

The Silvanidae of Israel (Coleoptera: Cucujoidea)

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ABSTRACT

The Silvanidae is a family comprising mainly small, subcortical, saproxylic, beetles with the more or less dorsoventrally flattened body. It is a family of high economic importance, as some of the species are pests of stored goods; some of them are distributed throughout the world, mainly by human activities. Nineteen species of Silvanidae in ten genera are hereby recorded from Israel. Eleven of those are considered alien, of which four are established either in nature or indoor; eight species are either indigenous or have been introduced in the very remote past. Seven species, *Psammoecus bipunctatus*, *P. triguttatus*, *Parasilvanus fairemairei*, *Silvanus castaneus*, *S. inarmatus*, *S. ?mediocris* and *Uleiota planatus*, are recorded from Israel for the first time. *Airaphilus syriacus* was recorded only once in 1913; its status is doubtful. *A. abeillei* may occur in Israel, although no material is available. Twelve species are associated with stored products, although only three, *Ahasverus advena*, *Oryzaephilus surinamensis* and *O. mercator*, are of distinct economic importance; the rest are either rare or only occasionally intercepted on imported goods. An identification key for all genera and species is provided.

KEYWORDS: Flat Bark Beetles, stored product pests, alien, invasive species, identification key.

INTRODUCTION

The family Silvanidae Kirby, 1837 is comparatively small, with almost 500 described species in 58 genera. The family contains relatively small subcortical saproxylic beetles, the body length 1.2–15.0 mm, but generally less than 10.0 mm, with the body more or less flattened dorsoventrally. The Silvanidae are distributed worldwide, although they are most diverse in the tropics. The Silvanidae were treated as a subfamily of Cucujidae until Crowson (1955) gave the taxon a family status. They are currently subdivide into two subfamilies, Brontinae (consisting of the tribes Brontini and Telephanini) and Silvaninae, both represented worldwide. Ten genera containing at least one species each became distributed worldwide or nearly so by the indirect human activities (e.g. commerce); some of these species are stored food pests. Thirty two species of Silvanidae (all Silvaninae, except one) belonging to 12 genera have been recorded in association with stored products in various parts of the world. These include four cosmopolitan (or nearly cosmopolitan) stored products pests, *Oryzaephilus surinamensis* (Linnaeus) (the saw-toothed grain beetle) and *O. mercator* (Fauvel) (the merchant grain beetle), which are among the commonest, economically most harmful and ancient synanthropic insects, and the less important *Ahasverus advena* (Waltl) and *Cathartus quadricollis* (Guérin-

Méneville). These pests are found in grain and other stores (commercial and farm) and domestic premises on cereal grains, particularly milled products, dried fruit, oil seeds, nuts etc. Many of the Silvanidae are at least partly fungivorous, feeding spores and hyphae, living on decaying plant matter, leaf litter etc. Under natural circumstances Brontini (Brontinae) and Silvaninae live under loose bark of dead standing trees, on fallen decaying trees, and on tree stumps. The Telephanini (Brontinae) are found on plants, predominantly on withered plants, and in leaf litter; some South American and Australian Silvaninae are myrmecophilous. The under bark habitat has probably been responsible for the spread of some of the silvanids associated with stored products, because they are occasionally found alive on dunnage (wood, mats etc., used to stow and secure cargoes) or could have come from timber cargoes. However, they are more commonly found on cereal grains, cereal products and other commodities traded between countries, and were conditions are suitable they may become established. The process of silvanid expansion with human commodities started in ancient times, and continues recently (Halstead 1973, 1980, 1986, 1993, 1997, 2011; King *et al.* 2014; Majka 2008; Thomas 1993*a, b*, 2002, 2005; Thomas and Yamamoto 2007; Thomas and Leschen 2010; Yoshida and Hirowatari 2014).

Data on the Silvanidae fauna of western Asia are sparse and fragmentary, based mainly on original descriptions and records from the late 19th and early 20th century. There are only three recent publications on Silvanidae from the Near East, dealing with species from Saudi Arabia (Slipinski 1984), United Arab Emirates (Halstead 2011) and Yemen (Socotra) (Halstead 2012).

The fauna of Silvanidae in Israel has never been comprehensively studied. Two species were described from Israel (Fauvel 1889; Reitter 1890). Sahlberg (1913) listed seven species of Silvanidae from Israel collected only or predominantly in natural habitats. Bodenheimer (1937) listed only three species of Silvanidae, all stored product pests; a few additional records of Silvanidae from Israel were made in the context of stored products pest management (Avidov and Harpaz 1961; Calderon and Donahaye 1964; Donahaye and Calderon 1969; Navarro *et al.* 2003). The late Ezra (Jonathan) Donahaye compiled a list of ten species of Silvanidae known from Israel, based on the Collection of Plant Protection and Inspection Services, Ministry of Agriculture, Bet Dagan, Israel, collection and records in literature and published it on the Internet, as a part of a wide scale project (Donahaye 2008). Unfortunately, the project was discontinued following his death in 2008, parts of his records appear erroneous, and major parts of his website are inaccessible.

The lack of the comprehensive, readily available and up-to-date information on the identification, occurrence and pest importance of Silvanidae intercepted by the quarantine services at ports in Israel and discovered by the plant protection services lead to the current study. The need for the study is well demonstrated by the number of Silvanidae samples sent to the author for identification by the quarantine services of the ports in Haifa and Ashdod and by the Plant Protection and

Inspection Services of the Ministry of Agriculture of Israel. A total of 88 samples representing various beetle families were received during 2014 and of these 15 were samples of silvanids (12 of *A. advena*) (mainly from China, but also from Europe and East Africa) (Friedman, unpublished data). Thus during 12 months 17% of all beetle interceptions made by this organizations were of silvanids.

In this study, 19 species of Silvanidae, representing ten genera, are recorded from Israel, including three clearly indigenous species, eleven clearly alien species and four species of less definite status. Three species are economically important store products pests. Further consideration of the status of species included is given in the Discussion section.

MATERIALS AND METHODS

The specimens mentioned in this paper are deposited in the following collections: PPIS – Collection of Plant Protection and Inspection Services, Ministry of Agriculture, Bet Dagan, Israel; SMNH-TAU – National Collection of Insects, The Steinhardt Museum of Natural History and Israel National Center for Biodiversity Studies, Tel Aviv University, Tel Aviv, Israel.

Drawings and measurements were made using a drawing tube and a Leica M125 stereo microscope. Drawings were scanned and processed with Adobe Illustrator 9.0. Images were taken with a Leica DFC295 digital camera mounted on a Leica M205C microscope, image stacks were processed with Leica Application Suite 4.2.0 and Helicon Focus 5.3. Final image editing was done with Adobe Photoshop CS5.

Genitalia were extracted by soaking the dry specimens in hot water, breaking off the posterior abdominal sternites and boiling them in a 10% aqueous solution of potassium hydroxide. Extracted genitalia were preserved in glycerin in plastic tubes and pinned next to the specimens on the same pin.

Transliterated names of localities in Israel follow the *Israel Touring Map* (1:250,000) and *List of Settlements*, published by the Israel Survey, Ministry of Labor (2009). Where names of localities have changed, the most recent transliterated Hebrew names are given followed by the old names in brackets, for example: Yerushalayim [Jerusalem]. Erroneous spellings are also included in brackets following the correct spelling. Plant names follow Feinbrun-Dothan and Danin (1991). Regional subdivision of Israel follows Theodor (1975).

SPECIES RECORDS

Subfamily Brontinae Erichson, 1845

Tribe Telephanini LeConte, 1861

Cryptamorpha desjardinsii (Guérin-Méneville, 1844)

Circumtropical stored product pest, originally Australasian, occasionally introduced in North and Central Europe and temperate parts of USA (Halstead 1993; Halstead *et al.* 2007; Ratti 2007). Associated with plant molds and found on juicy tropical fruit and vegetables (sugarcane, banana, pineapples etc); adults and

larvae were recorded feeding on sugarcane smut *Sporisorium scitamineum* (Syd.) M. Piepenbr., M. Stoll & Oberw. (Basidiomycota: Ustilaginomycetes) (Thomas 1993a, b). Recorded primarily from Israel by Klein and Chen (1983) on *Dracaena* sp. (Asparagaceae) imported from The Netherlands (specimen deposited in the PPIS). An additional specimen from the PPIS was reared from *Maranta* sp. (Marantaceae). The specimen deposited in the SMNH-TAU was collected in a natural habitat, in the Mediterranean maquis on the southern slope of a canyon incising the northern part of the Carmel Ridge in a west to east direction, although agricultural fields, green houses and banana plantations are located in the proximity of 2–3 km. *C. desjardinsii* has fully developed wings and good flight abilities, therefore it could arrive by flight from a long distance, particularly if attracted by light.

Material examined: Israel: Nahal Oren, 5.vii.1999, SFS2, V. Chikatinov, T. Pavliček, light trap (1 ex., SMNH-TAU); Intercepted in quarantine, from Holland, 22.xii.1982, ex *Dracaena* sp. (1 ex., teneral, PPIS), 2.i.1983, Y. Snuni, ex *Marantha* sp. (1 ex., PPIS).

Psammoecus bipunctatus (Fabricius, 1792)

The species is widely distributed in Palaearctic Region: Europe, northeastern Asia, Far East, Caucasus, Iran and Turkmenistan (Winkler 1926; Hetschko 1930; Halstead *et al.* 2007; Ratti 2007; Ratti and Nardi 2011; Yoshida and Hirowatari 2014); its presence in North Africa is doubtful (Karner 2012). The species is recorded here from Israel (and from the Middle East) for the first time, which is probably the southernmost limit of its distribution. The single specimen was collected 40 years ago in the foothills of Judea, far from sea-ports, markets and industrial zones, perhaps indicating the presence an unrevealed natural population. *Psammoecus* spp. are usually found in plant detritus (Karner 2012). *P. bipunctatus* is known to inhabit marshlands; recorded in large numbers on *Carex* detritus (Cyperaceae) (Warne 1963; Yoshida and Hirowatar, 2014). Not known as a stored product pest.

Material examined: Israel: Rosh ha' Ayin, 10.iv.1976, A. Freidberg (1 ex., SMNH-TAU).

Psammoecus triguttatus Reitter, 1874

Distributed in Russian Far East, Korea, China and Japan (Halstead *et al.* 2007; Yoshida and Hirowatari, 2014). Not known as a stored product pest; nothing is known of its biology. Introduced to Israel on green *Dracaena* (Asparagaceae) and intercepted by the PPIS.

Material examined: Israel: Ashdod Port, from Taiwan, 22.iv.2013, L. Gidron, on *Dracena* (1 ex., SMNH-TAU).

Uleiota planatus (Linnaeus, 1761)

Distributed widely in west Palaearctic, preferably in temperate regions: entire Europe, North Africa (Algerie, Tunisia), Caucasus, Iran, Turkey, Far East and Japan

(Halstead *et al.* 2007; Ratti 2007). Occurs under loose bark of various deciduous trees and conifers (Ratti 2007). Intercepted in Israel on imported timber.

Material examined: Israel: from France, 2.iv.2001, wood of *Pinus* sp. (1 ex., PPIS); from Ukraine, on wood (1 ex., PPIS).

Subfamily Silvaninae Kirby, 1837
Ahasverus advena (Waltl, 1834)

This cosmopolitan stored product pest originating from the Neotropical Region is found mostly in warm temperate and tropical regions, but can survive winter in Canada and northern Europe in unheated granaries (Halstead 1993); known by the common name ‘foreign grain beetle’. It feeds on surface molds such as *Penicillium glaucum* Link and *Aspergillus* sp. (Ascomycota: Eurotiomycetes) and is associated with many kinds of stored food of plant origin (Thomas 1993a, b).

It is first recorded from Israel by Bodenheimer (1937) and well established in Israel in granaries and warehouses on grain, cereal products and other stored crops (Navarro *et al.* 2003). It is unclear whether *A. advena* occurs in nature, but it frequently arrives with imported goods; thus, *A. advena* comprised 12 of 15 cases of Silvanidae intercepted by the PPIS and identified by the author in 2014. Some intercepted beetles were found on stored food (cinnamon, coriander, coffee, dry fruit, garlic) and some on inedible commodities of plant origin (bamboo, dried ornamental plants, papyrus mats, straw, wood).

Material examined: Israel: Deganya A, Bet Gordon, library, 24.xi.1966, Y. Palmoni (1 ex., SMNH-TAU); Deganya A, Bet Gordon, 21.viii.1969, Y. Palmoni (1 ex., SMNH-TAU); Afiqim, 2.iv.1966, Y. Palmoni, on book (1 ex., SMNH-TAU); Yerushalayim, 4.vi.1981, Q. Argaman (2 ex., PPIS); Ashdod Port, from China, 20.v.2013, A. Goffman, on ferns (1 ex., SMNH-TAU); Ashdod Port, from China, 9.xi.2014, PPIS, on bamboo (2 ex., SMNH-TAU); from Africa, 6.x.1999, on wood (4 ex., PPIS); from Bulgaria, 3.ix.2014, on *Coriandrum sativum* (4 ex., PPIS); from China, 4.x.1998, on *Allium sativum* (1 ex., PPIS), 15.viii.1999, on cinnamon (1 ex., PPIS), 7.ix.1999, on cinnamon (7 ex., PPIS), 23.ix.1999, on cinnamon (2 ex., PPIS), 3.x.2002 (3 ex., PPIS), 22.iv.2004 (2 ex., PPIS), 3.ix.2014, on bamboo (2 ex., PPIS), 7.ix.2014, on bamboo (3 ex., PPIS), 23.ix.2014, on bamboo (6 ex., PPIS), 1.x.2014, on bamboo (1 ex., PPIS); from India, 26.ix.2000, on coffee (2 ex., PPIS); from Laos, 22.v.2003, on *Coffea* (9 ex., PPIS); from Kenya, 22.x.2014, on dried flowers (2 ex., PPIS); from Nigeria, 19.x.2004, on dry fruit (3 ex., PPIS); from Thailand, 3.vi.2004 (1 ex., PPIS); from Ukraine, 21.ix.1999, on straw of wheat (1 ex., PPIS).

Airaphilus abeillei Grouvelle, 1889

The original description of *A. abeillei* was based on one or more specimens collected by E. Abeille de Perrin and A. Grouvelle in ‘Syria’. However, the definition of ‘Syria’ in the 19th century was vague, it differed in meaning from Syria *sensu stricto* (Syrian Arab Republic) to Syria *sensu lato* (the Levant or the Near East, viz. Southern Turkey + Syria + Lebanon + Israel + Jordan), with intermediate options. E. Abeille de Perrin visited ‘Syria’ twice: in 1874 and 1879, traveling to what now constitutes Israel, Lebanon, Syria and southern Turkey (Hatay Province) (Caillol 1911). It is impossible, therefore, to state the exact origin of the type series. The accurate provenance of this species type(s) is thus uncertain and hence Halstead *et al.* (2007) gave Syria, as in the original description, but in

quotation marks. The only additional record of *A. abeillei* is by Sahlberg (1913) from 'Syria': he sifted 20 specimens from fallen oak leaves in Jammour [probably recent Jamhour, 4 km SE Beirut], Lycus River Valley [probably Nahr el-Kalb] and Ain Sofar Baths in the Valley of Lebanon [Tell Ain Sofar, SW Zahle, Bekaa Valley], all localities being in present-day Lebanon.

No specimens of *A. abeillei* from Israel have been studied recently. However, *A. abeillei* may occur in Israel, particularly in the extreme north. It could be erroneously recorded as *A. arcadius* (see below).

Airaphilus arcadius Reitter, 1884

Distribution of this species includes Italy (Sicily), Albania, Greece and Turkey (Grouvelle 1913; Halstead *et al.* 2007; Ratti 2007). The sole record from the Levant is by Sahlberg (1913), from Israel (Yerushalayim) and Lebanon (the Cedar Forest, Mount Barouk).

A short redescription was given in Ratti (2007). According to the identification key in Grouvelle (1913), *A. arcadius* differs from *A. abeillei* by more slender elytra. Reitter (1884) in his identification key to *Airaphilus* stated that *A. arcadius* had thick antennae (compared to *A. ferrugineus* from West Mediterranean), but this character was omitted in the description of the species. *A. arcadius* has not been recorded since Sahlberg (1913). All *Airaphilus* specimens deposited in SMNH-TAU appear to me belong to *A. syriacus* (see below), including a few specimens collected in more or less close proximity to Yerushalayim. Perhaps Sahlberg's identification was erroneous, and his specimens represented either *A. abeillei* or *A. syriacus*.

Airaphilus syriacus Grouvelle, 1874

Described from three specimens collected by Ch.J. Piochard de la Brûlerie in 'Syria' (Grouvelle 1874) (for discussion on the exact definition of 'Syria' see *Airaphilus abeillei*). Ch.J. Piochard de la Brûlerie visited 'Syria' twice in spring and autumn of 1869. His trip is briefly described in his obituary (Simon 1876), and included several examples of typical geographical inter-mixtures, e.g. "He arrived in Syria on March 9 and landed at Jaffa" (p. 682, my translation from French). Yafo (=Jaffa) is a city in recent Israel, 160 km from the Lebanese border and 200 km from the Syrian border. Piochard de la Brûlerie visited the territories of recent Israel, Syria and Lebanon, Egypt (Alexandria, Suez and Sinai Mountains) and Cyprus. Therefore, it is not clear whether the type series originates from the territory of recent Syria or from recent Lebanon or Israel, etc. Due to this uncertainty Halstead *et al.* (2007), who had overlooked Sahlberg's (1913) record of *A. syriacus* from Israel (see below), used quotation marks when giving the distribution as 'Syria'. The only other published recent record of *A. syriacus* is from the United Arab Emirates (Halstead 2011).

Previously, the only record of *A. syriacus* from Israel was by Sahlberg (1913) He records it from near Yafo, where 18 specimens were collected on roots of

grasses, on a sandy hill at the marine shore. Recent distribution of *A. syriacus* in Israel includes the Golan Heights, Carmel Ridge, Coastal Plain, foothills of Judea, the Judean Mountains (the zone of Mediterranean type of vegetation), with one mysterious specimen collected in a light trap in the Ne'ot haKikkar oasis, at the southern edge of the Dead Sea. The only biological data available is that for the specimen collected in Yavne, which (apparently) emerged from stored sesame seeds.

The original description of *A. syriacus* (Grouvelle 1874) translated from the Latin is as follows: "Oblong, black-brown, densely yellow-pubescent, antennae and legs dark brown, shorter than head and pronotum together, 2nd article narrower and shorter than 1st, 3× as long as wide, 4–8 transverse, apex reddish brown; pronotum longer than wide, dorsally depressed, laterally crenulated; elytra flat, regularly evidently rugose punctated, seta yellow-gray, depressed, humeral angles not denticulated. Length 3 mm." Most of the described characters also apply to other species of *Airaphilus*. According to the key to *Airaphilus* in Grouvelle (1913), *A. syriacus* is defined by the following characters: no femoral lines on metasternum; femoral lines on 1st abdominal segment closed, but with a prolongation forming a very acute angle at the apex of the internal part; 1st abdominal segment about as long or a little longer than metasternum; elytra at most 2.5× as long as broad, hardly wider than pronotum; lateral margins of head converging in front of antennal bases; metasternum almost smooth; antennae with gradual club.

Material examined: Israel: Merom Golan, 12.vi.2000, V. Chikatunov (15 ex., SMNH-TAU); Nahal Oren, 27.iii.2000, V. Chikatunov, T. Pavliček, S3 (1 ex., SMNH-TAU); Hadera [Chedera], 17.i.19??, H. Bytinski-Salz (2 ex., SMNH-TAU); Nahal Sansan, 16.xi.2001, Y. Mandelik (1 ex., SMNH-TAU); Na'an, 20.x.1971 (1 ex., SMNH-TAU), 29.x.1971, D. Gerling (1 ex., SMNH-TAU); Giv'at Brenner, 21.iv.1971, D. Gerling (1 ex., SMNH-TAU); Yavne, 26.vii.1983, Q. Argaman, emerged from stored sesame seed indoor (1 ex., PPIS); Ashdod–Ashqelon, 5 km SE Ashdod, 14.ii.1971, D. Gerling (3 ex., SMNH-TAU); 3.5 km N Karmiyya, 7 km SW Ashqelon, 9.viii.1971, D. Gerling (1 ex., SMNH-TAU); Qiryat 'Anavim [Kirjat Anawim], 24.i.1932, on Weirstarch (?) (2 ex., PPIS); Ne'ot haKikkar, 13.x.1999, I. Yarom & V. Kravchenko, light trap BL (1 ex., SMNH-TAU).

Cathartus quadricollis (Guérin-Ménéville, 1844)

This is a circumtropical stored product pest, probably introduced from South America by commercial activities (Halstead 1993); it is frequently imported in temperate European countries (Ratti 2007). In nature the species develops on maize, attacking cobs in the field and developing in stored dried maize; in storage it infests a wide variety of stored plant products (Halstead 1993).

The species is first listed from Israel by Calderon and Donahaye (1964), but not mentioned among important stored product pests by Navarro *et al.* (2003). The studied specimens were collected both indoor and outdoor. The status of its acclimatization in Israel is unclear.

Material examined: Israel: Nahal Oren, 9.v.1979, D. Furth (1 ex., SMNH-TAU); Ma'agan Mikha'el, 27.i.1979, A. Valdenberg (4 ex., SMNH-TAU); Herzliyya, 15.xi.1981, A. Freidberg (2 ex., SMNH-TAU); Tel Aviv, Savyon, 1.x.1982, Y. Zvik (2 ex., SMNH-TAU); Yaffo, quarantine [P. I. L. Jaffa], from Ghana, xii.1962, ex maize cobs (2 ex., PPIS); from Kenya, on *Zea mays*, intercepted in quarantine (1 ex., PPIS).

Monanus concinnulus (Walker, 1858)

This is a circumtropical stored product pest, probably of the Oriental origin (Halstead 1993), one of the most common silvanids in India, living in nature in leaf litter and haystacks (Pal 1982). The species is associated with a wide range of dry stored products, mainly of plant origin, edible and inedible (e.g. basketware, herbarium specimens, Havana cigars), but also found on dry seafood (Halstead 1993).

Bodenheimer (1937) recorded *M. concinnulus* from Israel as *Monanus signatus* Frauenfeld (junior synonym). It seems that this species may have been repeatedly introduced on imported goods, but has never become established.

Material examined: Israel: Ashdod Port, from China, 30.iv.2009, L. Gahanama, on dried plants (1 ex., SMNH-TAU).

Oryzaephilus abeillei (Guillebeau, 1890)

O. abeillei was originally described from Israel and placed in *Silvanus*. It was transferred to *Oryzaephilus* by Hetschko (1930), but also erroneously included in the same publication as *Silvanus abeillei*. This caused the same error in later faunistic publications, e.g. it was recorded erroneously as *Silvanus abeillei* by Finkel *et al.* (2002) and Donahaye (2008). *O. abeillei* is found in Greece, Turkey, Syria and Israel (Halstead 1980; Halstead *et al.* 2007).

Sahlberg (1913) recorded *O. abeillei* (as *Silvanus*) from western slopes of the Judean Mountains, Wadi Nu'eima [north of the Dead Sea] and the Jordan Valley. According to specimens deposited in the SMNH-TAU, *O. abeillei* is distributed throughout Israel. Some of the specimens were collected with pitfall traps, a few on trees (*Quercus ithaburensis*, *Ficus sicamorus*), probably under bark. *O. abeillei* only occur in natural habitats and is not associated with stored products.

Material examined: Israel: [Palaestina], Reitter (2 ex., SMNH-TAU); Merom Golan, 12.vi.2000, V. Chikatunov (30 ex., SMNH-TAU); Nahal Keziv, 17.x.1998, T. Pavliček, M. Finkel (2 ex., SMNH-TAU), 31.x.1998, T. Pavliček, M. Finkel (3 ex., SMNH-TAU), 28.xi.1998, T. Pavliček, M. Finkel (4 ex., SMNH-TAU), 16.i.1999, M. Finkel (1 ex., SMNH-TAU), 24.iv.1999, M. Finkel (1 ex., SMNH-TAU), 12.xi.1999, M. Finkel (1 ex., SMNH-TAU); Haifa [Syria, Kaiffa], Reitter (1 ex., SMNH-TAU); Nahal Oren, 5.vii.1999, V. Chikatunov, T. Pavliček (1 ex., SMNH-TAU); Qiryat Tiv'on, 31.vii.1954, M. Sternlicht, on *Quercus ithaburensis* (2 ex., SMNH-TAU); Tel Aviv, 6.i.1978, D. Furth, ex *Ficus sycamorus* (3 ex., SMNH-TAU); Hulda, 9.iii.1921, I. Aharoni (1 ex., SMNH-TAU); Zur Hadassa, 31.iii.2001, Y. Mandelik (1 ex., SMNH-TAU); Shezaf Nature Reserve, Nahal Shezaf, 30°44.96'N 35°16.28'E, 10.x.1999, I. Yarom, V. Kravchenko, light trap BL (1 ex., SMNH-TAU); Yotvata, 16.viii.1999, I. Yarom, V. Kravchenko, light trap BL (1 ex., SMNH-TAU).

Oryzaephilus fauveli (Reitter, 1890)

This species was originally described from Israel and placed in *Silvanus*; it was transferred to *Oryzaephilus* by Hetschko (1932), but also erroneously by Halstead (1980). Type series is labeled 'Syrien, Kaifa', probably indicating that the specimens were collected in or near Haifa (Israel) or in the northern part of Israel. Sahlberg (1913) sifted 30 specimens from oak leaf litter in the Judean Mountains west of the

village of Deir Aban (ca. 1 km east of Bet Shemesh) and in a valley near Har Tavor. The only two specimens of *O. fauveli* in the SMNH-TAU were collected in the Judean Mountains, one of them at ca. 4 km SE of Bet Shemesh). Both specimens were collected in pitfall traps. The species is the smallest among *Oryzaephilus* spp., and is probably overlooked, therefore its distribution is probably wider than currently known. *O. fauveli* is not associated with stored products.

Material examined: Israel: Matta', 13.v.2006, I. Shtirberg (1 ex., SMNH-TAU); 'Adullam, 17.xi.2003, U. Columbus, T. Levanony (1 ex., SMNH-TAU).

Oryzaephilus mercator (Fauvel, 1889)

O. mercator is almost cosmopolitan, but mainly found in tropical and subtropical countries. It is frequently introduced in temperate parts of the world, where it may become established on artificially heated premises, being although unable to survive in natural habitats. *O. mercator* infests a wide range of commodities although it is most frequently found as a pest of oilseeds and their derivatives (Halstead 1980, 1993).

Sahlberg (1913) was the first to record *O. mercator* from Israel (19 specimens from Yafo), it was listed by Avidov and Harpaz (1961) and Calderon and Donahaye (1964), but surprisingly not recorded by Bodenheimer (1937). Navarro *et al.* (2003) suggested that there was no locally established population of *O. mercator* in Israel, but the beetles were frequently introduced on commodities from warm regions.

The SMNH-TAU and PPIS collections harbor numerous specimens of *O. mercator*, partly from domestic larders and stores (Herzliyya, Tel Aviv) and partly from natural habitats, the latter predominantly in the southern part of the country (Southern Coastal Plain, Negev, Dead Sea Area, and Arava Valley). They were found attacking various stored foods, particularly nuts (various undetermined nuts, macadamia nuts, peanuts, pine nuts, walnuts), other seeds (rice, sumac) and other edible commodities (sweets, cakes, dry fruit, cinnamon, pepper). An interesting record is of *O. mercator* from wheat infested with 'doodeh' [Arabic for any kind of insect pest, but in the Near East the word is usually used for the grain moth, *Scythris temperatella* (Gelechiidae) (Winch 2007)]; *O. mercator* attacked wheat grains that were already damaged by another pest. In nature, beetles were collected under bark of trees (e.g. *Ficus*). Recently they have been found by farmers in kibbutz Samar, southern part of Arava Valley, attacking dates and causing noticeable damage. Numerous adult beetles were found in dry dates, 1–3 in each date, between the stone and the edible part, making them no longer marketable (Dafna Karmeli and Nirit Ketner, pers. comm.).

Material examined: Israel: Ramot Naftali, 13.v.1998, V. Chikatunov (1 ex., SMNH-TAU); Zefat [Safad], 3.xi.1943, P. Jolles, ex seeds of *Rhus coriaria* (5 ex., PPIS); Deganya A, 27.xi.1964, Y. Palmomi, on cakes (1 ex., SMNH-TAU), 15.viii.1970, Y. Palmomi (1 ex., SMNH-TAU); Afiqim, 10.x.1966, Y. Palmomi, on crushed peanuts bought in Teverya (1 ex., SMNH-TAU), vii.1968, Y. Palmomi (1 ex., SMNH-TAU); Hawwat 'Eden, 11.vi.1984, Q. Argaman (1 ex., PPIS); Haifa, 24.iii.1949, N.H. Plaut, ex cucumber seeds (5 ex., PPIS); Nahal Oren, 17.v.1995, T. Pavliček (1 ex., SMNH-TAU); Allonim, 1.xii.1946, H. Bytynski-Salz (3 ex., SMNH-TAU); Ra'anana, 10.xii.1996, on Macadamia nut (3 ex.,

PPIS), 5.iii.1997, on Macadamia nut (3 ex., PPIS); Hadera [Chedera], 17.i.19??, H. Bytinski-Salz (2 ex., SMNH-TAU); Yarhiv, 28.xii.1980, D. Furth (1 ex., SMNH-TAU); Herzliyya, 15.xi.1981, A. Freidberg, breeding in stored nuts (55 ex., SMNH-TAU), 10.ii.1984, A. Freidberg (1 ex., SMNH-TAU); Tel Aviv, 23.viii.1973, M. Kaplan (1 ex., SMNH-TAU), 26.vii.2006, W. Kuslitzky, light trap (1 ex., SMNH-TAU), 6.viii.2006, W. Kuslitzky, light trap (3 ex., SMNH-TAU); Yerushalayim [Jerusalem], 21.xi.1937, A. Grunberg, ex walnuts (3 ex., PPIS), 4.vii.1940, J.H. Brair, ex sweets (23, PPIS); 12.x.1940, H. Bytinski-Salz (3 ex., SMNH-TAU), 12.iii.1941, S.Y. Husseini, ex wheat infested with 'doodeh' (1 ex., PPIS); 'Enot Zuqim Nature Reserve [Ein Peshkha, 15 km S Jericho], 2.ii.1967, D. Gerling (3 ex., SMNH-TAU); Nizzanim, 6.vi.2006, L. Friedman (1 ex., SMNH-TAU), 18.vi.2008, L. Friedman (1 ex., SMNH-TAU); Ashqelon, 26.x.1981, A. Lupo, on *Ficus sycamorus* (9 ex., SMNH-TAU); Rafiah, from Egypt, intercepted in quarantine, 22.iii.1984, M. Dodlish, ex *Oryza sativa* seeds (1 ex., PPIS); 'En Gedi, 16.xi.2002, V. Kravchenko, V. Chikatunov, light trap (1 ex., SMNH-TAU); 'En Boqeq, 22.ii.1985, A. Freidberg (1 ex., SMNH-TAU); Hazeva, 10.vi.2001, V. Kravchenko (1 ex., SMNH-TAU); Hazeva Field School, 30°46.70'N 35°14.25'E, 16.vii.1999, I. Yarom, V. Kravchenko, light trap BL (1 ex., SMNH-TAU); Samar, 28.ix.1989, A. Eitam (1 ex., SMNH-TAU), 16.iii.2006, E. Cohen, soil trap, x.2014, D. Karmeli, ex dry dates, between stone and flesh (24 ex., SMNH-TAU); Elot, x.1981, ex dry dates (6 ex., SMNH-TAU); Elat, 10.i.1978, M. Kehat, on dates, fruits (3 ex., PPIS); from Jordan, 11.iii.1999, on coffee (2 ex., PPIS); from Nigeria, 16.ii.1999, on pepper (1 ex., PPIS); from China, 19.viii.1999, on cinnamon (1 ex., PPIS); from Thailand, 7.vi.2000, on pine nuts (1 ex., PPIS); from Sri Lanka, 20.ix.2000, on nuts (3 ex., PPIS).

Oryzaephilus surinamensis (Linnaeus, 1758)

O. surinamensis (saw-toothed grain beetle) is a cosmopolitan species, that is principally a pest of cereals and cereal products, although it infests a wide range of dry commodities of plant origin; (Halstead 1980, 1993). *O. surinamensis* is one of the commonest synanthropic insects, having a long history of coexistence with man; its oldest record is from Horbat Rosh Zayit, Israel, ca. 1000 BP (Kislev and Melamed 2000). Halstead (1980) suggested that the biology of *O. surinamensis* points to its tropical origin, while morphologically it is most similar to the African *O. parallelus* and the Middle Eastern *O. abeillei*. According to archaeological data the invasion of *O. surinamensis* started in the Middle East followed by its spread into Greece and Italy, then into Western and Central Europe under the Roman Empire, and during the Age of Discovery (15th century) to the rest of the world (King *et al.* 2014). There is a strain of *O. surinamensis* (var. *bicornis* (Erichson)) common to the Mediterranean Region (Halstead 2011), in which larger males have backwardly curved genal horns.

Sahlberg (1913) recorded *O. surinamensis* in Israel occurring throughout the country in rotten wood and near roots of trees, and mentioned specifically males with genae produced into genal horns from the rotten wood of *Quercus* near Nahal Qishon (Yizre'el Valley). It was listed by Bodenheimer (1937) and Avidov and Harpaz (1961). Bytinski-Salz and Sternlicht (1967) recorded its association with oaks and mentioned that *O. surinamensis* was found in galls (presumably old dry ones of Cynipidae). This is the most harmful silvanid stored product pest in Israel, attacking grain and various seeds (e.g. buckthorn (*Rhamnus*), flax, maize, sunflower, rice), nuts (pistachio, walnuts), dry fruit, dry plants, chocolate and many other stored commodities). In nature, it has a distinct association with oaks (*Quercus caliprinos* and *Q. ithaburensis*), under bark and breeding in acorns,

although found under bark of other trees (*Pinus halepensis* and *Pistacia atlantica*) and breeding in seeds of the ornamental alien *Tetraclinis articulata* (Vahl) Masters (Cupressaceae).

Material examined: Israel: Har Hermon [Mt. Hermon, Galilee], 1500 m, 6.xii.1924, O. Theodor (3 ex., SMNH-TAU); Tel Dan, 27.x.1987, G. Coulon (5 ex., SMNH-TAU); Kefar Blum, dwelling house, 12.x.1960, Y. Palmoni, on stored food (4 ex., SMNH-TAU); Hermon Field School, 14.v.2012, L. Friedman, sifting litter (1 ex., SMNH-TAU); Bar'am, 18.v.1996, M. Warburg (1 ex., SMNH-TAU); Nahal Keziv, 17.x.1998, T. Pavliček, M. Finkel (7 ex., SMNH-TAU), 31.x.1998, T. Pavliček, M. Finkel (9 ex., SMNH-TAU), 14.xi.1998, T. Pavliček, M. Finkel (6 ex., SMNH-TAU), 28.xi.1998, T. Pavliček, M. Finkel (4 ex., SMNH-TAU), 12.xii.1998, T. Pavliček, M. Finkel (2 ex., SMNH-TAU), 16.i.1999, M. Finkel (1 ex., SMNH-TAU), 20.ii.1999, M. Finkel (1 ex., SMNH-TAU), 6.iii.1999, M. Finkel (1 ex., SMNH-TAU), 27.iii.1999, M. Finkel (1 ex., SMNH-TAU), 9.iv.1999, M. Finkel (9 ex., SMNH-TAU), 24.iv.1999, M. Finkel (16 ex.), 20.v.1999, M. Finkel (1 ex., SMNH-TAU), 4.vi.1999, M. Finkel (2 ex., SMNH-TAU), 7.viii.1999, M. Finkel (1 ex., SMNH-TAU); Merom Golan, 12.vi.2000, V. Chikatunov (1 ex., SMNH-TAU); Ne'ot Mordekhai, 30.v.2005, L. Zarabi, V. Chikatunov, pheromone trap (3 ex., SMNH-TAU); 'Akko [Acre], forest ranger, under bark of oak (3 ex., PPIS); 'En Ya'aqov, 23.iii.2006, I. Shtirberg (4 ex., SMNH-TAU), 12.v.2006, I. Shtirberg (1 ex., SMNH-TAU), 31.vii.2006, I. Shtirberg (1 ex., SMNH-TAU); Afeq, 22.xi.1976, J. Halperin, ex *Quercus ilex* acorns 5.x.1977 (19 ex., PPIS); Teverya, 25.x.1939, Y. Palmoni, on chocolate 'Lieber' (3 ex., SMNH-TAU); Deganya A, Bet Gordon, collections' room, 12.i.1946, Y. Palmoni (1 ex., SMNH-TAU); Deganya A, Bet Gordon, 16.iv.1969, Y. Palmoni, on table (1 ex., SMNH-TAU); Afiqim, 5.iii.2006, M. Vonshak (1 ex., SMNH-TAU); Sha'ar haGolan, 7.iii.2006, M. Vonshak (1 ex., SMNH-TAU); Bet Oren, 9.x.1940, Y. Palmoni (1 ex., SMNH-TAU); Nahal Oren, 8.x.1996, L. Friedman (1 ex., SMNH-TAU); Qiryat Tiv'on, 31.vii.1954, M. Sternlicht, on *Quercus ithaburensis* (6 ex., SMNH-TAU); Merhavva (Qibbutz), viii.1941 (crop pf 1940), Y. Palmoni, on *Linum ustiatissimum* seeds (5 ex., SMNH-TAU); Me'ir Shefeyya, 10.i.1942, under bark of pine (3 ex., SMNH-TAU); Zikhron Ya'aqov, 29.x.1958, ex seeds of *Rhamnus* (6 ex., PPIS); Gan Shemu'el, 7.xi.1982, Q. Argaman, ex rice grains (2 ex., PPIS); Rosh ha'Ayin, 15.x.1994, V. Chikatunov (1 ex., SMNH-TAU); Tel Aviv, iii.1959 (1 ex.); Yafo [Jaffa], 1.xii.1951, H. Bytinski-Salz, in sack of dates (1 ex., PPIS); Holon, in kitchen, 21.ii.1991, L. Friedman (1 ex., SMNH-TAU); Miqwe Yisrael [Mique Israel], 29.xii.1968, J. Halperin, ex *Callitris quadrivalvis* (1 ex., PPIS); Bet Dagan, Volcani Institute, xi.1978, lab. culture (16 ex., SMNH-TAU); Ben Shemen, 1926, F.S. Bodenheimer, ex wheat (18 ex., PPIS), vii.1926 (12 ex., SMNH-TAU); 8 ex., PPIS), F.S. Bodenheimer, ex wheat, 20.xii.1926, F.S. Bodenheimer, ex wheat (3 ex., SMNH-TAU); ?Rehovot, 4.ii.1921, I. Aharoni (3 ex., SMNH-TAU); Rehovot [Rechoboth], 1935, Hecht (8 ex., SMNH-TAU), [Rechobot], 25.ii.1945, ex rise (7 ex., PPIS), 3.vii.1948, H. Bytinski-Salz (1), 11.v.1982, Q. Argaman, ex *Helianthus* seeds indoor (1 ex., PPIS); Yavne, 6.iii.1982, Q. Argaman, ex stored seeds of *Helianthus annuus* (1 ex., PPIS); Matta', 9.xi.2006, I. Shtirberg (1 ex., SMNH-TAU), 4.ii.2007, I. Shtirberg (1 ex., SMNH-TAU); Yerushalayim, 28.viii.1929, R. Jolles (1 ex., PPIS), 12.xi.1939, S. Khadr, ex dry mints (1 ex., PPIS), 4.vii.1940, J.H. Brair, ex sweets (3 ex., PPIS), 1.ix.1955, ex toffee candies (2 ex., PPIS), 3.i.1966, J. Halperin, on *Pistacia atlantica* (12 ex., PPIS); Nahal Sansan, 15.ix.2001, Y. Mandelik (6 ex., SMNH-TAU), 17.v.2002, Y. Mandelik (1 ex., SMNH-TAU); 'Adullam, 15.ix.2001, Y. Mandelik (5 ex., SMNH-TAU), 22.iii.2002, Y. Mandelik (1 ex., SMNH-TAU), 17.viii.2003, U. Columbus, T. Levanony (1 ex., SMNH-TAU); Zekharya, 15.ix.2001, Y. Mandelik (1 ex., SMNH-TAU), 16.xi.2001, Y. Mandelik (9 ex., SMNH-TAU); Zur Hadassa, 31.iii.2001, Y. Mandelik (21 ex., SMNH-TAU), 21.iv.2001, Y. Mandelik (54 ex., SMNH-TAU); 'En Gedi, 29.xii.1970 (1 ex., SMNH-TAU); Timna', 3.iv.1997, L. Friedman (1 ex., SMNH-TAU); from Italy, 9.ix.1962, ex walnuts (3 ex., PPIS); from Romania, x.1937, R. Gabrielith, ex maize (1 ex., PPIS); from Ukraine, 20.x.1999, ex *Hordeum* sp. (2 ex., PPIS), 12.x.2013, seeds of sunflower (5 ex., PPIS); from Greece, 22.xii.2014, on *Pistacia vera* (3 ex., PPIS); from Jordan, 5.vii.1999, on dry dates (4 ex., PPIS), 28.vi.2004, on dates (9 ex., PPIS); from USA, 14.i.2004 (10 ex., PPIS), 8.ix.2014, on dried flowers (1 ex., PPIS). **Turkey:** Turcia, Reitter (1 ex., SMNH-TAU). **Syria:** Syria, Reitter (1 ex., SMNH-TAU).

Parasilvanus fairemairei (Grouvelle, 1882)

The species is widely distributed in the Afrotropical Region, sometimes imported with timber (intercepted in UK and Italy), found under bark of dead trees and

shrubs (*Ricinodendron*, *Canarium*, *Erythrophloeum*, *Chlorophora* etc.), in humus and on fruits of *Ficus capensis* (Halstead 1973).

It has been intercepted under bark of ailele (*Canarium schweinfurthii* Engl.) (Burseraceae) imported from West Africa.

Material examined: Israel: Pardes Hanna, TA'AL Factory, from West Africa, 21, xi.1977, J. Halperin, Ailele (bark) (2 ex., SMNH-TAU; 5 ex., PPIS).

Silvanus castaneus MacLeay, 1873

The species is indigenous to the Oriental and Australasian regions and has occasionally been found on imported commodities in temperate regions, but has not become established there (Halstead 1973, 1993; Halstead pers. comm.). It has not been recorded from the Palaearctic Region so far (Halstead *et al.* 2007). It has become established in Florida; one specimen was collected in a light trap in the United Arab Emirates (Halstead 2011). In nature this species occurs under bark (Halstead 1973, 1993, 2011).

Although the two specimens recorded from Israel (see above) were collected in natural habitats on indigenous trees (*Pinus* spp.), suggesting the possibility of its establishment, there have been no further field records. The other records refer to interceptions by the PPIS on bamboo and other unidentified wood imported from China and Ukraine.

Material examined: Israel: 'En Zetim [Ein Zeitim], 9.v.1977, J. Halperin, ex *Pinus brutia*, 16.ix.1977 (1 ex., PPIS). Ilanot, 8.viii.1982, Z. Mendel, under bark of decayed *Pinus* (1 ex., PPIS); from Ukraine, 24.vi.2009, on wood (1 ex., PPIS); from China, 2.x.2013, PPIS, on wood (1 ex., without head, SMNH-TAU), 2.x.2014, L. Zarabi, on bamboo (1 ex., PPIS).

Silvanus inarmatus Wollaston, 1867

Being indigenous to the Afrotropical Region, the species has been intercepted in the UK and Italy on various stored products imported from Africa. In its natural habitat in Africa it has been collected on maize heads, on dry fruits, on fruits of oil-palm (*Elaeis*), under bark of *Ficus* and often recorded from under bark and associated with the dead branches of various trees (Halstead 1973, 1993; Ratti 2007).

The records of the species from Israel are first for the country and possibly first outside its natural habitat in tropical Africa. The specimen from Nahal Tirza Nature Reserve was collected in a completely natural habitat, far from any human activities. This is possibly an indication of the establishment of this alien species population in nature. Association with any stored products has not been recorded in Israel.

Material examined: Israel: Haifa Port, from West Africa, 23.v.1966, M. Feldmann, on logs of ozigo+okoume (2 ex., PPIS), 1.vi.1966, Y. Palmoni, under bark of ozigo and okoume (1 ex., SMNH-TAU); Kefar haMakkabi, 13.ix.1979, J. Halperin, on *Pistacia atlantica* (2 ex., SMNH-TAU); Ilanot, 2.x–14.xi.1973, J. Halperin (1 ex., SMNH-TAU); Nahal Tirza Nature Reserve, bank of HaYarden [Nahal Tirza Res., 83. Zor Deir Shaman, Yordan store], 15.iii.2005, V. Chikatunov (1 ex., SMNH-TAU); Gedera, 7.iv–10.vi.1978, J. Halperin (1 ex., SMNH-TAU).

Silvanus ?mediocris Grouvelle, 1889

The identification of the single specimen is not certain, because it lacks a head.

The species is distributed in the Afrotropical Region: Côte d'Ivoire, Ghana, Nigeria, Cameroun, Democratic Republic of Congo (former Zaïre) and Uganda (Halstead 1973). It is not recorded as stored product pest.

The specimen recorded here was intercepted on timber of ozigo (*Dacryodes buettneri* (Engl.) H.J. Lam) and okoume (*Aucoumea klaineana* Pierre) (Bursera-ceae) from West Africa.

Material examined: Israel: Haifa Port, from western Africa, 1.vi.1966, Y. Palmoni, under bark of ozigo and okoume (1 ex., without head, SMNH-TAU).

Silvanus unidentatus Olivier, 1790

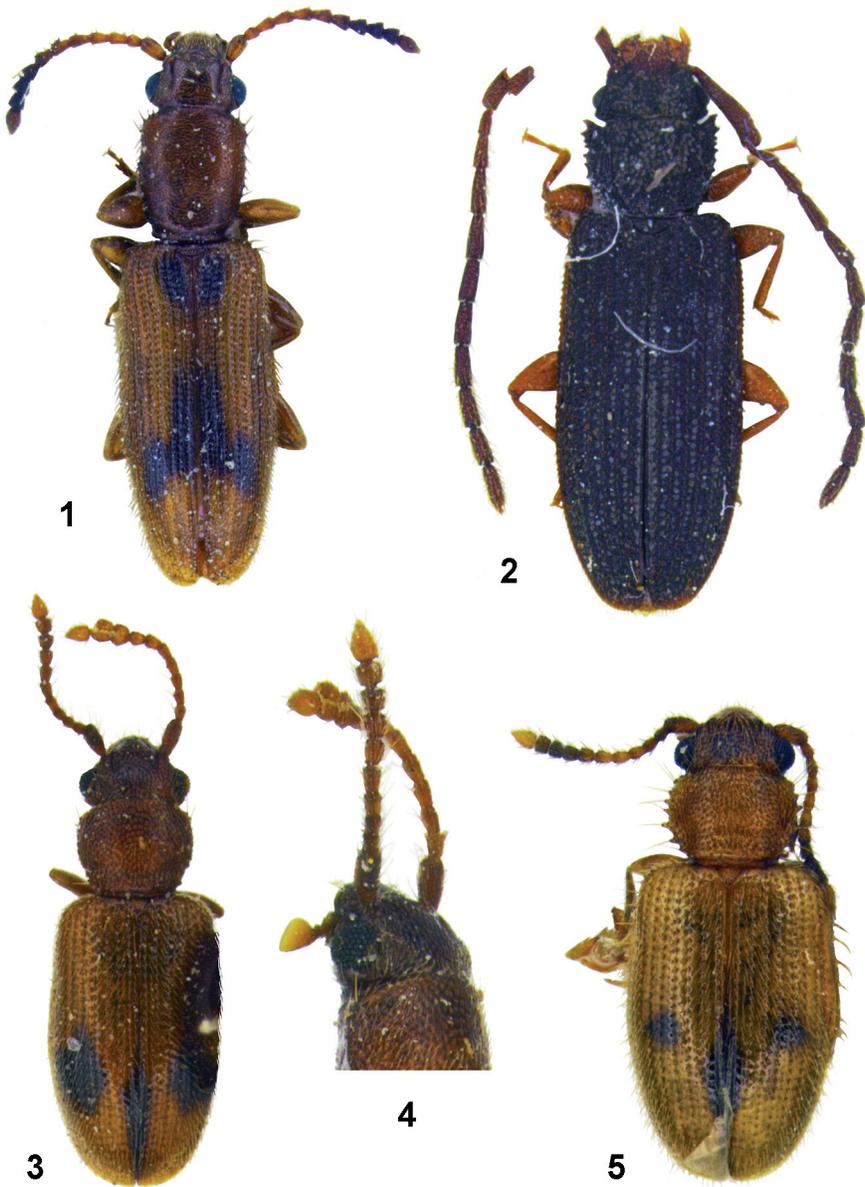
The species is widely distributed in the Palaearctic Region, but not in its warmer parts, although it has been recorded from Turkey, but not from North Africa, Near East and Iran. It is introduced to USA and Chile. It lives under the bark of various deciduous trees (*Carpinus*, *Fagus*, *Quercus* etc.) (Halstead 1973; Halstead *et al.* 2007). Although recorded by Donahaye (2008), its records were based on erroneous identifications of *S. castaneus* and *S. inarmatus* specimens.

In Israel, it has been intercepted by the PPIS on wood of *Pinus* sp. imported from France.

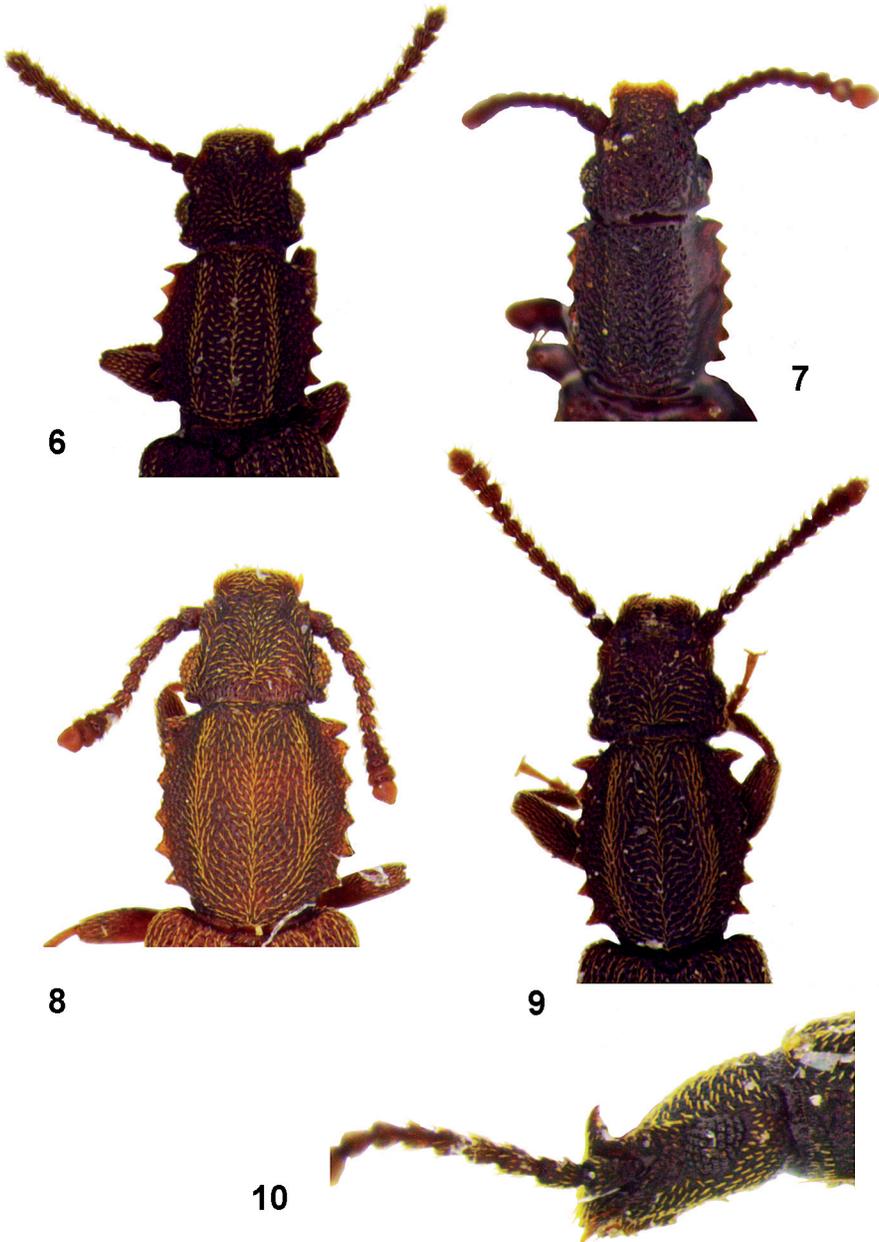
Material examined: Israel: from France, 2.iv.2001, on wood of *Pinus* sp. (4 ex., PPIS).

**Key to genera and species of Silvanidae included in the study
(intercepted on imports, established and indigenous in Israel)**

- 1 Antennal scape at least 2× as long as wide, antennal club indistinct; frons laterally with longitudinal sulcus (Figs 1–5)..... 2 (Brontinae)
- Antennal scape at most 1.5× as long as wide, antennal club distinct; frons laterally without longitudinal sulcus (Figs 6–10, 15–23) 5 (Silvaninae)
- 2 Antennal scape more than 5× as long as wide, antenna nearly as long as body length; pronotum at anterolateral angle with expanded denticulate lobe; pronotum and elytra strongly flattened; head, pronotum and elytra dull dark grey, brown or black-brown, elytra without pattern, legs testaceous (Fig. 2) ... *Uleiota planatus*
- Antennal scape 2–3× as long as wide, antenna at most as long as half body length; pronotum at anterolateral angle without lobe, at most with weak denticles; pronotum and elytra not or slightly flattened; head, pronotum, elytra and legs yellow, reddish, brownish or testaceous, elytra with dark pattern, consisting of stripes or spots 3
- 3 Distal segment of maxillary palpus not enlarged, body oblong, 3.3–4.4 mm, elytra yellow with dark band along suture and dark transverse band slightly before middle of elytra (Fig. 1)..... *Cryptamorpha desjardinsii*
- Distal segment of maxillary palpus enlarged, triangular, body less oblong, 2.3–2.8 mm, elytra yellow, dark round spot medially (Figs 3–5).... 4 (*Psammoecus*)

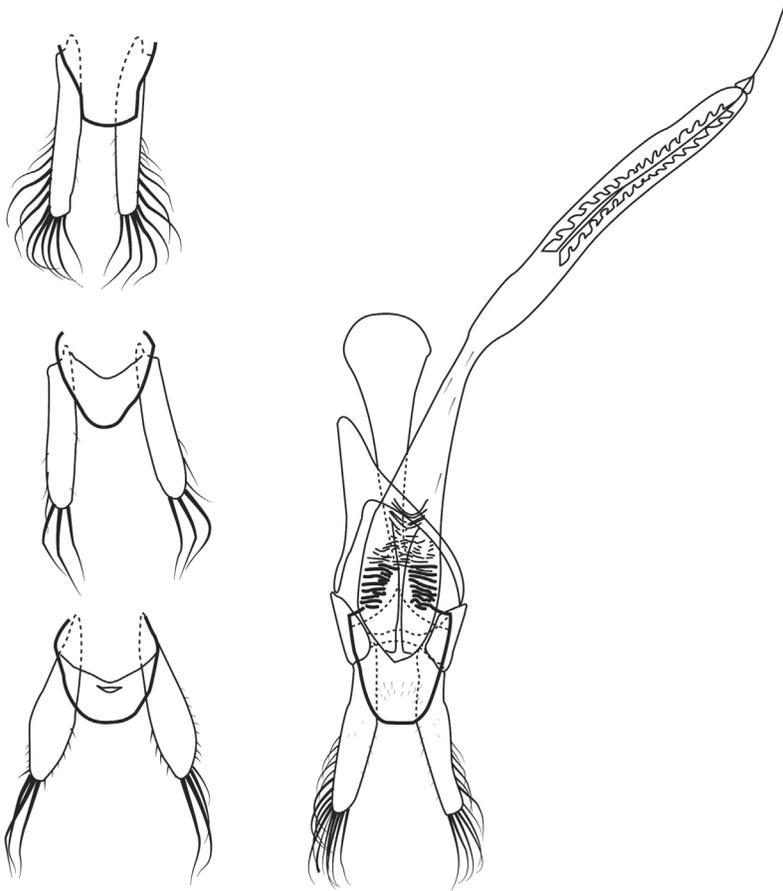


Figs 1–5: (1) *Cryptamorpha desjardinsii* (Guérin-Méneville), habitus, dorsal view; (2) *Uleiota planatus* (Linnaeus), habitus, dorsal view; (3) *Psammoecus bipunctatus* (Fabricius), dorsal view; (4) *P. bipunctatus* (Fabricius), head and maxillar palpus, dorso-lateral view; (5) *Psammoecus triguttatus* Reitter, habitus, dorsal view.



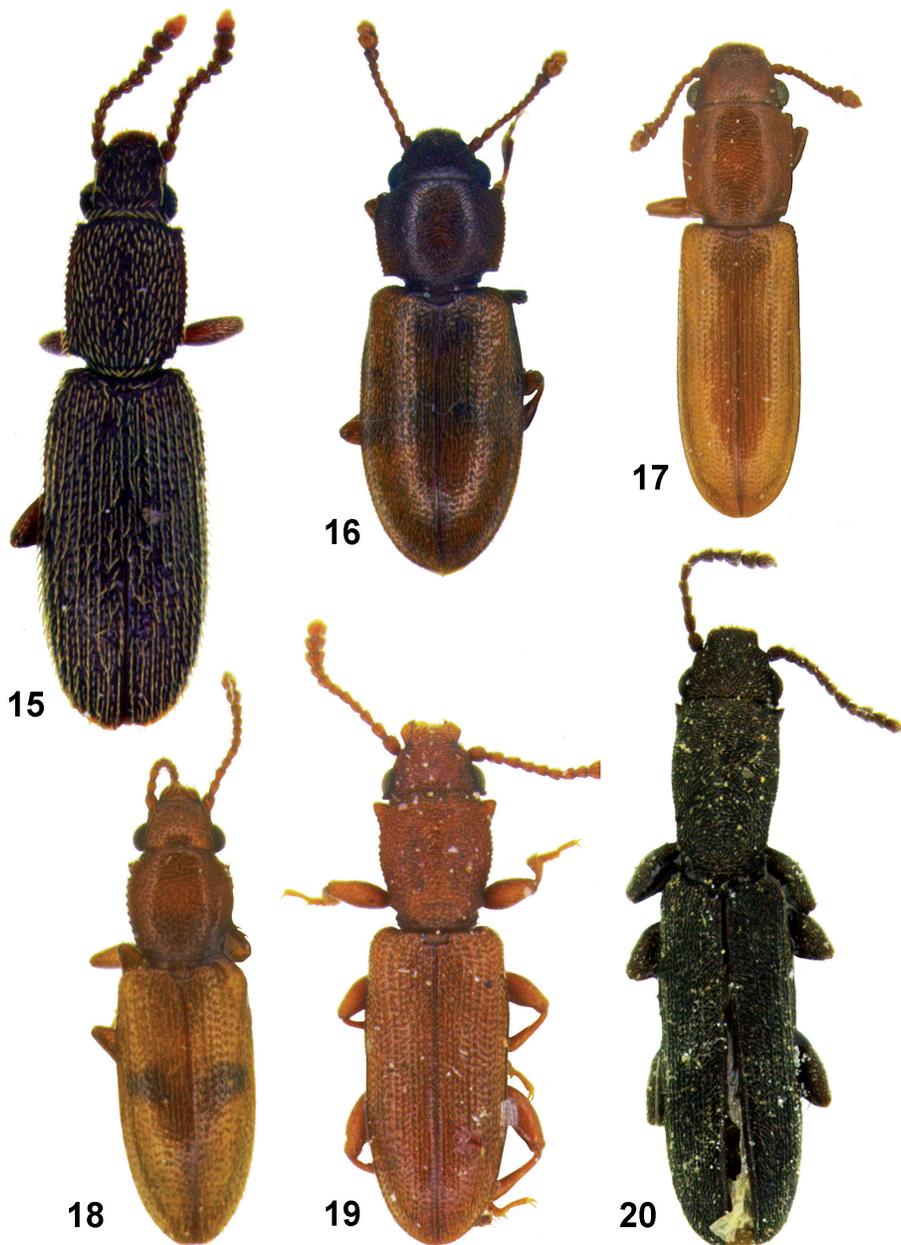
Figs 6–10: *Oryzaephilus* spp., head and pronotum, dorsal view (6–9) and head of male with distinct genal horn, lateral view (10): (6) *O. abeillei* (Guillebeau); (7) *O. fauveli* (Reitter); (8) *O. mercator* (Fauvel); (9) *O. surinamensis* (Linnaeus); (10) *O. surinamensis* (Linnaeus).

- 4 Pronotum with small to obsolete lateral denticles (Fig. 3) *P. bipunctatus*
 – Pronotum with distinct, long lateral denticles (Fig. 5) *P. triguttatus*
- 5 Pubescence dense, comprising long, thin transparent semi-erect or thick whitish attached hairs, elytra and pronotum appear hairy; head constricted immediately posteriorly to eyes, temples absent or obsolete (Figs 15, 18) 6
 – Pubescence microscopic, comprising short, transparent hair, if hair longer than thin and flatly attached, elytra and pronotum appear bare; head not constricted posteriorly or constricted posteriorly to distinct temple area (Figs 6–10, 16–17, 19–23) 9
- 6 Head as long as wide or slightly wider than long; body testaceous, elytra and legs paler, reddish-yellow; elytra medially with dark transverse band; hairs on lateral denticles of pronotum directed anteriorly; pronotum with anterolateral denticle small, emarginated at base (Fig. 18) *Monanus concinnulus*
 – Head nearly 2× as long as wide; body and appendages brown to black; elytra unicolor; hairs on lateral denticles of pronotum directed posteriorly; pronotum with anterolateral denticle indistinct or slightly larger than other lateral denticles, not emarginated at base (Fig. 15) 9 (*Airaphilus*)
- 7 1st abdominal sternite as long as or slightly longer than metasternum; color brown, pubescence whitish or yellowish; body length 3 mm *A. syriacus*
 – 1st abdominal sternite 1.5× as long as metasternum; color nearly black, pubescence brown; body length 2.0–2.5 mm 8
- 8 Elytra at most twice as long as wide; antenna slender; body length 2 mm
 *A. abeillei*
 – Elytra more than twice as long as wide; antenna thicker; body length 2.5 mm
 *A. arcadius*
- 9 Lateral margins of pronotum with six large teeth more or less of the same length (Figs 6–9) 10 (*Oryzaephilus*)
 – Lateral margins of pronotum serrated or smooth, with or without anterolateral tooth of variable form, larger than lateral denticles (Figs 16, 17, 19–23) 14
- 10 Genal horns present (Fig. 10) *O. surinamensis*, part of males
 – Genal horns absent 11
- 11 All elytral setae directed caudad; temples broad, about 1/3 as long as eye; pronotum with lateral ridges subparallel, medially equidistant from median ridge and margins of pronotum; median lobe of aedeagus gradually tapering apical, apex rounded, parameres narrow, parallel-sided, with 3 or 4 bent apical setae; male legs without secondary sexual characters; body length 1.8–1.9 mm (Figs 7, 12) *O. fauvei*
 – Part of elytra setae directed caudad and part directed latero-caudad or medio-caudad across entire row; temples variable; ridges of pronotum variable in form and location; median lobe of aedeagus rounded or strongly tapered subapically; parameres with numerous (ca. 10) long apical setae (Figs 11, 14),



Figs 11–14: *Oryzaephilus* spp., median lobe of aedeagus and parameres (11–13) and male genitalia (14): (11) *O. abeillei* (Guillebeau); (12) *O. fauveli* (Reitter); (13) *O. mercator* (Fauvel); (14) *O. surinamensis* (Linnaeus). (Redrawn after Halstead (1980))

- if with only 3 or 4 setae then parameres dilated (Fig. 13); body length 1.7–3.2 mm, usually above 2 mm 12
- 12 Temple at least half eye length, hind angle of temple rounded; eye 2.5× as long as wide; lateral ridges of pronotum curved, medially equi-distant from lateral margin and median ridge; 1st lateral tooth of pronotum longer than 6th; male leg with following secondary sexual characters: metatrochanter with tooth, metafemur with spine and metatibia with minute spine subapically; median lobe of aedeagus gradually rounded apically, parameres narrow, with numerous long setae along apical half of distal margin and at apex; body length 1.7–3.2 mm (Figs 9, 14)..... *O. surinamensis*



Figs 15–20: Habituses in dorsal view: (15) *Airaphilus syriacus* Grouvelle; (16) *Ahasverus advena* (Waltl); (17) *Cathartus quadricollis* (Guérin-Ménéville); (18) *Monanus concinnulus* (Walker); (19) *Silvanus unidentatus* Olivier; (20) *Parasilvanus fairemairei* (Grouvelle).



Figs 21–23: Head and pronotum in dorsal view: (21) *Silvanus castaneus* MacLeay; (22) *Silvanus inarmatus* Wollaston; (23) *Silvanus unidentatus* Olivier.

- Temple less than half eye length, hind angle of temple acute; eye 2.5–3.5× as long as wide; lateral ridges of pronotum subparallel to slightly curved, variable in their location; 1st lateral tooth/2nd lateral tooth ratio variable; male leg with or without secondary sexual characters; male hind leg with or without spine on femur; aedeagus characters described in next couplet..... 13
- 13 Temple 0.4× as long as eye; eye 2.5× as long as wide; pronotal teeth 1st and 6th of equal length or 6th pronotal tooth longer than 1st; lateral ridges of pronotum closer to median ridge than to margin of pronotum; male legs without spine on femur; median lobe of aedeagus strongly tapered subapically, truncated apically, without ventral process, parameres narrow, with numerous long setae along apical half of distal side and at apex; body length 2.0–2.7 mm (Figs 6, 11).....
..... *O. abeillei*
- Temple 0.2× as long as eye; eye 3.5× as long as wide; 1st pronotal tooth longer than 6th; lateral ridges of pronotum equi-distant from median ridge and margin of pronotum; male legs with secondary characters as in *O. surinamensis*; median lobe of aedeagus rounded apically, with transverse ventral process, parameres gradually widened from base to middle, then tapered apicad, with 3 or 4 setae at apex; body length 2.2–3.1 mm (Figs 8, 13) *O. mercator*
- 14 Pronotum laterally smooth (without denticles), anterolateral region slightly produced, not forming obvious tooth; pronotum quadrate to elongate (large males); legs with 3rd tarsal segment lobed below; 1st club segment (9th antennal segment) distinctly separated from 2nd club segment (10th antennal segment), transverse, as large as 2nd (Fig. 17) *Cathartus quadricollis*
- Pronotum laterally serrated (with denticles), with distinct anterolateral tooth; pronotum transverse to strongly elongate; legs with 3rd tarsal segment lobed or not lobed below; 1st club segment (9th antennal segment) not separated from 2nd

- club segment (10th antennal segment), as large as or distinctly smaller than 2nd (Figs 16, 19–23) 15
- 15 Body less oblong, 2.5× as long as wide, shiny, covered with oblong bent fine hairs; elytra laterally rounded, widely rounded at apex; pronotum transverse, with anterolateral tooth rounded, strongly emarginated at base, laterally finely serrated; 1st segment of antennal club distinctly smaller than 2nd (Fig. 16)
*Ahasverus advena*
- Body more oblong, 3.5× as long as wide, matt, covered with short straight scales; elytra laterally sub-parallel, narrowing towards apex; pronotum longer than wide, with anterolateral tooth pointed, not emarginated or slightly emarginated at base, laterally strongly serrated; 1st segment of antennal club of same size as 2nd (Figs 19–23) 16
- 16 8th antennal segment (pre-club segment) at least 1.3 shorter and narrower than 7th; temple laterally obtuse or straight; pronotum 2× as long as wide, with small anterolateral tooth; body black, general body form obviously elongate (Fig. 20)*Parasilvanus fairemairei*
- 8th antennal segment (pre-club segment) as long and wide as 7th, or slightly shorter and narrower; temple laterally pointed; pronotum 1.2× as long as wide, anterolateral tooth slightly to strongly developed (obtuse to acute); body testaceous, general body form not as elongate (19, 21–23) 17 (*Silvanus*)
- 17 Anterolateral tooth of pronotum obtuse, gradually emarginated at base; pronotum laterally moderately convergent to base (Fig. 22)*S. inarmatus*
- Anterolateral tooth of pronotum acute, moderately to more strongly developed; pronotum with sides more convergent to base (Figs 21, 23) 18
- 18 Eyes small, 0.25× as long as head, slightly prominent; anterolateral tooth of pronotum slightly produced forward beyond anterior margin of pronotum; pronotal disc laterally with sides not raised, basally slightly depressed (Figs 19, 23) *S. unidentatus*
- Eyes large, more than 0.3× as long as head, prominent; anterolateral tooth of pronotum either slightly or obviously produced forward; pronotal disc laterally usually slightly raised forming rounded ridge, most obvious at basal half, basally not depressed 19
- 19 Anterolateral tooth of pronotum obviously produced forward beyond anterior margin, sides of pronotum moderately convergent to base; temple not forming pointed prominence; general appearance dull (Fig. 21) *S. castaneus*
- Anterolateral tooth of pronotum slightly produced forward (as on Fig. 23), sides of pronotum strongly convergent from apical two fifths to base; temple extremely narrow, forming minute pointed lateral prominence at eye/head junction; general appearance shiny *S. mediocris*

DISCUSSION

Nineteen species of Silvanidae in ten genera are recorded here from Israel, most of them alien. Eleven species are clearly invasive: *Cryptamorpha desjardinsii*, *Psammoecus triguttatus*, *Uleiota planatus*, *Ahasverus advena*, *Cathartus quadricollis*, *Monanus concinnulus*, *Parasilvanus fairemairei* and four *Silvanus* spp. Two of them can be considered as established in Israel, viz. *A. advena* and *C. quadricollis* (collected mainly indoor), and two are possibly established, viz. *C. desjardinsii* and *S. inarmatus* (collected in natural habitats). The remaining seven species (*P. triguttatus*, *U. planatus*, *M. concinnulus*, *P. fairemairei*, *Silvanus castaneus*, *S. ?mediocris* and *S. unidentatus*) are intercepted on imported goods.

Airaphilus arcadius was probably recorded erroneously, but there is no way to prove this. *Airaphilus abeillei* was described and recorded from Lebanon, which is very similar biogeographically to the northern part of Israel, and relying on previous experience can occur also in Israel. *Psammoecus bipunctatus* occurs widely throughout the Palaearctic Region, but the single specimen collected in Israel does not permit me to draw a definite conclusion on its status.

Airaphilus syriacus, *Oryzaephilus abeillei* and *O. fauveli* can be certainly considered as indigenous species, all three probably endemic to Israel or to the southern Levant.

Oryzaephilus surinamensis and *O. mercator* have cosmopolitan distributions; today it is difficult to impossible to reveal their origin. However, the archaeological data show that at least *O. surinamensis* occurred in Israel in the distant past (Kislev and Melamed 2000; King *et al.* 2014). It is possible to assume that its original distribution or at least part of its original distributional range was in Israel; this is emphasized also by the existence in Israel of two closely related species, *O. abeillei* and *O. fauveli*, occurring in nature, by the association of *O. surinamensis* with natural oaks, and by its repeated and massive collection in natural habitats. *Oryzaephilus mercator* has more restricted distribution in comparison to *O. surinamensis*, predominantly in warm areas, tropics and subtropics. In Israel it mainly occurs indoors in the northern part of the country, but in the south is collected in natural habitats. It does not behave as a stored product pest in the Arava Valley and Southern Negev, where it attacks dates in orchards, and was collected also in remote areas.

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CHECKLIST OF SILVANIDAE INCLUDED IN THE STUDY

Brontinae Erichson, 1845**Brontini Erichson, 1845***Uleiota planatus* (Linnaeus, 1761)**Telephanini LeConte, 1861***Cryptamorpha desjardinsii* (Guérin-Méneville, 1844)*Psammoecus bipunctatus* (Fabricius, 1792)*Psammoecus triguttatus* Reitter, 1874**Silvaninae Kirby, 1837***Ahasverus advena* (Waltl, 1834)*Airaphilus abeillei* Grouvelle, 1889*Airaphilus arcadius* Reitter, 1884*Airaphilus syriacus* Grouvelle, 1874*Cathartus quadricollis* (Guérin-Méneville, 1844)*Monanus concinnulus* (Walker, 1858)*Oryzaephilus abeillei* (Guillebeau, 1890)*Oryzaephilus fauveli* (Reitter, 1890)*Oryzaephilus mercator* (Fauvel, 1889)*Oryzaephilus surinamensis* (Linnaeus, 1758)*Parasilvanus fairemairei* (Grouvelle, 1882)*Silvanus castaneus* MacLeay, 1873*Silvanus inarmatus* Wollaston, 1867*Silvanus ?mediocris* Grouvelle, 1889*Silvanus unidentatus* Olivier, 1790

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