

## A review of the saproxylic weevil subfamily Cossoninae (Coleoptera: Curculionidae) in Israel

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### ABSTRACT

Nine species of the saproxylic cossonine weevils are recorded from Israel. A key to genera and species, as well as distributional and biological data are provided. The genera *Melicius* Alonso-Zarazaga, 2002 and *Rhyncolus* Germar, 1817 (represented by *Melicius gracilis* (Rosenhauer, 1856) and *R. sculpturatus* Waltl, 1839 correspondently) are recorded for the first time in Israel. *Pseudomimus avocadi* Folwaczny, 1972, described from Israel and previously considered as an endemic Israeli species of Afrotropical origin, is here considered a junior subjective synonym of *Caulophilus oryzae* (Gyllenhal, 1838), a widespread stored grain pest of Neotropical origin, which develops mainly in the rotten seeds of avocado, but also in wet and damaged stored products.

**KEYWORDS:** Biodiversity, faunistic, identification key, new record, taxonomy, dead wood, saproxylic, pest, avocado seed, Cossoninae, weevils, Israel, Levant, Mediterranean, Middle East.

### תקציר

תשעה מינים של חדקוניות החיות בעץ רקוב מתת-משפחת Cossoninae מדווחות מישראל, בליווי מפתח לזיהוי הסוגים והמינים, נתונים על תפוצתם, פונדקאים ופרטי אורח חיים. הסוגים *Melicius* (הכוללים המינים *M. gracilis* ו-*R. sculpturatus*) בהתאם) מדווחים מישראל לראשונה. *Pseudomimus avocadi*, שתואר מישראל ונחשב בעבר למין אנדמי לישראל ממוצא אפרוטרופי, התגלה כטעות בזיהוי של *Caulophilus oryzae* מין פולש מזיק מחסן ממוצא ניאוטרופי, שאכן מתפתח בגלעיני אבוקדו רקובים, אך גם במוצרים מאוחסנים רטובים או ניזוקים. מילות מפתח: מגוון מינים, טקסונומיה, פאונסיטיקה, עץ רקוב, עץ מת, מזיק, אבוקדו, גלעין, גרעין, חדקוניות, ממצא חדש, מפתח זיהוי, ים תיכון, המזרח הקרוב, לבנט, ישראל.

### INTRODUCTION

Cossoninae Schoenherr, 1825 are a relatively small subfamily of weevils occurring worldwide with about 1700 described species in 275 genera, and some. 300 species in 85 genera in the Palaearctic Region (Alonso-Zarazaga & Lyal 1999; Jordal 2014; Alonso-Zarazaga *et al.* 2023). Most cossonines are saproxylic, broadly polyphagous and associated with any kind of decaying or dead wood, whereas some other groups are more restricted in their host preference (e.g. several groups of the Southern Hemisphere are associated with Araucariaceae) (Anderson 2002; Jordal 2014). Cossoninae are most diverse in tropical regions and on oceanic islands such as Saint Helena, where they presumably reached passively in floating wood and then underwent rapid diversification (Decelle & Voss 1972; Jordal 2014). Some species are almost or completely cosmopolitan, spread by oceanic currents or by human

activity (Anderson 2002; Jordal 2014). Cossoninae occur in a very wide range of biotopes from humid rainforests to deserts, and many of the most widespread species are associated with maritime habitats (Anderson 2002; Jordal 2014). A few species are known as pests of processed timber (Morris 2002; Whitehead 1982, 1991; Cebeci *et al.* 2011; Whitehead 2006).

Cossonines can be recognized by the large inwardly curved hook-like uncus at the apex of the metatibia, which lacks an apical comb of setae. They are generally small, with a body length 1.5–3.0 mm, rarely over 5 mm (with the exception of some species of *Mesites* Schoenherr, 1838, that reach 10 mm). The cossonine body is slender, cylindrical or slightly compressed dorso-ventrally, dark-colored, dark red to dark brown, devoid of scales or long setae, completely glabrous or with only short obsolete vestiture, rarely bearing short peg-like scales on the apical part of elytra or on entire body. The legs are short, and the funicular segments are short and stout and reduced in number in some groups. Cossoninae usually have a shortened stout rostrum, as long as, or hardly longer than the pronotum, and some have the rostrum nearly indistinct, shorter than the head. In those with an elongate rostrum, it is straight, often conspicuously to strongly dilated at its apical third, spoon-shaped (although not in members of the Israeli fauna). The genus *Mesites* demonstrates a striking sexual dimorphism in the form of the rostrum: in males the rostrum is large, coarsely sculptured, and dilated medially, with antennae inserted at or around its middle in the area of the dilation; in females it is narrow, glabrous throughout its length, and dilated basally, with antennae inserted in the area of the dilation immediately before eyes. The apex of the rostrum bears a series of distinct hypostomal setae. The eyes are completely flat to strongly protruding from the head outline, usually small; in some species rudimentary or absent. The antennal club is conical to slightly flattened, with distinct sutures (except those from the tribe Rhyncolini 1848, in which the antennal club lacks distinct sutures) and resembles that in the unrelated dryophthorines (Folwaczny 1973; Anderson 2002; Morris 2002; Jordal 2014; UK beetles 2023).

The cylindrical form of the often smooth and glabrous body, short and often stout rostrum, small eyes, and short appendages are definitely adaptations to the saproxylic life style inside wood. Being saproxylic, Cossoninae strongly resemble other groups of saproxylic weevils, e. g. *Dryophthorus* Germar, 1823 (Dryophthorinae Schoenherr, 1825), Scolytinae Latreille, 1804 and Platypodinae Shuckard, 1840, from which they can be readily separated by the number of antennal segments (four in *Dryophthorus*, five to seven in Cossoninae) and the form of the metatibial apex (Scolytinae without an uncus, Platypodinae with apical comb of setae, even if the uncus is present) (Anderson 2002; Jordal 2014).

Cossoninae are small weevils, partly nocturnal, hiding in crevices in wood and under bark, and therefore are rarely collected occasionally or by the common collecting methods (e.g. sweeping). Different methods should be attempted, e.g. light trapping, bait trapping (smell of decaying wood and fungi, pheromones),

sieving decaying wood, and rearing from the host wood. The last method can be time-consuming and requires keeping a significant amount of dead wood samples for an extended period of time.

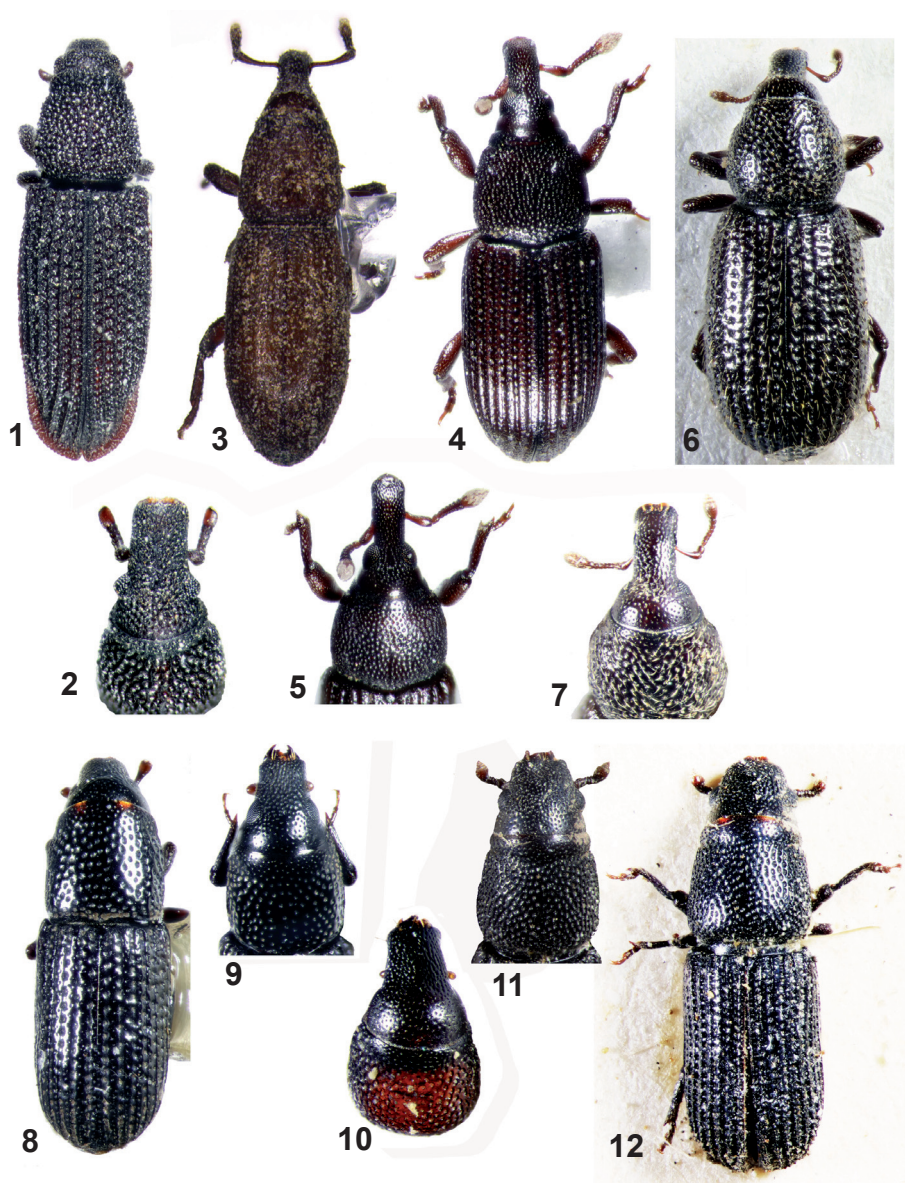
Probably for this reason the Israeli Cossoninae were never studied comprehensively and are poorly known even in comparison to other groups of weevils. Surprisingly, no cossonines were recorded by Bodenheimer (1937). Folwaczny (1972) received a series of cossonines from Hanan Bytinski-Salz reared occasionally from avocado stones and described a new endemic species that he assigned to the Afrotropical genus *Pseudomimus*, which was a unique case for the Palaearctic fauna of Cossoninae. *Pseudomimus avocadi* has never been recollected since and has remained enigmatic until recently. Two species, *Amaurorhinus bewickianus* (Wollaston, 1860) (an old unverified record) and *P. avocadi*, were mentioned from Israel in the review of the East Mediterranean fauna (Osella *et al.* 1993). Joseph Halperin, a forest entomologist, used to rear insect wood pest insects from their hosts, and therefore was the first to acquire some understanding of the Israeli Cossoninae. After his survey (Halperin & Fremuth 2003), six species were recorded, namely *Brachytemnus porcatus* (Germar, 1823), *Choerorhinus squalidus* Fairmaire, 1858, *Mesites cunipes* Boheman, 1838, *Mesites pallidipennis* Boheman, 1838, *Pselactus spadix* (Herbst, 1795) and *P. avocadi*, the latter only known to him from the literature. Finally, Friedman (2009) recorded eight species in seven genera.

The Cossoninae fauna of the neighboring East Mediterranean countries has been surveyed more intensively, particularly in recent decades: ca. 40 species are recorded from Turkey (Osella *et al.* 1993; Avcin & Colonnelli 2011; Legalov *et al.* 2021; Ünal *et al.* 2022), five species from Lebanon (Szénási *et al.* 2019), and eight from Egypt (Omar 2012). There are numerous additional species recorded for the area (Alonso-Zarazaga *et al.* 2023); however, some of these records originate from old literature and need confirmation.

The current study shows that there are nine species of Cossoninae presently known in Israel, at least one of them introduced. It is possible that additional species will be reported later, either indigenous or introduced. In 2007, the author sent 40 specimens of Israeli Cossoninae to a young European researcher who was intending to work on them but since then contact with him was lost. According to the author's records those included *Brachytemnus porcatus*, *Caulophilus oryzae*, *Choerorhinus squalidus*, *Mesites cunipes*, *M. pallidipennis*, *Pselactus spadix* and two specimens belonging to genera that the author was unable to identify in 2007.

#### MATERIALS AND METHODS

The studied material is deposited in the Coleoptera Collection of The Steinhardt Museum of Natural History, Tel Aviv University, Israel (SMNHTAU). The type series of *Pseudomimus avocadi* is deposited in the Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany (SGN), the photographs of *P. avocadi* were kindly made and provided by Ms Laura Marrero Palma (SGN).



**Figs 1–12.** Cossoninae of Israel, dorsal view: (1) *Choerorhinus squalidus*, habitus; (2) *Choerorhinus squalidus*, head and pronotum; (3) *Amaurorhinus bewickianus*, habitus; (4) *Caulophilus oryzae*, habitus; (5) *Caulophilus oryzae*, head and pronotum; (6) *Pselactus spadix*, habitus; (7) *Pselactus spadix*, head and pronotum; (8) *Brachytemnus porcatus*, habitus; (9) *Brachytemnus porcatus*, head and pronotum; (10) *Melicius gracilis*, head and pronotum; (11) *Rhyncolus sculpturatus*, head and pronotum; (12) *Rhyncolus sculpturatus*, habitus.



Photographs of the beetles 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 in Adobe Photoshop CS5. Photographs of habitats and plants were taken by the author, unless stated otherwise.

Transliterated names of localities in Israel follow the *Israel Touring Map* (Survey of Israel 2009). Where names of localities have changed, the most recent transliterated Hebrew names are given followed by the alternative, old or erroneously cited names in brackets, e.g. 'En Hemed [Aqua Bella].

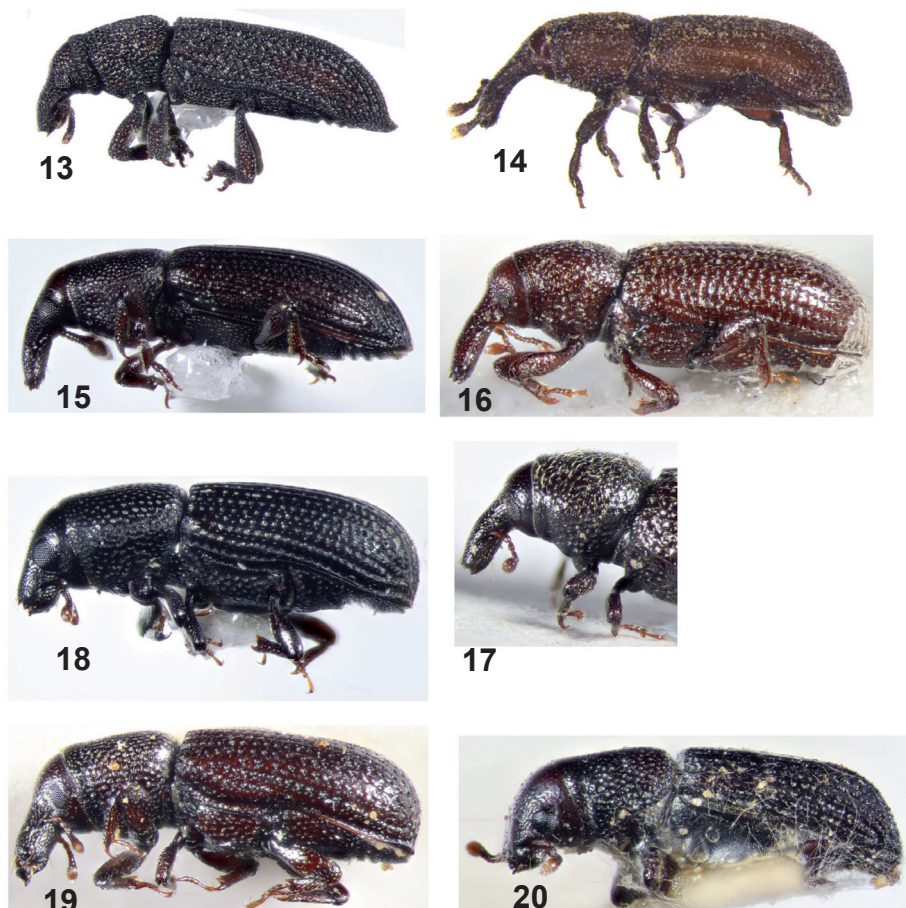
The countries in the Distribution section are listed from north to south and from west to east within larger geographic units.

The full synonymy of the taxa treated in the present article is covered by Alonso-Zarazaga *et al.* (2023).

## TAXONOMY

### Key to genera and species of Cossoninae in Israel

- 1 Humeral calli absent, elytral base rounded; flightless (Figs 3, 6)..... 2
- Humeral calli present, elytral base angular; able to fly (Figs 1, 2, 4, 8, 12) ..... 3
- 2 Antennal funicle 5-segmented; rostrum bent at antennal insertion in lateral view; eye small, with <5 ommatidia; body slender, elytra glabrous, appearing completely bare, rarely at apical third with small erect setae, much shorter than width of elytral interstriae; body length 1.9–2.7 mm (Figs 3, 14).....  
..... *Amaurorhinus bewickianus*
- Antennal funicle 7-segmented; rostrum nearly straight; eye large, flat, with >20 ommatidia; body more rounded, elytra coarsely sculptured, covered entirely by straight subrecumbent setae, distinctly longer than width of elytral interstriae; body length 2.7–3.8 mm (Figs 6, 7, 16, 17)..... *Pselactus spadix*
- 3 Antennal funicle 5-segmented; body and elytra coarsely sculptured, pronotal punctures of irregular form, more or less contiguous, interstriae narrow, sharp, smaller than diameter of a puncture, medially sharply upraised to form sharp ridges; body length 2.3–3.2 mm (Figs 1, 2, 13)..... *Choerorhinus squalidus*
- Antennal funicle 7-segmented; body and elytra finely sculptured, glabrous or slightly shagreened, other characters variable ..... 4
- 4 Rostrum at least twice as long as head; body slightly flattened dorso-ventrally; protibia medially with blunt projection ..... 5
- Rostrum at most 1.1× as long as head or shorter; body cylindrical; protibia medially without projection ..... 7
- 5 Antenna inserted at middle or slightly before middle of rostrum in both sexes; body length 1.9–3.2 mm (Figs 4, 5, 15, 30)..... *Caulophilus oryzae*
- Antenna inserted behind middle of rostrum (male rostrum wide, coarsely punctate) or at base or close to base (female rostrum slender, glabrous); body length 3.5–7.5 mm (Figs 21–29)..... 6



**Figs 13–20.** Cossoninae of Israel, lateral view: (13) *Choerorhinus squalidus*, habitus; (14) *Amaurorhinus bewickianus*, habitus; (15) *Caulophilus oryzae*, habitus; (16) *Pselactus spadix*, female, habitus; (17) *Pselactus spadix*, male, head and pronotum; (18) *Brachytemnus porcatus*, habitus; (19) *Melicius gracilis*, habitus; (20) *Rhyncolus sculpturatus*, habitus.

- 6 Body unicolorous, dark brown to reddish brown; pronotal disc distinctly micro-reticulate between punctures; interpunctural spaces on elytral declivity with well separated round punctures; body length 4.0–7.5 mm (Figs 21–23, 26, 27).....  
 ..... *Mesites cunipes*
- Body usually bicolorous: pronotum darker, nearly black, elytra and appendages brown to testaceous; pronotal disc between punctures smooth; interpunctural spaces on elytral declivity coarsely punctated by contiguous irregular, often transverse punctures; body length 3.5–7.0 mm (Figs 24, 25, 28, 29).....  
 ..... *Mesites pallidipennis*

- 7 Rostrum slightly longer than head; eye flat; pronotum with contiguous punctures; male profemur incrassate; body length 2.2–3.5 mm (Figs 10, 19) ..... *Melicius gracilis*  
 – Rostrum as long as, or shorter than head; eye flat or strongly protruding; pronotum with distinct round or oblong punctures..... 8
- 8 Eye flat; rostrum longer than wide in dorsal view, not tapering apically; pronotal punctures round; interstriae slightly convex; body length 2.9–3.8 mm (Figs 8, 9, 18) ..... *Brachytemnus porcatus*  
 – Eye strongly protruding; rostrum as long as wide, slightly tapering apically; pronotal punctures oblong; interstriae medially upraised into longitudinal ridges; body length 3.5–4.5 mm (Figs 11, 12, 20)..... *Rhyncolus sculpturatus*

Subfamily Cossoninae Schoenherr, 1825

Tribe Choerorhinini Folwaczny, 1973

Genus *Choerorhinus* Fairmaire, 1858

*Choerorhinus squalidus* Fairmaire, 1858

(Figs 1, 2, 13, 33)

**Material examined: Israel:** *Upper Galilee:* Gush Halav, 18.v.1959, J. Halperin, ex *Ficus carica* (2 ex.); *ibidem*, 8.vi–29.ix.1959, J. Halperin, light trap on *Ficus carica* (1 ex.); *Lower Galilee:* Shefar'am, 7.i.1959, J. Halperin, ex *Ficus carica* (1 ex.); *ibidem*, 3.i.1959, J. Halperin, ex *Ficus carica* stem (1 ex.); *Judean Hills:* Yerushalayim, 'En Kerem, 11.xi.2019, Y. Salaviz, on *Ficus carica* trunk (1 ex.).

**Distribution:** Circum-Mediterranean. Europe: Spain, France, Hungary, Italy, Malta, Bosnia and Herzegovina, Croatia, Greece; North Africa: Algeria, Tunisia, Egypt; Asia: Turkey, Lebanon, Israel (Halperin & Fremuth 2003; Hlaváč & Maughan 2013; Alonso-Zarazaga et al. 2023).

**Biology:** This species is associated with *Celtis australis* L. (Cannabaceae), *Ficus carica* L. (Moraceae), *Ilex aquifolium* L. (Aquifoliaceae), *Juglans regia* L. (Juglandaceae), *Platanus orientalis* L. (Platanaceae), *Populus alba* L. (Salicaceae), *Quercus petrae* (Matt.) Liebl. (as *sessiliflora* Salisb.), *Q. robur* L. (as *ruber*) (Fagaceae) and *Ulmus glabra* Huds. (as *campestris* L. Mill., Wilkomm) (Ulmaceae) (Folwaczny 1973). Halperin and Fremuth (2003) recorded the association of this species in Israel with *Celtis australis*, *Populus euphraticus* Oliv. and *Ulmus minor* Mill. Amazingly, all specimens from Israel, either those by Halperin or more recent, were collected or reared from *Ficus carica* (Fig. 33).

Tribe Cossonini Schoenherr, 1825

Genus *Mesites* (s. str.) Schoenherr, 1838

*Mesites cunipes* Boheman, 1838

(Figs 21, 22, 23, 26, 27, 35)

**Material Examined: Israel:** *Hula Valley:* Nahal 'Iyyon, S Mappal haTahana, 480 m, 14.viii.2017, L. Friedman (1 ex.); Qiryat Shemona, 3.i.1958, J. Halperin, ex dead trunk of (?) *Salix* (1); *ibidem*, 3.viii.1959, J. Halperin, ex old trunk of (?) *Salix* (1 ex.); *Golan Heights:* Panyas, 2.viii.1978, D. Simon

(6 exx.); *ibidem*, 6.viii.1986, A. Freidberg (1 ex.); Zenobar [Golan, Sanabir], 6.xi.1967, J. Halperin, ex *Salix*, 25.v.1968 (1 ex.); *Lower Galilee*: Nahal Zippori, 'En Yivqa', shaded side, 27.viii.2018, L. Bentor (1 ex.); *Carmel Ridge*: Nahal Shelef, 'En Meholelim, 19.iv.2023, T. Eshcoly (1 ex.).

**Distribution:** Mediterranean, Caucasus and Middle Asia. Europe: Spain, France, Switzerland, Italy, Croatia, Macedonia, Bulgaria, Greece, Romania, Ukraine, Russia; North Africa: Algeria, Egypt; Asia: Turkey, Cyprus, Israel, Azerbaijan, Iran, Turkmenistan (Folwaczny 1973; Halperin & Fremuth 2003; Hlaváč & Maughan 2013; Nazarenko & Gontarenko 2017; Alonso-Zarazaga *et al.* 2023). In Israel, confined to the northern part of the country: Golan Heights, Upper and Lower Galilee, Carmel Ridge and Yizre'el Valley.

**Biology:** This species lives and develops in dead trunks of *Populus* and *Salix* (Salicaceae) (Folwaczny 1973; Nazarenko & Gontarenko 2017). Halperin and Fremuth (2003) reported *Pinus* spp. (Pinaceae), *Populus* spp. and *Salix* spp.; the material in SMNHTAU includes three specimens collected by Halperin that emerged from *Salix* sp. The only specimen the author collected was spotted walking on the trunk of *Salix* sp (Fig. 35). The association with pines (unlikely) and poplars (possible) remains unconfirmed.

*Mesites pallidipennis* Boheman, 1838

(Figs 24, 25, 28, 29, 36)

**Material examined:** **Israel:** *Northern Coastal Plain*: Qiryat Hayyim, 22.iv.2001, A. Orlov, "under sea rubbish" (2 exx.); 3 km N of 'Atlit, sea coast, 17.v.2002, A. Orlov, "under sea rubbish" (2 exx.).

**Distribution:** Circum-Mediterranean: Europe: Spain, France, Italy, Croatia, Macedonia, Bulgaria, Greece, Romania, Ukraine, Russia; North Africa: Algeria, Tunisia, Egypt; Asia: Turkey, Cyprus, Lebanon, Azerbaijan (Folwaczny 1973; Hlaváč & Maughan 2013; Nazarenko & Gontarenko 2017; Alonso-Zarazaga *et al.* 2023). Recorded from Israel by Halperin and Fremuth (2003) from the Upper Galilee and Yizre'el Valley, which probably refers to misidentified specimens of *M. cunipes*.

**Biology:** This species develops in sea-water-soaked wood: driftwood, wooden parts of constructions, etc., but also in old trunks of *Pinus* and *Populus* (Folwaczny 1973; Nazarenko & Gontarenko 2017). In Israel it has recorded from *Populus* spp., *Salix* spp. (Halperin & Fremuth 2003) but these are most probably misidentifications of *M. cunipes*.

Tribe Dryotribini LeConte, 1876

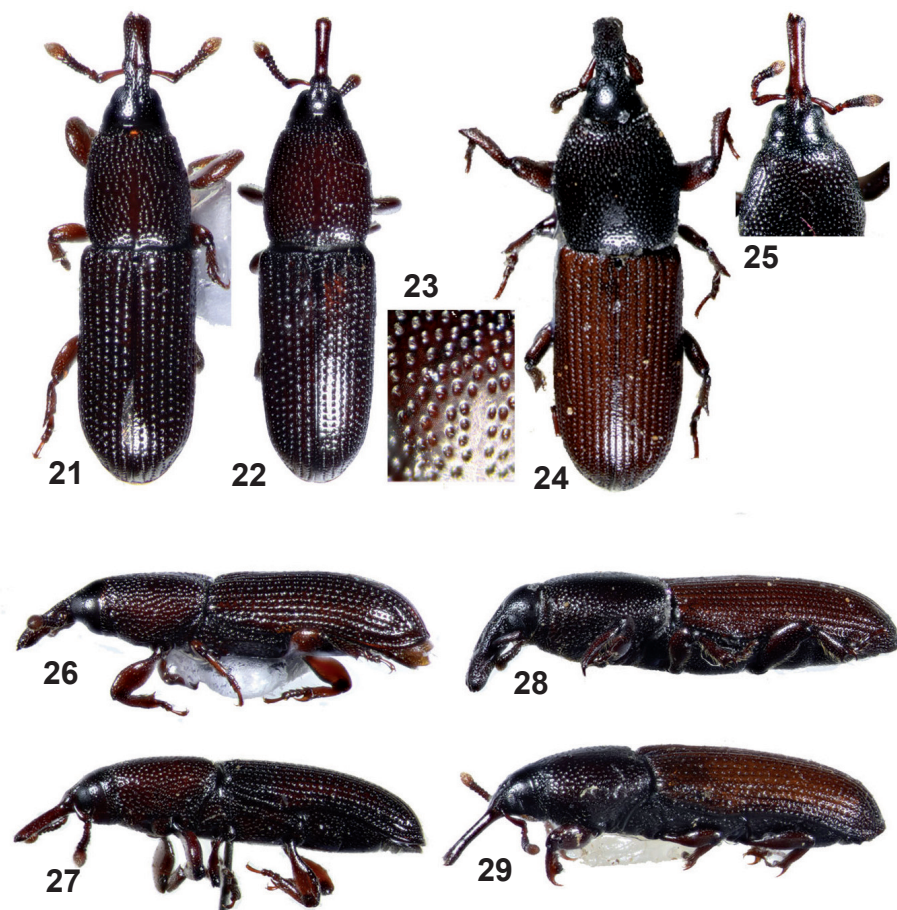
Genus *Amaurorhinus* Fairmaire, 1860

*Amaurorhinus bewickianus* (Wollaston, 1860)

(Figs 3, 14, 34)

**Material examined:** **Israel:** *Judean Desert*: Tell, Lahav-'Arad, ii.1969, M. Warburg (4 exx.), either *Judean Desert*: Har Herodion, or *Central Coastal Plain*: Bar-Ilan University, ex cork from Portugal, 2019, E. Weiss (1 ex.) (see Comments below).





Figs 21–29. *Mesites* spp.: (21) *M. cunipes*, male, dorsal view; (22) *M. cunipes*, female, dorsal view; (23) *M. cunipes*, microsculpture of pronotum; (24) *M. pallidipennis*, male, dorsal view; (25) *M. pallidipennis*, female, head and pronotum, dorsal view; (26) *M. cunipes*, male, lateral view; (27) *M. cunipes*, female, lateral view; (28) *M. pallidipennis*, male, lateral view; (29) *M. pallidipennis*, female, lateral view.

**Distribution:** Circum-Mediterranean. Europe: Spain, France (Corse), Italy, Malta, Greece; North Africa: Canary Islands, Madeira, Algeria, Tunisia, Egypt; Asia: Cyprus, Syria, Lebanon, Israel (Folwaczny 1973; Hlaváč & Maughan 2013; Alonso-Zarazaga et al. 2023).

**Biology:** This species develops in rotten wood; occurs on seashores, in detritus in flooded areas, under dung, in walls (built of wood or containing wooden parts) (Folwaczny 1973). Alfieri (1976) recorded this species from ancient Egyptian mummies, emphasizing, that this was most probably a recent infestation.

**Comments:** So far, only very few specimens of *A. bewickianus* have been found in Israel. Four specimens originate from an unnamed locality on the road between Lahav and 'Arad, that is noted as "tell", the local name for an artificial mound formed by the overlying debris of ancient settlements (after Negev and Gibson 2001). Most probably the weevils were found in the archaeological site, known recently as Tel 'Arad, the archaeological mound above the Canaanite (5,000 – 2,500 BCE) and Israelite (2,500 – 600 BCE) settlements. The weevils were collected by the late Prof. Michael R. Warburg, who studied wood-lice (Isopoda), and collected numerous samples of the latter and, as a by-product, a rich assortment of other soil arthropods. Therefore, it is clear that the weevils were either sifted from the soil samples or collected with pitfall soil traps. An additional single specimen collected recently in Israel is of an unclear source. It was found on the plant remnants collected by archaeobotanists in the 2,000-year-old fortress of Herodion (Herodium) (Fig. 34), built on the western edge of the Judean Desert by order and under personal supervision of Herod the Great (ca. 72 BCE – ca. 4 BCE); although it was also suspected of emerging from the cork stoppers for glass tubes used in the archeobotanical lab, imported from Portugal (Ehud Weiss, pers. comm.). The author visited Herodion recently and noted numerous remnants of the ancient wooden beams protruding from the walls. Both localities are in the desert. All this confirms that *A. bewickianus* prefers dead wood, and particularly old dry dead wood.

Genus *Caulophilus* Wollaston, 1854  
*Caulophilus oryzae* (Gyllenhal, 1838)  
 (Figs 4, 5, 15, 30, 31)

*Rhyncolus oryzae* Gyllenhal, 1838: 1075.

*Rhyncolus lauri* Gyllenhal, 1838: 1076.

*Cossonus pinguis* Horn, 1873: 442.

*Caulophilus sculpturatus* Wollaston, 1854: 315.

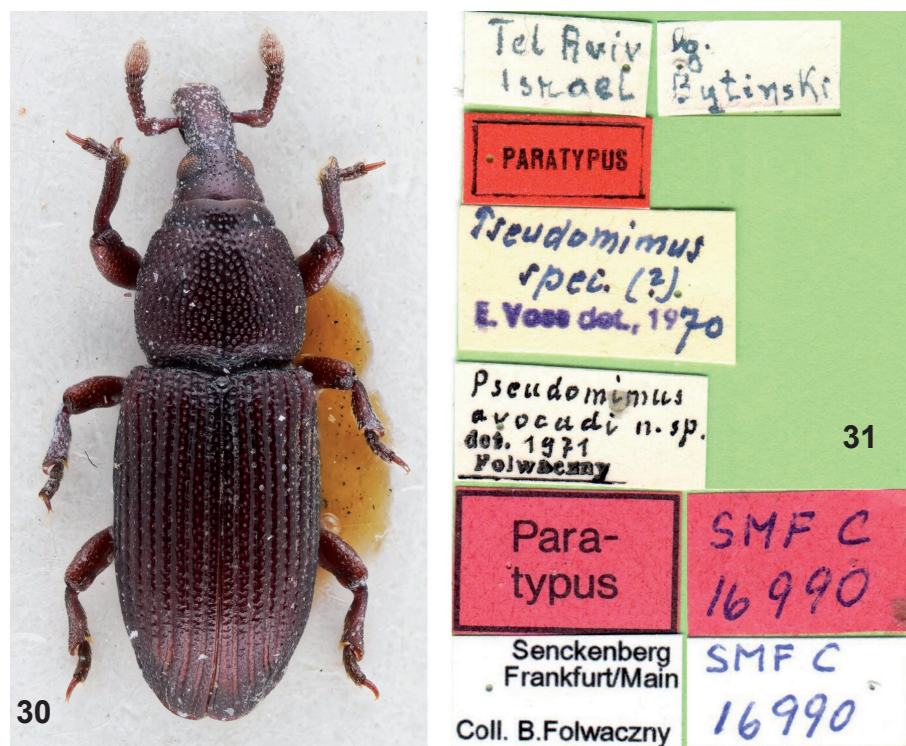
*Pseudomimus avocadi* Folwaczny, 1972: 91, **n. syn.**

**Holotype:** sex unknown (SGN, not examined): Israel: Tel Aviv, leg. Bytinski.

**Material examined: Israel:** *Central Coastal Plain:* Gan Shemu'el, avocado plantation, 14.i.2018, PPIS (1 ex.), *ibidem*, 22.i.2018 (3 exx.); Ra'anana, vi.1967, H. Bytinski-Salz, ex Avocado (9 exx.); *Southern Coastal Plain:* Gan Shelomo, avocado plantation, 23.ii.2018, L. Friedman, ex seed of *Persea americana* (16 exx. adults + some larvae in alcohol).

**Distribution:** Nearctic Region, introduced in Europe (described from Sweden) (Gyllenhal 1838; Kuschel 1962; Whitehead 1982; Anderson 2002; Peck 2005; Hlaváč & Maughan 2013; Alonso-Zarazaga *et al.* 2023). Although Alonso-Zarazaga *et al.* (2023) record it only from Spain, UK, Canary Islands and Madeira, it is most probably more widely distributed, if not cosmopolitan (Whitehead 1991). First recorded from Israel by Friedman (2009).

**Biology:** This species develops in the rotten seeds of avocado (*Persea americana* Mill.) (Lauraceae); recorded from a large variety of stored commodities: rice, corn, pulses, mammy apple, cola nuts, yam tubers, ginger roots, seeds of various plants



Figs 30–31. *Caulophilus oryzae*, paratype of *Pseudomimus avocadi* Folwaczny, 1972 (SGN): (30) habitus, dorsal view; (31) labels (both photographs courtesy Laura Marrero Palma, SGN).

etc., although it definitely prefers avocado seeds (Cotton 1921, 1922; Kuschel 1962; Whitehead 1982, 1991; Salas-Araiza *et al.* 2001; Anderson 2002). Considered as a stored product pest of low importance, it does not attack well-dried and previously undamaged stored products (Whitehead 1982, 1991). In Israel, avocado plantations occupy approximately 7,000 hectares and an expected yield of almost 100,000 tons of fruit per year; 70 % of the plantations in the coastal area, and the remaining in the Yizre'el Valley, the Hula Valley and the Jordan Valley (Dor 2023). *Caulophilus oryzae* occurs in all avocado plantations, but is completely overlooked by the agriculturalists, hence both adults, eggs, larvae and pupae stay unnoticed in the rotten seeds in the ripening fruit on the ground causing no damage.

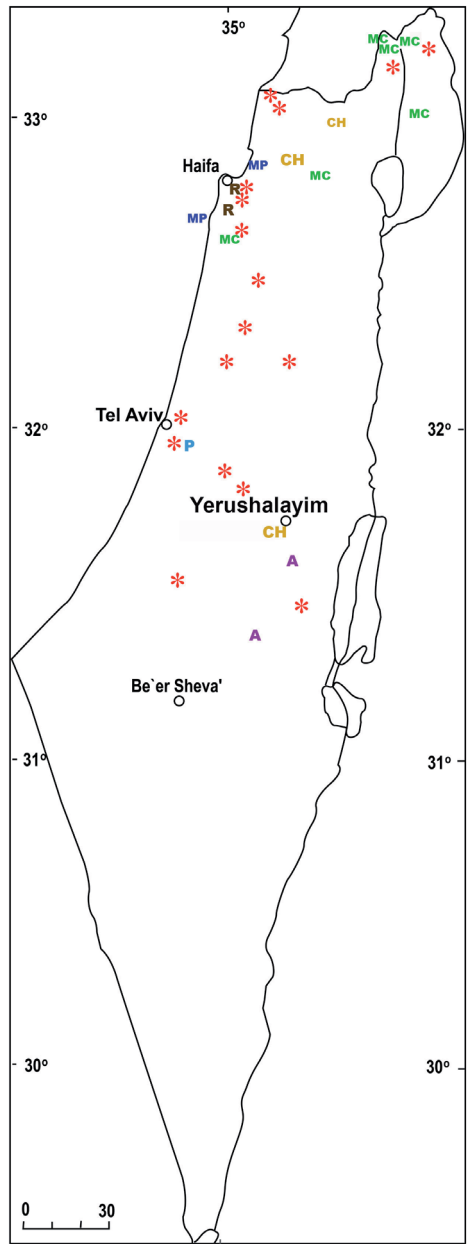
**Comments:** *Caulophilus* Wollaston is a mainly Neotropical genus, composed of four fossil in Dominican amber (Davis & Engel 2007) and 16 extant (Kuschel 1962) species, four of them occurring in the Caribbean, and extending also into the Nearctic Region (Northern Mexico, Southern USA) (Kuschel 1962; Whitehead 1982; Salas-Araiza *et al.* 2001; Anderson 2002; Peck 2005). One of them, *C. oryzae*, is known as a pest of stored products and in particular of the seeds of avocado (!)

(Cotton 1921, 1922; Kuschel 1962; Whitehead 1982, 1991; Salas-Araiza *et al.* 2001; Anderson 2002). *Caulophilus oryzae*, the broad-nosed grain weevil, was described by Gyllenhal (1838: 1075) from Stockholm, Sweden, found damaging rice of unknown origin in merchant shops, and immediately redescribed by the same Gyllenhal (1838: 1076) under the junior synonymous name of *Rhyncholus lauri* (Gyllenhal, 1838) from avocado seeds (!) from Mexico. Thus, this American weevil, even before being described, was already an invasive pest in Europe before the middle of the nineteenth century.

*Pseudomimus* Hartmann, 1904 was originally erected for *P. corpulentus* Hartmann, 1904 from Tanzania. Since then, several species from the western, central and eastern tropical Africa have been assigned to it (Alonso-Zarazaga & Lyal 1999). *Pseudomimus avocadi* Folwaczny, 1972 was described by Bronislaw Folwaczny (1972) from a series of ten individuals from Tel Aviv, reared by the eminent Israeli entomologist Hanan Bytinski-Salz from the seeds of avocado. The series of nine above cited specimens, mostly teneral, labeled “ex Avocado, Ra’anana, c.l.vi.1967, Bytinski-Salz” has probably been reared together with the type series of *Pseudomimus avocadi*. The difference between the recorded localities (Tel Aviv and Ra’anana respectively) can be easily explained: either the avocado orchard was in Ra’anana and the weevils were reared in Tel Aviv, or Tel Aviv was used as a common denominator for both places (Ra’anana is located 16 km NE of Tel Aviv, in 1960s it was a small place, hardly appearing on a map). According to the labels (Fig. 31), the type series was previously studied by the famous weevil expert Edward Voss and then by Folwaczny. The author of this paper speculates that both specialists were influenced by Bytinski’s ideas on the presence of Afrotropical elements in the Israeli entomofauna (Bytinski-Salz 1961), and this misled them to misidentify the American *Caulophilus* as an African *Pseudomimus*. Unfortunately, they did not take into account the low probability that an Afrotropical species would attack specifically a *Persea*, the plant native to the Neotropical Region. *Pseudomimus avocadi* was never collected since its original description before being discovered by the author in rotten avocado seeds in 2018. Most of the attempts to find this species were concentrated in the Jordan Valley, the ‘Arava Valley and the Negev Desert, areas in Israel in which insects with Afrotropical affinities predominantly occur (Bytinski-Salz 1961; Freidberg 1988; Friedman 2009, 2019). The weevils from the type series in SGN, and those from 1967 and from 2018 in SMNHTAU, are identical and perfectly fit the description of *P. avocadi* (Folwaczny 1972), and lead to *Caulophilus* and not to “*Pseudomimus*” in the key to the Palearctic Cossoninae (Folwaczny 1973).

Therefore, *Pseudomimus avocadi* Folwaczny, 1972 is here proposed as a new junior subjective synonym of *Caulophilus oryzae* (Gyllenhal, 1838). Note that *Caulophilus* belongs to the tribe Dryotribini LeConte, whereas *Pseudomimus* to the tribe Rhyncolini Gistel. Thus, this is not an Israeli endemic with Afrotropical affinities, but an invasive species of Nearctic or Neotropical origin.





**Fig. 32.** The distribution of the Cossoninae species in Israel: A – *Amaurorhinus bewickianus*, CH – *Chorerorhinus squalidus*, MC – *Mesites cunipes*, MP – *Mesites pallidipennis*, P – *Pselactus spadix*, R – *Rhyncolus sculpturatus*, \* – *Brachytemnus porcatus*.



**Figs 33–36.** Natural habitats and host plants of the Cossoninae in Israel: (33) the trunk of *Ficus carica* L. (Moraceae), on which *Choerorhinus squalidus* was collected in ‘En Kerem, one of the southwestern suburbs of Yerushalayim; (34) ruins of Herodion fortress in the Judean Desert, the habitat of *Amaurorhinus bewickianus*, probably feeding and developing on the ancient timbers used in the fortress construction ca. 2,100 years ago; (35) Mappal haTahana, one of the waterfalls of the Nahal ‘Iyyon, the author is standing left to it, in front of *Salix* thicket, where *Mesites cunipes* was collected (photo taken by one of the author’s children); (36) sea shore near Qesarya, ca. 25 km south of ‘Atlit, habitat of *Mesites pallidipennis* (photo courtesy Anna Rozen).

Tribe Onycholipini Wollaston, 1873  
 Genus *Brachytemnus* Wollaston, 1873  
*Brachytemnus porcatus* (Germar, 1823)

(Figs 8, 9, 18, 37)

**Material examined: Israel:** *Golan Heights*: ‘En Ziwan, 3.iv.2022, Shahr Mizrahi (photographs); *Hula Valley*: Ne’ot Mordekhay, 25.iv.2004, L. Zarabi, V. Chikatunov, pheromone trap (1 ex.); *ibidem*, 14.vi.2004 (3 exx.); *ibidem*, 30.v.2005 (2 exx.); *Upper Galilee*: Shelomi, 30.v.2023, Ran Levi (photographs); Nahal Keziv, 20.v.1999, M. Finkel (1 ex.); *Carmel Ridge*: Haifa, Mt. Carmel, 22.ii.1946, H. Bytinski-Salz, ex *Pinus halepensis* (10 exx.); *ibidem*, 19.iv.1964, J. Halperin, ex *Pinus*

*halepensis* (5 exx.); *ibidem*, 22.iv.1964, J. Halperin, ex *Pinus halepensis* (1 ex.); *ibidem*, 30.iv.1964, J. Halperin, ex *Pinus halepensis* (8 exx.); *ibidem*, 11.v.1964, J. Halperin, ex *Pinus halepensis* (4 exx.); *ibidem*, 12.vii.2003, V. Kravchenko, V. Chikatunov (4 exx.); Horeshat ha'Arba'im, 4–25.vi.2007, J. Buse (3 exx.); *ibidem*, 8–29.vi.2007, J. Buse, window trap on *Quercus calliprinos* (1 ex.); 'En haShofet, Irish Bridge, 19.v.2004, A. Gasith (1 ex.); *Samaria*: Horvat [H.] Dardar, 26.viii.1981, Q. Argaman (2 exx.); Kokhav Ya'ir, 27.xii.2001, A. Freidberg, Y. Zvik, L. Friedman, under bark of pine (3 exx.); Qedumim, 24.vi.2007, L. Friedman (7 exx.); *ibidem*, 16.v.2009, emerging from beam (70 mounted exx. + numerous unmounted exx.); *ibidem*, 23.iii.2018 (1 ex.); *Central Coastal Plain*: Tel Mond, 8.vi.2016, E. Gefen (4 exx.); Qiryat Ono, 27.vi.2002, I. Kedar, L. Friedman (21 mounted + numerous unmounted exx.); Tel Aviv, 13.vi.2007, W. Kuslitzky, light trap (1 ex.); *Southern Coastal Plain*: Segula, near Qiryat Gat, 5.v.1996, V. Chikatunov (9 exx.); *Foothills of Judea*: Ben Shemen Forest, Horvat Birit, 13.xii.2020, L. Friedman, under bark of *Pinus* (50 mounted exx. + numerous unmounted exx.); *Judean Hills*: Kesalon, 17.ix.1980, J. Halperin, ex *Pinus halepensis* (1 ex.); *Judean Desert*: Ma'on, 25.xii.2018, Yehuda Keller (photographs).

**Distribution:** West Palaearctic. Europe: Azores, Spain, France, Belgium, Sweden, Denmark, Latvia, Lithuania, Germany, Switzerland, Italy, Czech Rep., Austria, Poland, Slovakia, Hungary, Slovenia, Croatia, Montenegro, Albania, Bulgaria, Greece, Romania, Ukraine, Russia; North Africa: Morocco, Algeria; Asia: Turkey, Cyprus, Syria, Lebanon (Hlaváč & Maughan 2013; Alonso-Zarazaga *et al.* 2023). Recorded from Israel by Halperin and Fremuth (2003). One of the most widely distributed west Palaearctic cossonines, and the most common cossonine species in Israel, distributed throughout the Mediterranean part of the country, and penetrating into the desert areas following human activities.

**Biology:** This species lives and develops in decaying wood of various conifers (*Abies*, *Cedrus*, *Picea*, *Pinus*), and rarely also in deciduous trees; in living trees at various stages of deterioration, tree stumps and dead wood (Folwaczny 1973;



**Figs 37–38.** Natural habitats and host plants of the Cossoninae in Israel: (37) the stump of *Pinus halepensis* in Ben-Shemen Forest, the habitat of *Brachytemnus porcatus*; (38) the upper part of the Carmel Ridge, “Little Switzerland” Forest, *Pinus* spp. (Pinaceae) mixed in the Mediterranean scrub of the oaks *Quercus calliprinos* Webb (Fagaceae), the habitat of *B. porcatus* and *Rhyncolus sculpturatus*.

Yunakov *et al.* 2018; Legalov *et al.* 2021). In Israel, the weevils were found under bark of pines (*Pinus*) (Pinaceae), mainly *Pinus halepensis* Mill. (Halperin & Fremuth 2003; personal observations). Single individuals or small groups of individuals are found under bark of living pines, while aggregations can be found associated with dead or decaying wood. The author found an incalculable number of weevils under the bark of a relatively fresh pine stump in Ben Shemen Forest (Fig. 37); the weevils were preyed-upon by clown-beetles (Histeridae) of at least two species. Often clouds of swarming beetles emerge from the processed wood, sometimes years after its processing, scaring the owner of the property. The author personally observed such a swarm in May 2009 in his house in Qedumim, Israel. Beetles were emerging from the particular beam that was used for repair of the veranda windowsill, approximately two years earlier (summer 2007). The swarming masses of beetles resembled wisps of smoke as much as that at the first site the author was genuinely convinced that the beam was smoldering. From time to time the author received complaints from households, offices, sawmills, warehouses etc., while usually the source of the weevils was a single board. However, no significant damage was ever reported, even after the greatest appearance of the weevils.

Genus *Pselactus* Broun, 1886

*Pselactus spadix* (Herbst, 1795)

(Figs 6, 7, 16, 17)

**Material examined:** Israel: Central Coastal Plain: Ganne Yehuda, 6.v.1987, Asher, ex *Myrtus communis* (2 exx.).

**Distribution:** Cosmopolitan. Europe: Azores, UK, Ireland, Portugal, Spain, France, Belgium, Luxemburg, Norway, Sweden, Denmark, Estonia, Latvia, Lithuania, the Netherlands, Germany, Switzerland, Italy, Malta, Czech Rep., Austria, Poland, Slovakia, Hungary, Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Montenegro, Albania, Bulgaria, Macedonia, Greece, Romania, Belarus, Ukraine, Russia; North Africa: Madeira, Morocco, Algeria, Egypt; Asia: Turkey, Iran; introduced into the Australian, Nearctic and Neotropical Regions; now probably distributed worldwide (Folwaczny 1973; Hlaváč & Maughan 2013; Alonso-Zarazaga *et al.* 2023). Recorded from Israel by Halperin and Fremuth (2003).

**Biology:** This species occurs in the littoral zone and in wooden constructions. It lives and develops on dead wet wood, and has been recorded from various deciduous trees and shrubs: *Acer* (Aceraceae), *Celtis* (Cannabaceae), *Populus*, *Salix* (Salicaceae), *Ulmus* (Ulmaceae), and *Cotinus coggygria* Scop. (Anacardiaceae) (Folwaczny 1973), from *Pinus* spp. (Halperin & Fremuth 2003), rotten timber (Yunakov *et al.* 2018). Here it is recorded from the cultivated *Myrtus communis* L. (Myrtaceae). This cossonine is extremely polyphagous.



Tribe Rhyncolini Gistel, 1848  
 Subtribe Phloeophagina Voss, 1955  
 Genus *Melicius* Alonso-Zarazaga, 2002  
*Melicius gracilis* (Rosenhauer, 1856)  
 (Figs 10, 19)

**Material examined: Israel:** locality unknown [intercepted?], 2.v.1999, PPIS, 11088, “*Eremotes porcatus*” det. Q. Argaman (4 exx.).

**Distribution:** West Palaearctic. Europe: Portugal, Spain, France, Austria, Italy, Malta, Slovenia, Croatia, Bosnia-Herzegovina, Bulgaria, Montenegro, Russia; North Africa: Morocco, Algeria, Egypt (Omar 2012; Hlaváč & Maughan 2013; Alonso-Zarazaga *et al.* 2023). New record for Israel.

**Biology:** This species lives and develops in dead wood of deciduous trees, and has been recorded from the following genera: *Acer* (Aceraceae), *Fagus* (Fagaceae), *Fraxinus* (Oleaceae), *Juglans* (Juglandaceae), *Quercus* (including *Quercus suber* L.) (Fagaceae), *Populus* (Salicaceae), *Ulmus* (Ulmaceae) (Folwaczny 1973).

**Comments:** This species may not be resident in Israel. The studied material originates from the collection of the Plant Protection and Interception Services, Ministry of Agriculture of Israel. The author is indebted to Dr Shahar Samra, Dr Eitan Recht and Dr Merav Hadar-Maor (PPIS) for their attempt to reveal the origin of this sample, but the search was fruitless. Therefore, the author is not sure if the weevils were collected in Israel or only intercepted on some kind of cargo.

One would expect instead to find in Israel *Melicius cylindrus* (Boheman, 1838) which is recorded from the East Mediterranean (e.g. Turkey, Syria and Lebanon); however, the existence of *M. gracilis* in Israel is not particularly surprising, as it is recorded from Egypt. According to Folwaczny (1973), Omar (2012) and Zabaluev (2023), *M. gracilis* is easily separated from *M. cylindrus* by the following characters. In *M. gracilis* pronotum as long as wide, rostrum slender, distinctly longer than head, tempus shorter than eye, head not constricted at tempora, procoxae sub-contiguous; whereas in *M. cylindrus*: pronotum longer than wide, rostrum thick, nearly as long as head, temple as long as eye, head slightly but distinctly constricted at temple, and procoxa widely separated.

Subtribe Rhyncolina Gistel, 1848  
 Genus *Rhyncolus* Germar, 1817  
*Rhyncolus sculpturatus* Walzl, 1839  
 (Figs 11, 12, 20, 38)

**Material examined: Israel:** Carmel Ridge: Mt. Carmel, Technion, 3.vi.1964, J. Halperin, ex *Pinus pinea*, 14.iv.1966 (1 ex.); *ibidem*, ex *Pinus pinea*, 2.v.1966 (1 ex.); Nahal Oren, 24.iv.1995, T. Pavliček & V. Chikatunov (1 ex.).

**Distribution:** West Palaearctic. Europe: Spain, France, Norway, Sweden; Finland, Denmark, Germany, Czechia, Austria, Italy, Hungary, Croatia, Bosnia-Herzegovina, Montenegro, Greece, Latvia, Lithuania, Poland, Slovakia, Romania, Belarus, Russia; Asia: “Caucasus”, Turkey (Folwaczny 1973; Hlaváč & Maughan 2013; Alonso-Zarazaga *et al.* 2023). New record for Israel.

**Biology:** This species occurs in mixed forests where it lives and develops in dead wood of coniferous and deciduous trees (Folwaczny 1973). In Israel it has been reared from *Pinus pinea* L. (Pinaceae).

**Comments:** This is a new record for Israel, both the genus and the species. Only three specimens are available, all from the upper part of the Carmel Ridge; two of them reared from the introduced species *P. pinea*, either planted or escaped from cultivation (Danin & Fragman-Sapir 2023). The natural distribution of *R. sculpturatus* does not reach the East Mediterranean. Most probably *R. sculpturatus* is an introduced species in Israel, perhaps introduced together with its host plant.

*Rhyncolus sculpturatus* is the first and the only *Rhyncolus* species recorded so far from Israel, although one would rather expect to find the East Mediterranean *Rhyncolus syriacus* Desbrochers des Loges, 1892, known from Greece, Cyprus, Turkey and Syria (Alonso-Zarazaga *et al.* 2023). Additional endeavors to find it should be attempted in the Upper Galilee, northern parts of the Golan Heights and on Har Hermon, the areas comprising a significant number of the “northern” faunal elements.

## DISCUSSION

Israel is located on the southern border of the Palaearctic Region, its fauna possesses mainly species of West Palaearctic origin, comprising Euro-Siberian, Irano-Turanian (steppe), Saharo-Sindian (desert) and Mediterranean elements, as well as local endemics and occasionally Afrotropical and (rarely) Oriental faunal elements. We would expect these elements to be represented, in some proportion, in every studied group of animals, particularly in insects.

According to the recent study, the Israeli fauna of Cossoninae is purely Palaearctic, although not as rich and diverse as might be expected. Some genera, rich in species and widely distributed in the Palaearctic Region, are not represented in Israel (e.g. *Cossonus* Clairville, 1798, *Phloeophagus* Schoenherr, 1838), or have a very limited representation (e.g., *Rhyncolus*). The Cossoninae fauna of Israel represents the southernmost edge of the distributional ranges of widely distributed West Palaearctic or Circum-Mediterranean species. Neither species with Saharo-Sindian, Afrotropical or Oriental affinities, nor local endemics were recorded so far. *Pseudomimus avocadi*, the sole species that has been previously considered as an Israeli endemic with Afrotropical affinities, proved to be a junior synonym of *Caulophilus oryzae*, an introduced stored grain pest of Neotropical origin.

The number of species of the Israeli fauna of Cossoninae (see Appendix, p. 96) does not differ much from that of nearby Lebanon in the north (Szénási *et al.*

2019) and Egypt in the south (Omar 2012), and is much less than in the Turkish fauna (Osella *et al.* 1993; Avgin & Colonnelli 2011; Legalov *et al.* 2021; Ünal *et al.* 2022). However, there are some species that might have been overlooked and will be revealed probably in the future, e.g. the Eastern Mediterranean *Rhyncolus syriacus*, the widely distributed Palaearctic species of *Rhyncolus* (*R. ater* (Linnaeus, 1758), *R. elongatus* (Gyllenhal, 1827), *R. punctatulus* Boheman, 1838, *R. reflexus* Boheman, 1838), the Circum-Mediterranean *Melicius cylindrus* (Boheman, 1838), and the cosmopolitan invasive *Hexarthrum exiguum* (Boheman, 1838).

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**APPENDIX****CHECKLIST OF COSSONINAE IN ISRAEL**

Taxa new to Israel are marked with an asterisk (\*).

Choerorhinini Folwaczny, 1973

*Choerorhinus squalidus* Fairmaire, 1858

Cossonini Schoenherr, 1825

*Mesites cunipes* Boheman, 1838

*Mesites pallidipennis* Boheman, 1838

Dryotribini LeConte, 1876

*Amaurorhinus bewickianus* (Wollaston, 1860)

*Caulophilus oryzae* (Gyllenhal, 1838)

Onycholipini Wollaston, 1873

*Brachytemnus porcatus* (Germar, 1823)

*Pselactus spadix* (Herbst, 1795)

Rhyncolini Gistel, 1848

Phloeophagina Voss, 1955

\**Melicius gracilis* (Rosenhauer, 1856)

Rhyncolina Gistel, 1848

\**Rhyncolus sculpturatus* Walzl, 1839