribution range: Lebanon ("Chaîne du Liban").

Distribution in Israel: Listed by Chikatunov et al. (2006) for Israel (in light traps) but no verifiable record in TAU. Dubious record, as this wingless beetle is not able to fly.

9. ***Trechus dayanae*** **spec. nov.**

Dispersal power: Brachypterous. Habitat selection: Woodlands and pastures above ~ 1000 m a.s.l. (see below).

Phenology: Probably winter larvae, in higher altitude development may be interrupted by frost periods.

Distribution in Israel: Known exclusively from Mount Hermon and Golan Heights.

10. ***Trechus saulcyanus*** **Csiki, 1928**

Dispersal power: Macropterous.

Habitat selection: Litter of deciduous woodlands (e. g. Fig. 10) and in other moist and / or humid habitats (e. g. dolines, cave entrances).

Phenology: Tenerals from March to May, probably an autumn breeder with winter larvae.

Distribution range: From Turkey to the Levant (Egypt, Israel, Jordan, Lebanon, Syria), also in Cyprus (Austin et al. 2008).

Distribution in Israel: In Israel up to now known only from Upper and Lower Galilee, no records from the Golan Heights.

11. ***Trechus labruleriei*** **Jeannel, 1921**

Hindwing development: Hindwings dimorphic (macropterous and brachypterous).

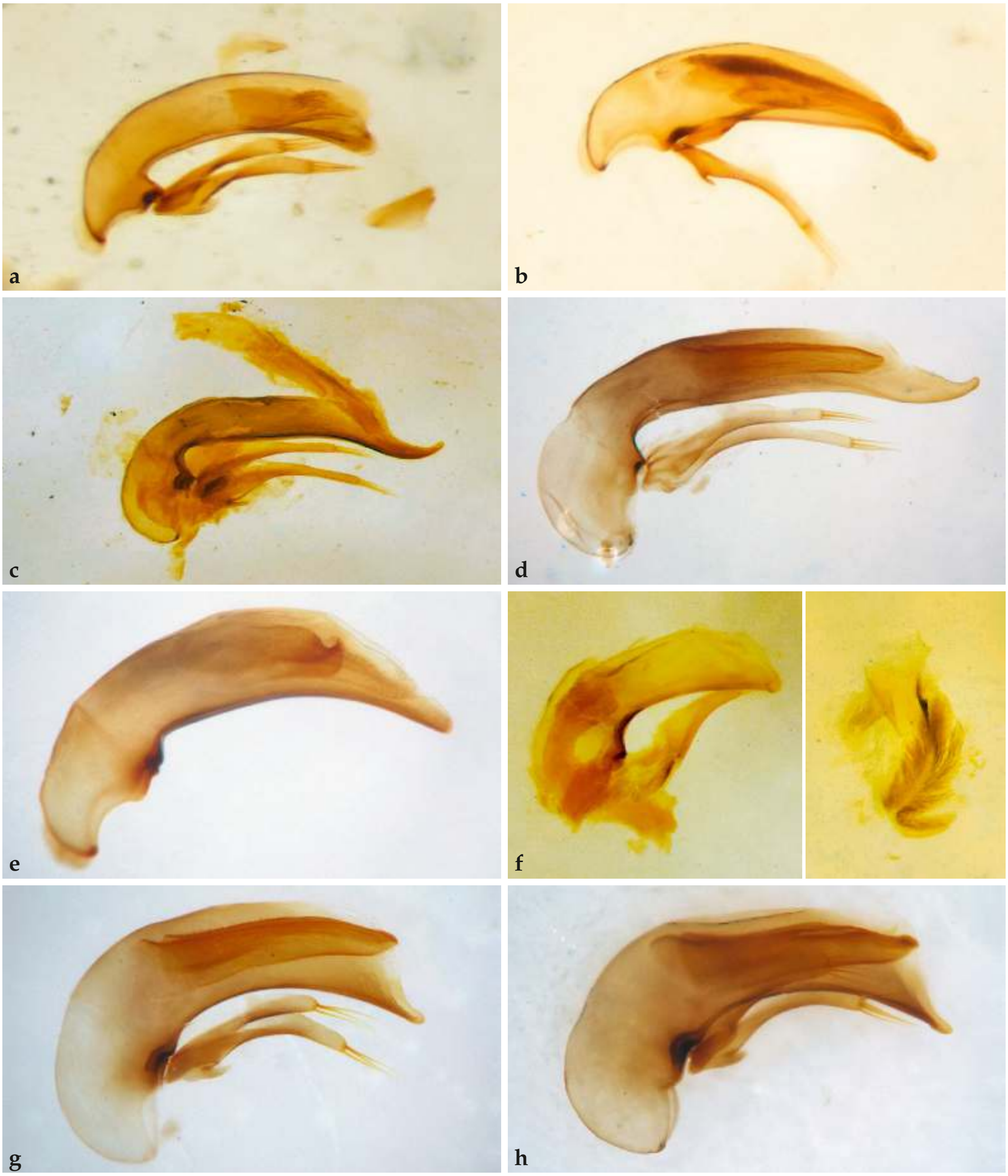

Fig. 4. Male genitalia (median lobus) of **a.** *T. crucifer*; **b.** *T. quadristriatus*; **c.** *T. libanensis* (holotype); **d.** *T. libanensis*; **e.** *T. saulcyanus*; **f.** *T. labruleriei* (holotype, left: median lobus and parameres, right: copulatory pieces); **g.** *T. dayanae* spec. nov. (paratype); and **h.** *T. pamphylicus*.

Habitat selection: In southern Turkey an inhabitant of woodland litter and cave entrances.

Phenology: unknown.

Distribution range: Known from Turkey (the record from Jordan may be misidentified, see below under taxonomic notes).

Distribution in Israel: No record.

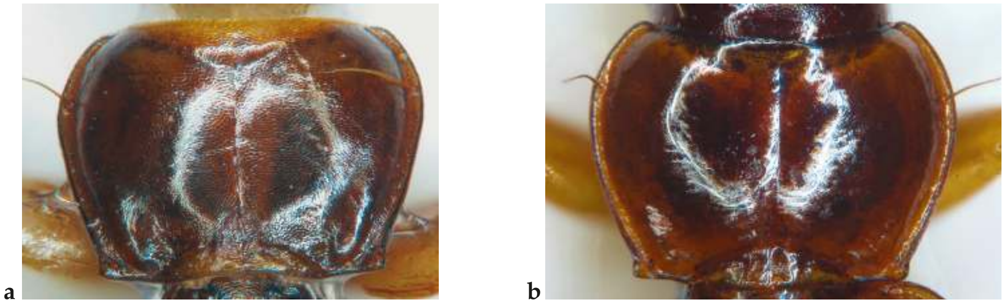

Fig. 5. Pronotum of *T. dayanae* spec. nov. (**a**) and *T. pamphylicus* (**b**).

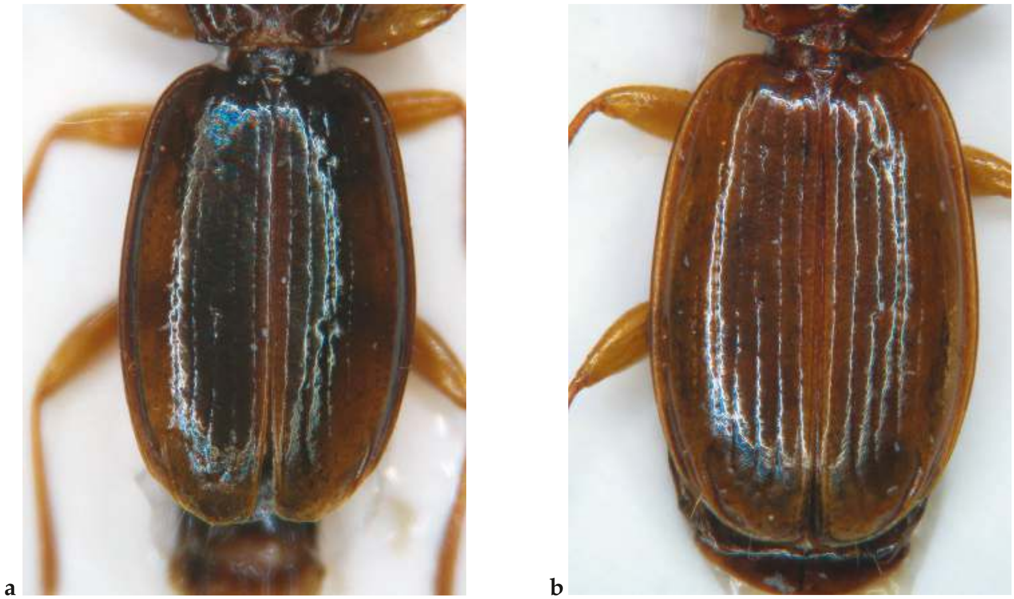

Fig. 6. Elytra of *T. dayanae* spec. nov. (**a**) and *T. pamphylicus* (**b**).

Taxonomic notes on the species status of *Trechus labruleriei* Jeannel, 1921

Pawłowsky (1979) mentioned this taxon as a junior synonym of *T. austriacus* Dejean, 1831, Moravec & Zieris (1998) and Moravec et al. (2003) as one of *T. subacuminatus* Fleischer, 1898 (whose species rank was (re-)established from synonymy with *T. austriacus* by Moravec & Zieris 1998). The latter authors discussed the problems of synonyms in the *Trechus austriacus* group and stressed the importance of studying type material. We were able to study type material of *T. labruleriei* (collection Jeannel in NHMP):

(1) Holotype (Balghar Dagh, Turkey, Fig. 1g) differs clearly from *T. austriacus* and *T. subacuminatus* (microsculpture of head, especially of frons, form of elytra, copulatory piece of aedeagus, Fig. 4f). Specimens from southern Turkey fit well to this specimen and we suggest re-establishing the species status of *T. labruleriei* (stat. nov.).

(2) Another type specimen from Ghor, not Ghör (labeled: <Ghor> (green label with black cursive), <Collect. de Saulcy>, <type>, <Museum Paris / Coll. R. Jeannel, 1931>, <La Bruleriei / n. sp.> (white label with black cursive), <Trechus ♀ / crucifer LaBrul. ? / Lompe 2009 vid.>) does not belong to this species and is perhaps an immature individual of *T. crucifer* which occurs in the surroundings of Ghor (today Jordan).

(3) In spite of painstaking efforts we were not able to find the third specimen (from "Cephalonie") mentioned by Jeannel (1927: 415, should be preserved in NHMP).

The misidentification of the specimen collected in Ghor means that no proven record of *T. labruleriei* is known from the Levant. The final evaluation of the species in this group will likely only be possible when more *Trechus* material is readily available, not only from Greece and Turkey but also from Syria and Jordan.

Trechus dayanae Assmann and Wrase, spec. nov.

Figs 2, 3, 4g, 5a, 6a

Types. Holotype, male (TAU), and 45 paratypes (23 ♂♂, 22 ♀♀): N-Israel, Golan Heights, Merom Golan, *Quercus* stand, N33°07.974' E035°47.493', ~940 m, 12.02. 2006, leg. Th. Assmann (holotype and 10 paratypes: 6 ♂♂, 4 ♀♀); same data except for dates: 23.04.2006 and 30.04. 2006 (1 ♂, 1 ♀); same data except for: 936 m, 23./30.04. 2006, leg. D. W. Wrase (1 ♂); same data except for: 2.2. 2007, Starke leg. (1 ♂, 1 ♀); same data except for: 2.II.2007, leg. B. Feldmann (2 ♀♀).

N-Israel, Golan Heights, Hermon Ridge, Har Khavushit, ca. 1700 m, edge of snow field, 25.02.2005, leg. W. Starke (1 ♂); same data except for: 1800 m, small forest of *Quercus libani*, leaf litter sifted, 10.03.2008, leg. D. W. Wrase (5 ♂♂, 7 ♀♀): same data except for: 24.03.2008 (6 ♂♂, 1 ♀); same data except for 1900–2050 m below lift station (stony subalpine slopes, u. stones) 33°18.479' N/035°74.096' E and 24.03.2008 (1 ♂); same data except for 10.03.2008 leg. J. Buse (2 ♀♀, 1 ♂); same data except for 10.3.2008 and 8.3.2007 leg. Th. Assmann (4 ♀♀). Paratypes in TAU, CBL, CHD, CSW, COK, CWB, ZSM (incl. CAB).

Diagnosis. A small, slender, brown, brachypterous species of the *Trechus austriacus* group with strong microsculpture and a large copulatory piece of the median lobe.

Description

BL 2.8–3.5 mm, EW 1.1–1.3 mm. Habitus moderately slender (Figs 2, 3). Shiny middle brown, antennae, mouthparts, legs and marginal parts of pronotum and elytra brightened, in some specimens also the middle line of pronotum and suture of elytra.

Head medium sized; ⁴⁄₅ of the width of pronotum. Eyes subconvex, their diameter ¹⁄₃ longer than scape and 2–3 times longer than temples. Frontal furrows moderately impressed, diverging toward the anterior border. Distinct microsculpture with isodiametric meshes. Antennae exceed half of BL, in some males the antennae are longer than the elytra.

Pronotum (Fig. 5a) transverse; PW/PL: 1.32–1.45, PW/PBaW: 1.25–1.29. Margins arcuate in apical ²⁄₃, then convergent and reflexed to very brief basal sinuosity; hind angles moderate, sharp and right. Marginal gutter distinct, not widened at the anterior seta, which is situated at anterior third of the pronotum; basal foveae separated from marginal gutter by a low ridge. Disk convex; in the centre a median sulcus deeply developed, obsolete toward the front, reduced at the base; pronotal base with a transverse fold, impressed in the middle. Without punctures, but with small wrinkles at the base and overall a distinct microsculpture with isodiametric to slightly transverse meshes.

Elytra (Fig. 6a) moderately convex; EW/EL: 0.65–0.73. Longitudinal inner striae 1–4 feebly impressed, slightly punctuated; stria 5 weak, but perceptible; outer striae 6–8 reduced, only some small punctures visible. Apical recurrent groove impressed, running into direction of 5th longitudinal stria (without connection). First discal seta at level of 4th marginal humeral seta. Fine microsculpture with transverse meshes.

Legs moderately robust. Protibiae with a slight groove on the outer side. In males, first two segments of protarsi enlarged.

Median lobe of aedeagus (Fig. 4g) 0.6–0.7 mm; upper and lower side evenly rounded (lateral view); apical projection strong rightwards bent (dorsal view), apex acuminate, but clearly rounded. Copulatory piece formed like a long spatula with a rounded apex and upwardly curved margins; prominently large, about ²⁄₃ of length of median lobe. Parameres with 3–4 setae.

Comparisons. Members of the *Trechus austriacus* group have the following features in common (cf. Pawłowski 1979, Jeannel 1927): elytral apical recurrent groove without a connection to the 5th longitudinal stria, all elytral striae punctated, pronotum cordiform and with deep basal foveae, copulatory piece of the aedeagus lamelliform, formed like a spatula. *T. dayanae* spec. nov. shares all these characters with the other members of the group. The external form of the aedeagus, the large copulatory piece and the habitus of the new species are similar to *Trechus pamphylicus* Jeanne, 1996 (Figs 1i, 4h, 5b, 6b) described from southern Turkey (Antalya: Toros Mountains; Jeanne 1996) and its subspecies *T. pamphylicus rudischuhi* described by Donabauer (2006) from the Osmaniye Mountains (southern Turkey).

Trechus dayanae spec. nov. can be distinguished from *T. pamphylicus* by (1) darker coloration of the body, (2) (on average) smaller size, (3) longer antennae (sometimes longer than the elytra, cf. Figs 1i, 2, 3), (4) pronotum less constricted at base and hind angles less pronounced (PW/PBaW for *T. dayanae* spec. nov.: ≤1.29; PW/PBaW for *T. pamphylicus*: ≥1.29; cf. Fig. 5), (5) stronger microsculpture, especially on pronotum (Fig. 5) and elytra, (6) elytral intervals flatter and the stria and punctuation finer (Fig. 6), (7) apex of median lobe in apical projection stronger rightwards bent, and (8) copulatory piece narrower and slender (in lateral view; Figs 4g,h, see also Donabauer 2006: Figs 29, 31).

T. dayanae can be distinguished from the other *Trechus* species in the Levant by its small body length and the unique form of the large copulatory piece.

Etymology. It gives us great pleasure to dedicate this new species to Dr. Tamar Dayan, our friendly colleague and supervisor, respectively, Professor for Zoology at Tel Aviv University and Director of The National Collections of Natural History, Tel Aviv University (TAU).

Distribution. The two sites where we found the new species are located approximately 18 km linear distance from each other in the northern Golan Heights and in southern Mount Hermon.

Habitats. The habitats of both sites are different: In the Mount Hermon massif the species occurs on limestone in an open (and semi-open) pasture landscape with few single trees (mostly *Quercus libani* Olivier, *Q. boissieri* Reuter and *Q. cerris* L.; see Assmann et al. 2008: Fig. 19) together with other ground beetles with a preference for high humidity and/or low temperatures (e. g. a *Platyderus* species). The beetle has been found in sinkholes, grooves in limestone, edges of smelting snow fields, and litter in the shade of small trees. The known population in the Golan Heights (volcanic rocks) was found together with the ground beetle *Metadromius carmelitanus* Mateu in the litter horizon of a tiny old-growth woodland with *Quercus caliprinos* Webb and *Q. boissieri* Reuter as the dominant tree species (Fig. 8a). In spite of painstaking efforts (e. g. in the nature reserve Ya'ar Odem), no further populations have been detected. At both sites *Trechus dayanae* spec. nov. lives together with the eurytopic *Trechus quadristriatus*.

In late autumn (October to December) we were not able to detect the species in litter samples of the type locality; however, we did find it in higher altitudes of Mount Hermon. In early spring (February and March) most specimens, including some tenerals, were found, especially after heavy rainfall. Combining these data and knowledge on reproductive rhythms of ground beetles (e. g. Paarmann 1979, Den Boer and Den Boer-Daanje 1990) we believe that *Trechus dayanae* spec. nov. is a species with larval development during winter.

Discussion

Our knowledge of Israeli trechine beetles can now be summarised as follows: Five species were listed by Moravec et al. (2003) for Israel but the occurrence of two of these is questionable *(Trechoblemus micros, Perileptus areolatus)*. We found a new species (*T. dayanae* spec. nov.), and a clear misidentification *(T. libanensis)* and we re-establish an already described species *(T. labruleriei)*. This faunistic information makes it clear that the Trechini fauna of Israel and adjacent regions is clearly less well studied than the one in Europe, thus supporting Schuldt et al.'s (2009) assessment that the current inventory of Levant's (incl. Israel's) carabid fauna is poor.

Following the biological and distributional characterization, the Levantine *Trechus* species belong to two groups with different dispersal power and distribution patterns: The fully winged species *T. crucifer*, *T. saulcyanus*, and *T. quadristriatus* are widespread and prefer lower altitudes (the latter species extends its altitudinal range to the mountains). *T. libanensis* from the mountains in eastern Lebanon and *T. dayanae* spec. nov. from Mount Hermon and the Golan Heights are unwinged and live exclusively at higher altitudes (above ~ 1000 m a.s.l.). The latter two species are related to *T. pamphylicus* which also lives exclusively in mountain habitats (southern Turkey). *Trechus polonorum*, known only from a singleton, may also belong to this group.

Brachyptery and macroptery in ground beetles have a simple genetic basis of two (or at least few) alleles at one locus, as revealed by crossing experiments (Lindroth 1946, Aukema 1987, Desender 1989b). In young populations, the proportion of long-winged individuals (most of them able to fly) is higher than in old (established) populations, especially if the latter are isolated from other populations (den Boer 1970). The fitness of long- and short-winged individuals differs in many species, with the short-winged individuals usually showing higher fecundity (Aukema 1987, Desender et al. 1998, Desender 2000). – The positive relationship between brachyptery and habitat continuity is seen not only at the species but also at the assemblage level: In stable and old habitats the proportion of short-winged ground beetle species is higher than in unstable and young habitats (e. g. mountain habitats, ancient and recent woodlands, floodplain habitats; Brandmayr 1981, Assmann 1999, Desender et al. 1999, Bonn et al. 2002).

For the constantly short-winged Levantine *Trechus* species which inhabit higher mountain regions we can postulate long-lasting habitat continuity and ancient populations. This is especially true for the isolated population of *T. dayanae* spec. nov. in a small woodland in the Golan Heights. In the past, the old-growth oak trees of those woodlands were considered sacred by (some) Muslims and were thus not subjected to the hazards of habitat destruction (e. g. intensive livestock grazing); these people believed that a curse would fall on anyone who (or anyone

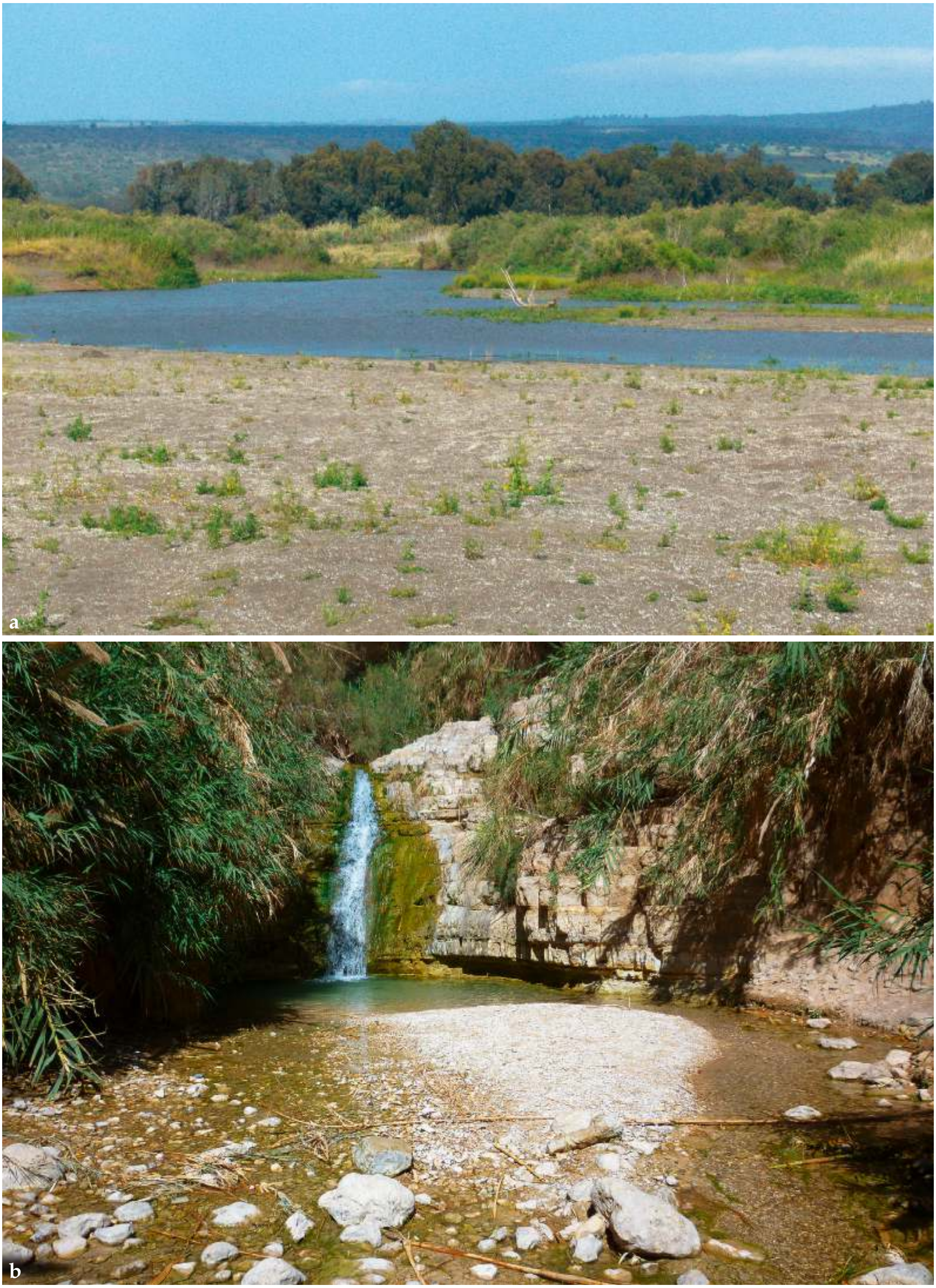

Fig. 7. Habitats of *Perileptus stierlini*: banks in the floodplain north of the Sea of Galilee (**a**) and in the Nature Reserve En Gedi (**b**).

Fig. 8. Habitats of woodland dwelling *Trechus* species: old-growth woodlands on a former Circassian cemetery (Merom Golan; *T. dayanae* spec. nov. (**a**)) and secondary woodland (Meron Forest; *T. saulcyanus* and *T. crucifer* (**b**)).

whose herds) cut or damaged the trees (Danin 1988: 134). In the subalpine altitudes, *T. dayanae*'s preferred habitats (e. g. edges of snowfields, sinkholes, deep grooves in the limestone) are not heavily influenced by grazing or any other human land use practices. These microhabitats are also stable and enable the long-term existence of these small ground beetles with poor power of dispersal.

The species inhabiting the lower altitudes show fully developed hindwings and are flight-active. In the last millennia, overexploitation of the landscape in the Middle East, e. g. cutting of trees and intensive grazing, led to the large-scale transformation of woodlands to open habitats, the so-called batha (Naveh & Dan 1983, Danin 1988). Woodlands were restricted to very small remnants which, however, did not remain stable for long periods of time (cf. Westphal et al. 2009). Most *Trechus* species are not able to survive (exception: *T. quadristriatus*) under open habitat conditions at low altitudes. We can thus postulate that most populations were lost during the woodland devastation periods. In the 20th century, former batha was planted with coniferous, often non-native tree species, or the reduced grazing pressure enabled natural succession to oak woodlands (Ginsberg 2006, Buse et al. 2010). These secondary woodlands (especially the oak woodlands) can act as habitats for *Trechus* species which prefer cold and humid habitats. The species were able to survive woodland destruction in the Mediterranean part of Israel because they also inhabit other microhabitats such as cave entrances (Pawłowski, 1979; own observations from Alma Cave and Sharakh Cave).

The two *Perileptus* species live close to streams on banks with sandy, loamy or gravel grounds. As known from many other riparian species (including *Perileptus* species) the unpredictable water dynamics of streams are very important for the occurrence of ground beetles on stream and river banks (e. g. Naiman & Decamps 1997, Bonn et al. 2002, Andersen and Hanssen 2005). Habitat conditions for these beetles are not good in contemporary Israel, however, because of strong anthropogenic impacts on water dynamics (Levin et al. 2009). Due to their vagility, all ground beetle species of this ecological group are macropterous; a revival of these species is possible after habitat regeneration (for a positive example after floodplain restoration see Günther & Assmann 2005).

The above-mentioned relationships between habitat continuity, power of dispersal, and habitat quality demonstrate that ground beetles with their specific features have the potential to play an important role in landscape ecological and conservation biological studies in the Middle East. However, knowledge of their basic systematics and taxonomy is a prerequisite for an effective usage of this group of organisms in conservation biology and bioindication (Rainio & Niemelä 2003, New 2010).

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