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Grasshoppers and locusts (Orthoptera: Caelifera) from the Palestinian territories at the Palestine Museum of Natural History

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ABSTRACT

We report on the collection of grasshoppers and locusts from the Occupied Palestinian Territories (OPT) studied at the nascent Palestine Museum of Natural History. Three hundred and forty specimens were collected during the 2013–2016 period. Forty species belonging to four families and ten subfamilies are recorded from various habitats. This is a rich fauna and this baseline survey can help understand the ongoing habitat destruction in this unstable part of Western Asia.

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Introduction

The first collections of Orthoptera built up by Dr. Festa from Jordan, Lebanon, Palestine, and Syria were studied by Giglio-Tos (1893, 1894) and Swinton (1899). Extensive detailed studies appeared at the turn of the twentieth century (Uvarov 1922a, 1922b, 1923a, 1923b, 1927, 1933, 1939; Buxton and Uvarov 1923).

The most comprehensive recent study on the Orthoptera of Palestine was published by Fishelson (1985). Since then, few additional studies on the taxonomy of Orthoptera have appeared (Eades 2000; Bidau 2014; Song et al. 2015). At the regional level, the family Acrididae was studied in several Middle Eastern countries. 48 species were recorded in Jordan (Harz 1985; Amr et al. 1997; Katbeh-Bader 2001; Eid et al. 2009; Willemse 2009), 79 in Egypt (Haggag et al. 2008; Haggag 2011), and 61 in Turkey (Mol, Şirin, and Taylan 2014). Popov (1980, 1981a, 1981b, 1997) reported on the Acridoidea, Pamphagidae and Tettigoniidae of Arabia and Oman. Other studies focused on the Orthoptera of Lebanon and Syria (Collingwood 1967; Massa and Fontana 2007). Thus there is a paucity of studies on this order of insects in the occupied Palestinian territory (OPT, central Palestine or the 'West Bank' of Jordan). This communication documents the collection of grasshoppers held at the Palestine Museum of Natural History (PMNH) at Bethlehem University, a new museum whose goals include the study of the neglected biodiversity of the Occupied Palestinian Territory.

Materials and methods

Field trips aimed to collect grasshoppers from different parts of the OPT were conducted in 2012–2016 (Annex 1). All specimens were preserved and deposited at PMNH. For identification, several keys and other sources were used (Fishelson 1985; Haggag et al. 2008; Massa, Buzzetti, and Fontana 2010). All scientific names and their authorities were verified according to Orthoptera Species File Online (www.orthoptera.speciesfile.org) and the Catalogue of Life (www.catalogueoflife.org).

Results

Family Acrididae

This is the largest family of grasshoppers with several subfamilies (Eades 2000). In Palestine, this family is represented by six subfamilies (Acridinae, Calliptaminae, Cyrtacanthacridinae, Eyprepocnemidinae, Gomphocerinae, and Oedipodinae).

Subfamily Acridinae

Acrida bicolor (Thunberg, 1815); Figure 1a.
Material examined: Deir Ballout (PMNH7129, 10 August 2015), Ithna (PMNH5029, 23 August 2014; PMNH5038, 23 August 2014).
Notes: This species was reported from East Africa and the Eastern Mediterranean region (Fishelson 1985). These are the new records from the OPT. It was reported from

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Figure 1. Pronotum of (a) *Acrida bicolor*; (b) *Truxalis eximia*; (c) *Truxalis procera*; (d) *Truxalis grandis*.

southern and central coastal plains and North of the Naqab Desert (Fishelson 1985).

Truxalis eximia Eichwald, 1830; Figure 1b.
Material examined: Kufr Zibad (PMNH1755.16, 18 May 2013). At Tayba (PMNH1734.26, 12 April 2013).
Notes: Distributed across Western and Central Asia and from the Caucasus to India (Fishelson 1985; Katbeh-Bader 2001). It was previously collected from the Jordan Valley and the Jerusalem hills (Fishelson 1985).

Truxalis grandis Klug, 1830; Figures 1d, 7a.
Material examined: Wadi Fukeen (PMNH6679, 27 May 2015).
Notes: This species is known from North and East Africa and Western Asia (Fishelson 1985). It was previously collected locally from Jericho (Giglio-Tos 1893; Buxton and Uvarov 1923).

Truxalis procera Klug, 1830; Figure 1c.
Material examined: Wadi Al Quff (PMNH3000.7, 13 August 2013).
Notes: This species is distributed across North and East Africa, Western Asia to as far as India (Fishelson 1985).

Duroniella laticornis (Krauss, 1909); Figure 2a.
Material examined: Bethlehem (PMNH5694, 8 February 2015; PMNH7540, 6 March 2016; PMNH7542, 6 March 2016). Salfit (PMNH6871, March 2015). Wadi Al Haramiya (PMNH7517, 13 March 2016).
Notes: This species is found in the area stretching from Bulgaria to Pakistan (Katbeh-Bader 2001; Sultana, Wagan, and Wagan 2013), and Anatolia (Mol and Zeybekoğlu 2013). Buxton and Uvarov (1923) collected this species from Jerusalem.

Subfamily Calliptaminae

Calliptamus barbarus palaestinensis Ramme, 1930; Figure 3.
Material examined: Dura (PMNH7940, 22 July 2016); Mar Saba (PMNH7912–13, 20 July 2016, PMNH7914–19, 20 July 2016, PMNH7909–10, 20 July 2016); Nabi Mousa (PMNH7911, 20 July 2016).
Notes: This is one of the most problematic species in the area studied. Jago (1963) presented a review of the genus *Calliptamus*. He suggested that two subspecies occur in Palestine based on the male phallic structural variation and the fact that in some localities such as Haifa, the two subspecies are found together (sympatry). *Calliptamus calliptamus coelesyriensis* inhabits same areas where both subspecies of *C. barbarus* occur. On the other hand, Fishelson (1985) recognized two subspecies of *palaestinensis* (*C. p. palaestinensis* and *C. palaestinensis erythrocnemis* Ramme, 1951) and two subspecies of *barbarus* (*C. b. pallidipes* Chopard 1943, and *C. barbarus deserticola* Vosseler 1902). He stated that *C. p. erythrocnemis* is distributed in the upper Galilee and the northern coastal plains, while *C. palaestinensis* occurs almost in all historic Palestine. As for *C. barbarus* subspecies, *C. b. pallidipesis* and *C. b. deserticola* are distributed in the coastal areas and the Naqab desert. However, both *C. p. erythrocnemis* and *C. b. deserticola* are now considered to be synonymous with *C. b. barbarous. C. barbarous* has three recognized subspecies, of which we have collected only *palaestinensis* (http://orthoptera.speciesfile.org/). However, the north-western areas of the OPT should also have *C. b. barbarous* (Jago 1963).

The confusion is likely due to the fact that this is a highly polymorphic species and subspecies differences are not determined. For example, there are significant variations in the colour of femur and tibia and the pronotum shape (Figure 3).

Calliptamus coelesyriensis Giglio-Tos, 1893; Figures 2b, 7c.
Material examined: Ain Samia (PMNH7181, 31 August 2015). Mar Saba (PMNH1748.8, 13 May 2013). Deir Ballout

Figure 2. (a) *Duroniella laticornis*; (b) *Calliptamus coelesyriensis*; (c) *Sphodromerus serapis*; (d) *Anacridium aegyptium*; (e) *Schistocerca gregaria*; (f) *Heteracris morbosa cincticollis*; (g) *Acrotylus insubricus*; (h) *Aiolopus thalassinus*; (i) *Oedipoda aurea* (Scale bar = 1 cm).

(PMNH7128, 10 August 2015). Nuwaima (PMNH6533–35, 24 April 2015). Wadi Al Abyad (PMNH6506–7, 24 April 2015; PMNH6515, 24 April 2015; PMNH6526, 24 April 2015; PMNH6528, 24 April 2015; PMNH6530, 24 April 2015). Wadi Al Makhrour (PMNH7192, 31 August 2015). Wadi Ta'amrah' (PMNH7328, 11 November 2015).

Notes: This species was reported from Palestine and Egypt (Uvarov 1939; Jago 1963; Fishelson 1985). Jago (1963) synomized *Metromerus* with *Calliptamus,* which was ignored by Fishelson (1985) and Katbeh-Bader (2001). The species was previously collected from Jericho (Giglio-Tos 1893), Wadi Kelt (Buxton and Uvarov 1923), the Jordan Valley, and the Jerusalem hills (Fishelson 1985). We noted some differences between the specimens from the arid regions (such as Mar Saba) and those from the regions with more Mediterranean-climate (such as Deir Ballout and Al-Makhrour), which may indicate that these specimens belong to a different subspecies. Yet a third species of *Calliptamus* (*C. tenuicercis*) might be found in our region but this genus needs careful revision since the last revision by Jago (1963).

Sphodromerus serapis (Serville, 1838); Figure 2c.

Material examined: Mar Saba (PMNH7910, 20 July 2016). Wadi Al Darajeh (PMNH8162, 9 May 2016). Wadi Ta'amrah (PMNH6905, 3 June 2015).

Notes: According to Fishelson (1985), two species are found in Palestine (*Serapis* and *Pillipes*). Harz (1985) described a new species from Jordan (*starcki*). But Katbeh-Bader (2001) mentioned only one from Jordan (*S. sacer*, yet the fourth species of the genus likely to occur in Palestine). This genus still needs revision, and we have very few specimens to evaluate and our specimens most closely resemble *Serapis*. According to Fishelson (1985), it was recorded in the rocky slopes of the Jerusalem hills associated with *Zygophyllum* and *Raemuria* vegetation.

Subfamily Cyrtacanthacridinae

Anacridium aegyptium (Linnaeus, 1764); Figure 2d.

Material examined: Hindaza (PMNH5279, 14 October 2014). Jiftlik (PMNH1708.7, 27 March 2014). Mar Saba (PMNH4099, 13 January 2014). Wadi Al Quff (PMNH3000.9, 30 August 2013).

Figure 3. Variations in morphology of the pronotum of *Calliptamus barbarus palaestinensis*.

Notes: The Egyptian Tree Locust has a wide distribution in North Africa, Europe, central and western Asia (Fishelson 1985; Gillett 2000; Katbeh-Bader 2001). It is reported from Jerusalem (Swinton 1899), the Jordan Valley and the Dead Sea areas (Fishelson 1985). It is considered to be a serious pest in many countries.

Schistocerca gregaria (Forskål, 1775); Figure 2e.
Material examined: At Tayba (PMNH1734.22, 12 April 2013).
Notes: The Desert Locust has a wide range of distribution extending from Africa, southern Europe, across the Middle East to Asia. It is considered to be one of serious pests in many countries.

Subfamily Eyprepocnemidinae

Eyprepocnemis plorans plorans (Charpentier, 1825)
Material examined: Ithna (PMNH5025, 23 August 2014).
Notes: This species was reported from Africa, the circum-Mediterranean region, the Caucasus to the Arabian Peninsula (Dirsh 1958; Katbeh-Bader 2001). It was also reported from Jerusalem (Giglio-Tos 1893).

Heteracris morbosa cincticollis (Walker, 1870); Figure 2f.
Material examined: Al Auja (PMNH7967, 25 July 2016). Nabi Mousa (PMNH7911, 20 July 2016). Wadi Al Qult (PMNH5879, 9 March 2015).
Notes: Two subspecies of *Heteracris morbosa* are recognized; *Heteracris morbosa morbosa* (Serville 1838) and *Heteracris morbosa cincticollis* (Walker 1870). Popov (1981b) summarized differences between these subspecies. This subspecies was collected from Hebron and Ein Gedi from the West Bank and from several localities in the Al Naqab Desert (Popov 1981b).

Heteracris syriaca (Brunner von Wattenwyl, 1861); Figure 4a.
Material examined: Beit Bassa (PMNH5776, 25 February 2015; PMNH5793, 25 February 2015). Bethlehem (PMNH6059, 21 March 2015; PMNH7536, 6 March 2016). Jericho (PMNH5435, 12 January 2015; PMNH7774–5, February 2016). Marah Rabah (PMNH3784, 15 March 2014). Wadi Al Quff (PMNH3725, 28 February 2014; PMNH3866, 16 March 2014; PMNH3870, 16 March 2014). Wadi Al Haramiya (PMNH7572, 13 March 2016). Wadi Al Qult (PMNH5900, 9 March 2015). Wadi Ta'amrah (PMNH7327, 11 November 2015).
Notes: This species is endemic to Lebanon, Palestine, Syria (Fishelson 1985). It was found in humid areas around Bethlehem (Mar Andrea) and Ramallah (Wadi Haramiya). Both *Pareuprepocnemis syriaca* (Brunner von Wattenwyl 1861) and *Pezotettix syriaca* Brunner von Wattenwyl, 1861 are considered to be synonyms of this species (Popov 1981b; Massa and Fontana 1998). Popov (1981b) listed specimens from Lebanon, Palestine and Jordan deposited in European museums. In Palestine, it was recorded in Jerusalem, Wadi Sarar and Artuf, and the Nablus area (Popov 1981b).

Subfamily Gomphocerinae

Chorthippus peneri Fishelson, 1969; Figure 5a.
Material examined: Bethlehem, (PMNH7937, 19 July 2016).
Notes: This species was originally described from Mount Hermon, Syria (Fishelson 1969). Other specimens were recorded in the Jerusalem hills in the West Bank (Fishelson 1985). It appears to be endemic to southern Syria, Palestine and perhaps Lebanon. Our specimen had a white tip on the last segment of antenna.

Dociostaurus curvicercus Uvarov 1942
Material examined: Bettein (PMNH8039, 27 July 2016; PMNH8041, 27 July 2016). Deir Jareer (PMNH8076–77, 27 July 2016; PMNH8084, 27 July 2016). Dura (PMNH7941, 22 July 2016). Tal Al Asour (PMNH8057, 27 July 2016). Wadi Al Qarn (PMNH8102, 29 July 2016). Yabroud (PMNH8030, 27 July 2016).
Notes: This species is endemic to the eastern Mediterranean (Fishelson 1985).

Dociostaurus* (*Kazakia*) *genei (Ocskay, 1832); Figure 5b.
Material examined: Mar Saba (PMNH7938–39, 20 July 2016).
Notes: Known from Europe, North Africa and Asia Minor (Fishelson 1985). Collected previously from Nebi Samwil, Jerusalem and Jericho (Buxton and Uvarov 1923).

Figure 4. (a) *Heteracris syriaca*; (b) *Dociostaurus genei*; (c) *Pyrgodera armata*; (d) *Oedaleus senegalensis*; (e) *Sphingonotus savignyi*; (f) *Scintharista notabilis blanchardiana*; (g) *Dericorys millierei*; (h) *Orchamus hebraeus*; (i) *Eremotmethis carinatus*; (j) *Tmethis pulchripennis asiaticus* (Scale bar = 1 cm).

Dociostaurus* (*Stauronotulus*) *hauensteini (Bolívar, 1893)
Material examined: Hebron Hills (PMNH6601, 13 May 2015). Nuwaima (PMNH6503, 24 April 2015; PMNH6522–23, 24 April 2015; PMNH6525, 24 April 2015). Sa'ir (PMNH1713.1, 7 April 2013). Wadi Al Quff (PMNH3932, 22 March 2014; PMNH3950–51, 11 April 2014).
Notes: This species is known to occur in Turkey, from the Trans-Caucasus to Iran, Palestine and Syria (Fishelson 1985; Şirin and Mol 2013).

Dociostaurus maroccanus (Thunberg, 1815)
Material examined: Wadi Ta'amrah (PMNH6911, 3 June 2015).
Notes: Known to occur in North Africa, Europe and Asia (Fishelson 1985). Previously reported from Wadi Kelt (Buxton and Uvarov 1923).

Notostaurus anatolicus (Krauss, 1896); Figure 5c.
Material examined: Artas (PMNH4707, 12 August 2014, PMNH4728, 13 August 2014).
Notes: This species is widespread across the southern states of the former Soviet Union through Iran and the Eastern Mediterranean (Fishelson 1985). It was previously reported from Nablus and Tulkarem (Buxton and Uvarov 1923).

Subfamily Oedipodinae

Acrotylus insubricus (Scopoli, 1786); Figure 2g.
Material examined: Ain Kenia (PMNH7086, 3 August 2015; PMNH7099, 3 August 2015; PMNH7111, 3 August 2015). Ajul (PMNH8105–13, 3 August 2016). Al Auja (PMNH7969, 25 July 2016). Al Walaja (PMNH4638, 8 August 2014; PMNH5247, 20 September 2015). Al Zawya (PMNH7116, 10 August 2015). Beir Zeit (PMNH7218, 2 September 2015). Beit Jala (PMNH5671, 4 February 2015). Bethlehem (PMNH7539; 6 March 2016; PMNH7541, 6 March 2016; PMNH7543, 6 March 2016). Suleiman Pools (PMNH5705, 16 February 2015; PMNH4971, 17 August 2014; PMNH4954, 17 August 2014). Deir Jareer

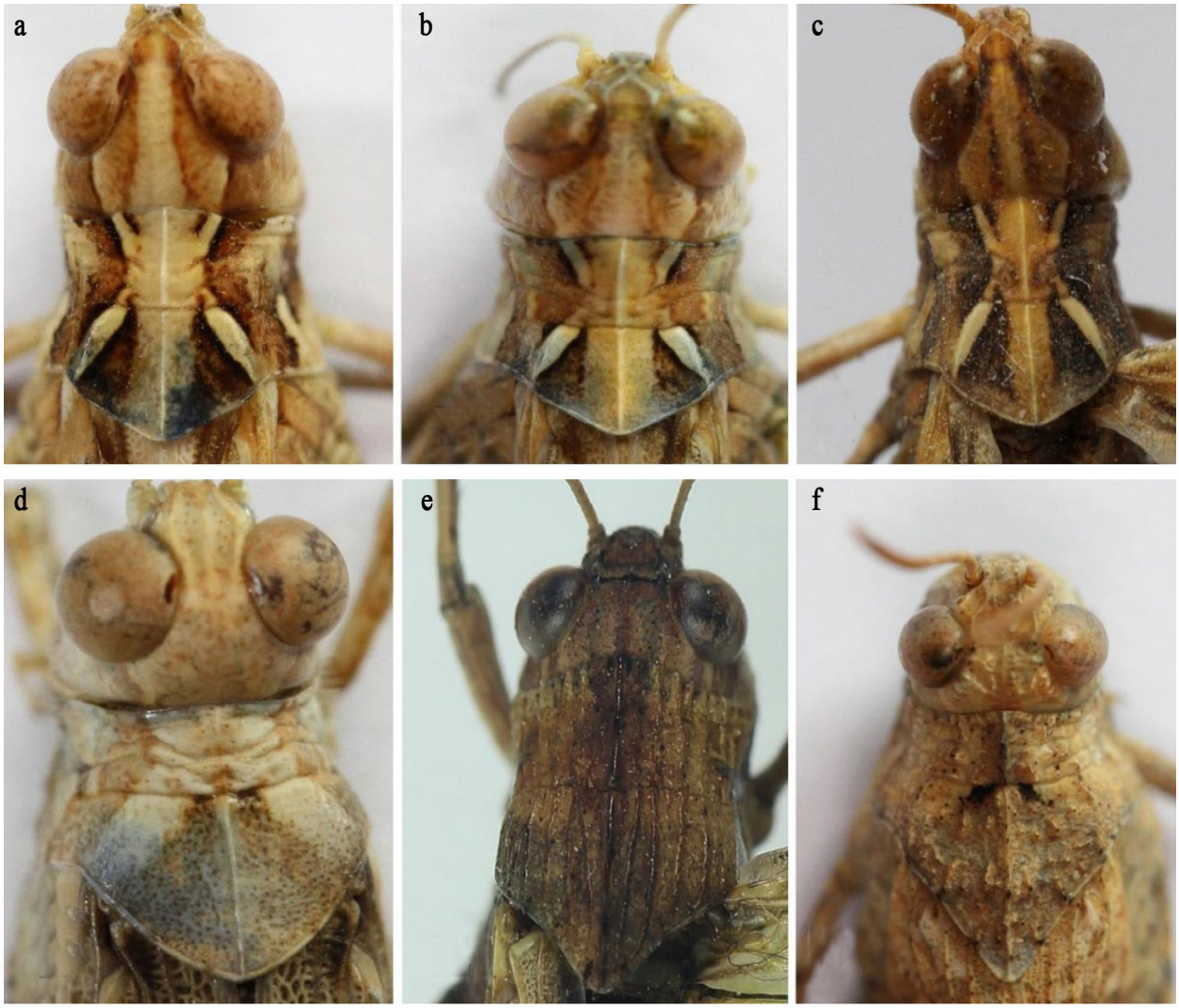

Figure 5. (a) *Chorthippus peneri*; (b) *Dociostaurus* (*Kazakia*) *genei*; (c) *Notostaurus anatolicus*; (d) *Crinita hirtipes*; (e) *Morphacris fasciata*; (f) *Oedipoda miniata*.

(PMNH8019, 27 July 2016). Em El Tout (PMNH7556, 10 March 2016). Ithna (PMNH5009, 23 August 2014; PMNH5036, 23 August 2014). Bethlehem (PMNH7908, 19 July 2016; PMNH7934–36, 19 July 2016). Salfit (PMNH6867, February 2015; PMNH5162, 22 August 2014; PMNH5063, 22 August 2014). Wadi Al Hakeem (PMNH7036, 27 July 2015). Wadi Fukeen (PMNH7533, 7 March 2016). Wadi Al Makhrour (PMNH7183, 31 August 2015; PMNH7593, 23 September 2015). Wadi Mikhmas (PMNH3887, 20 March 2014). Wadi Ta'amrah (PMNH5709, 16 February 2015).

Notes: The distribution range of *Acrotylus insubricus* stretches over the Balkans, to the south-western Ukraine, Turkey, Iran, Iraq, Syria and Palestine (Sevgili and Çiplak 2000). It was previously recorded from Jerusalem (Swinton 1899; Buxton and Uvarov 1923).

Aiolopus thalassinus thalassinus (Fabricius, 1781); Figure 2h.

Material examined: Al Auja (PMNH7948, 25 July 2016; PMNH7955, 25 July 2016; PMNH7957, 25 July 2016).

Notes: This species has a wide range of distribution from Africa to China and southern Europe (Fishelson 1985). It was previously collected from Jericho (Buxton and Uvarov 1923).

Crinita hirtipes (Uvarov, 1923); Figures 4b, 5d.

Material examined: Mar Saba (PMNH7901–5, 16 July 2016). Wadi Qumran (PMNH7929–32, 20 July 2016).

Notes: This species was originally described from Jericho (Uvarov 1923b). It was recorded in Jericho, Jerusalem and Wadi Kelt (Buxton and Uvarov 1923; Dirsh 1949). This species is endemic to Palestine. Katbeh-Bader (2001) did not report this species from Jordan.

Morphacris fasciata (Thunberg, 1815); Figures 2i, 5e.

Material examined: Al Auja (PMNH7968, 25 July 2016; PMNH7958, 25 July 2016). Ain Deouk (PMNH7970, 25 July 2016; PMNH7973, 25 July 2016).

Notes: This species has a wide range of distribution across central and North Africa, the Iberian Peninsula and France, southwest Asia to India (Buzzetti, Fontana, and Massa 2014). It was reported from Jericho and Wadi Kelt as *Morphacris fasciata sulcata* Thunberg 1815 (Buxton and Uvarov 1923) and from Jericho (Giglio-Tos 1893).

Pyrgodera armata Fischer von Waldheim, 1846; Figures 4c, 6a.

Material examined: At Tayba (PMNH1734.8, 12 April 2013; PMNH1734.9, 12 April 2013). Beni Neim (PMNH1714.8, 7 April 2013; PMNH1714.9, 7 April 2013; PMNH1714.11, 7 April 2013; PMNH1714.32, 7 April 2013). Ubaidiah (PMNH1748.6, 13 May 2013; PMNH1748.14, 13 May 2013; PMNH1748.15, 13 May 2013). Kufr Zaibad (PMNH1755.14, 18 May 2013). Mar Saba (PMNH4327, 13 January 2014; PMNH1748.13, 13 May 2013). Sa'ir (PMNH1713.14, 7 April 2013). Wadi Al Abyad (PMNH6508, 24 April 2015; PMNH6519–21, 24 April 2015; PMNH6527, 24 April 2015).

Notes: This species has a wide range of distribution extending from the middle reaches of the Volga River region, southern states of the former Soviet Union (Central Asia and Transcaucasia) to Afghanistan, Iran across Turkey to Jordan and Palestine (Kaltenbach 1980; Katbeh-Bader 2001; Garai 2010; Mol, Şirin, and Taylan 2014). It was collected from the Jordan Valley and the Jerusalem hills (Fishelson 1985). Adults were collected during April and May in densely vegetated areas.

Oedipoda aurea Uvarov, 1923

Material examined: Ain Kenia (PMNH4804, 15 August 2014; PMNH4795, 15 August 2014). Ain Sinia (PMNH8075, 27 July 2016). Ain Yabroud (PMNH7983, 27 July 2016; PMNH7985–90, 27 July 2016; PMNH7992, 27 July 2016; PMNH7998, 27 July 2016; PMNH8010, 27 July 2016; PMNH8062–64, 27 July 2016; PMNH8071, 27 July 2016). Ajul (PMNH8114, 3 August 2016). Al Aruob (PMNH4590, 7 July 2014). Al Rihan (Beir Zeit) (PMNH8140, 10 August

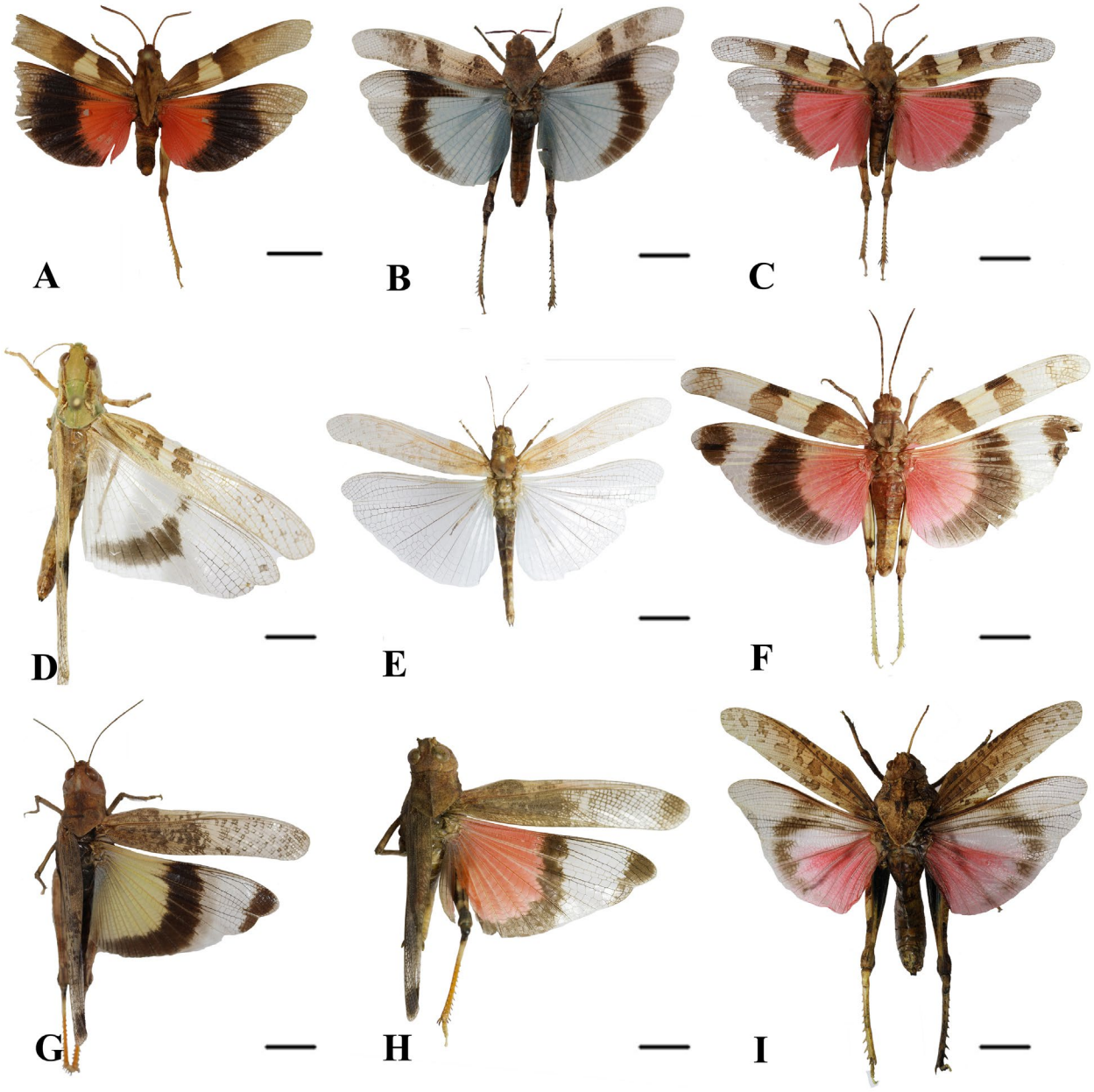

Figure 6. (a) *Pyrgodera armata*; (b) *Oedipoda caerulescens*; (c) *Oedipoda miniate*; (d) *Oedaleus senegalensis*; (e) *Sphingonotus* (*Sphingonotus*) *rubescens*; (f) *Sphingonotus* (*Sphingonotus*) *octofasciatus*; (g) *Scintharista notabilis blanchardiana* (Yellow winged form); (h) *Scintharista notabilis blanchardiana* (Red winged form); (i) *Tmethis pulchripennis asiaticus* (Scale bar = 1 cm).

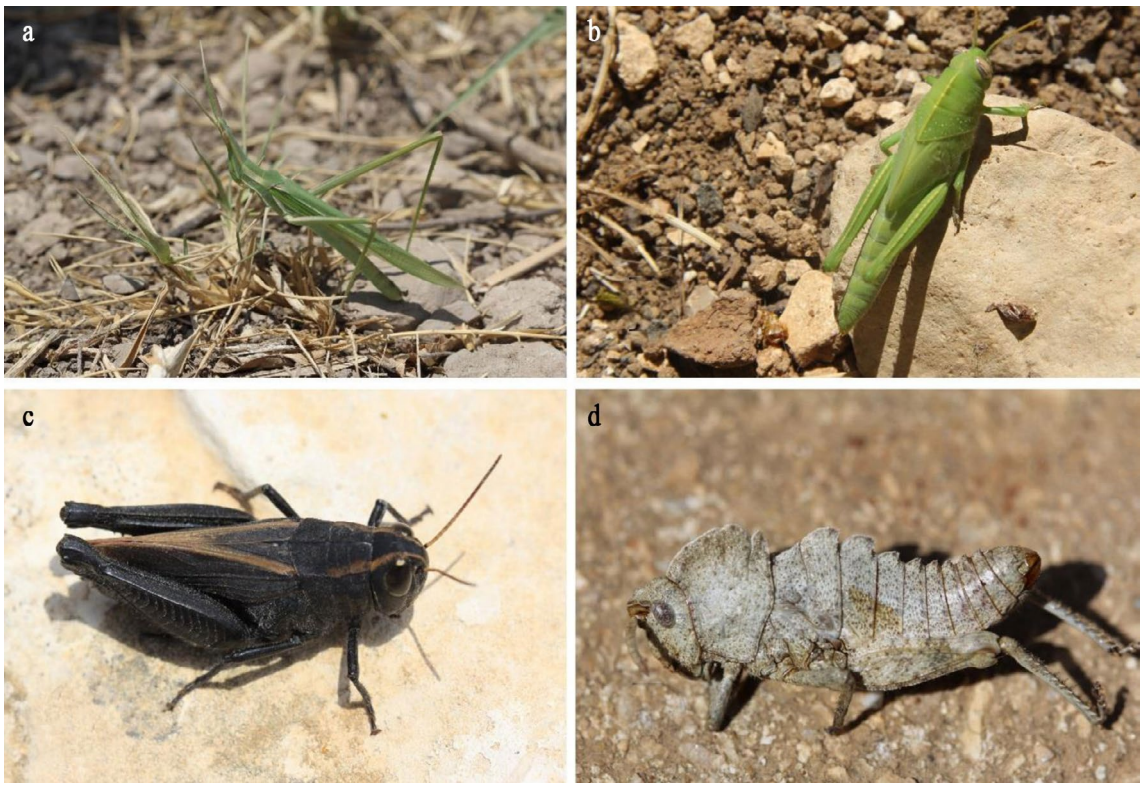

Figure 7. (a) *Truxalis grandis*; (b) *Anacridium aegyptium* nymph.; (c) *Calliptamus coelesyriensis*; (d) *Prionosthenus galericulatus*.

2016). Artas (PMNH4724, 12 August 2014; PMNH4726, 13 August 2014). Batir (PMNH6675, 27 May 2015). Beir Zeit (PMNH7220, 2 September 2015). Bethlehem (PMNH7907, 17 July 2016). Bettein (PMNH8036–37, 27 July 2016). Sulaiman Pools (PMNH4960, 17 August 2014; PMNH4750, 12 August 2014). Deir Jareer (PMNH8016, 27 July 2016; PMNH8018, 27 July 2016; PMNH8021, 27 July 2016; PMNH8081–82, 27 July 2016). Dura (PMNH7942–44, 22 July 2016; PMNH7981, 22 July 2016). Jenin (PMNH1805.4, 13 June 2013). Mar Saba (PMNH1953.4, 22 June 2013). Nablus (PMNH7259, 16 September 2015; PMNH7261, 16 September 2015). Nahaleen (PMNH6948, 8 June 2015). Salfit (PMNH6868, August 2014). Tal Al Asour (PMNH8044–45, 22 July 2016). Tubas-Sirees (PMNH7278–79, 17 September 2015). Wadi Al Qarin (PMNH8096–99, 29 July 2016). Wadi Al Quff (PMNH4337, 3 May 2014). Wadi Fukeen (PMNH6706, 27 May 2015; PMNH7073, 29 July 2015; PMNH4685, 9 August 2014). Wadi Al Makhrour (PMNH7190–91, 31 August 2015). Yabroud (PMNH8147, 27 July 2016).

Notes: This species was originally described from Palestine, with a limited distribution in Asia Minor (Fishelson 1985).

Oedipoda caerulescens (Linnaeus, 1758); Figure 6b.

Material examined: Ain Kenia (PMNH7100, 3 August 2015). Al Walaja (PMNH4663, 8 August 2014). Salfit (PMNH5059, 22 August 2014). Ain Yabroud (PMNH7994, 27 July 2016).

Notes: A widespread species reported from North Africa to Iran, across the Middle East, its distribution range extending northwards to central and northern Europe, reaching as far as China (Fishelson 1985).

Oedipoda miniata (Pallas, 1771); Figures 5f, 6c.

Material examined: Ain Samia (PMNH7169, 26 August 2015; PMNH7172, 26 August 2015; PMNH7180, 26 August 2015). Al Walaja (PMNH4662, 8 August 2014). Bethlehem (PMNH7864, 3 June 2016). Bettein (PMNH803435, 27 July 2016). Sulaiman Pools (PMNH4751, 12 August 2014; PMNH4753, 12 August 2014; PMNH4950, 17 August 2014; PMNH4967, 17 August 2014; PMNH4969, 17 August 2014). Deir Ballout (PMNH7130, 10 August 2015). Deir Jareer (PMNH8017, 27 July 2016; PMNH8020, 27 July 2016; PMNH8079, 27 July 2016; PMNH8087, 27 July 2016). Ithna (PMNH5008, 23 August 2014; PMNH5013, 23 August 2014). Jenin (PMNH1805.3, 13 June 2013). Nahaleen (PMNH6949, 8 June 2015). Tal Al Asour (PMNH8049, 22 July 2016; PMNH8051, 22 July 2016). Ubaidiah (PMNH7924–28, 20 July 2016).

Notes: This species is distributed along North Africa to central Europe reaching Siberia and the Middle East (Fishelson 1985). It was previously reported from Nablus and Jerusalem, the Dead Sea area and the Jordan Valley (Buxton and Uvarov 1923; Fishelson 1985).

Oedaleus senegalensis (Krauss, 1877); Figures 4d, 6d.

Material examined: Wadi Al Abyad (PMNH6512–13, 24 April 2015).

Notes: Ritchie (1981) presented an excellent review for the genus *Oedaleus*. This species is widely distributed from the Canary Islands westwards, across North and Sub-Saharan Africa, Middle East and the Arabian Peninsula, western states of the former Soviet Union to as far eastward as India (Ritchie 1981).

Pseudoceles ebneri Dirsh, 1949
Material examined: Mar Saba (PMNH7899–900, 16 July 2016). Wadi Qumran (PMNH7929, 20 July 2016).
Notes: The visual appearance of the specimens examined corresponds to the descriptions given by Dirsh (1949). This species is endemic to Lebanon, Palestine and Syria (Dirsh 1949; Fishelson 1985). It is the most abundant species of the Orthoptera occurring in Azraq, Jordan, and was collected from all the study sites during early and late April. Huge numbers of this grasshopper were seen in Amman and many people thought that they were waves of locust swarms (Amr et al. 1997).

Sphingonotus* (*Sphingonotus*) *rubescens (Walker, 1870); Figure 6e.
Material examined: Ain Hijla (PMNH4009, 18 April 2014; PMNH4022, 18 April 2014). Ain Kenia (PMNH4810, 18 May 2014). Al Walaja (PMNH4694, 8 August 2014). Wadi Al Qult (PMNH6122, 4 April 2015; PMNH6126, 4 April 2015).
Notes: The distribution range of this species extends from the Canary Islands to France and Spain across North Africa reaching as far as India (Sevgili and Çiplak 2000; Defaut 2003; Hochkirch and Husemann 2008). It was reported from Jerusalem and Wadi Muallah SE of Bethlehem (Buxton and Uvarov 1923). Defaut (2003) provided a key to differentiating between species of the genus *Sphingonotus* in France and Spain, with detailed features for *S. rubescens*.

Sphingonotus* (*Sphingonotus*) *octofasciatus (Serville, 1838); Figure 6f.
Material examined: Wadi Al Qult (PMNH6126, 4 April 2015; PMNH6120, 4 April 2015).
Notes: This species is known from Algeria to Egypt, across the Middle East to Central Asia (Massa, Buzzetti, and Fontana 2010). It was previously recorded in Jericho (Giglio-Tos 1893), Wadi Kelt and Jerusalem (Buxton and Uvarov 1923).

Sphingonotus pictus onerosus Mishchenko, 1936
Material examined: Wadi Qumran (PMNH7930, 20 July 2016).
Notes: This species has a wide range of distribution extending from Pakistan to Sinai (Fishelson 1985). It was reported from arid regions around the Dead Sea (Fishelson 1985).

Sphingonotus savignyi Saussure, 1884; Figure 4e.
Material examined: Mar Saba (PMNH1953.5, 22 June 2013). Wadi Ta'amrah' (PMNH6924, 3 June 2015).
Notes: It is a widespread species, with the distribution range stretching from the Canary Islands in the west across North and East Africa to southwest and central Asia (Buzzetti, Fontana, and Massa 2014). It was reported from the shores of the Sinai Peninsula (Fishelson 1985).
Scintharista notabilis blanchardiana (Saussure, 1888); Figures 4f, 6g and h.
Material examined: Wadi Al Qult (PMNH6123–24, 4 April 2015; PMNH6133, 4 April 2015; PMNH6135, 4 April 2015; PMNH6137, 4 April 2015).
Notes: This species is known from the Arabian Peninsula, Syria and Palestine (Fishelson 1985). Uvarov (1922a) considered the Asiatic *Scintharista brunneri* to be a geographical race of the Western Mediterranean *Scintharista notabilis*. He stated that the difference between them is too insignificant to consider them as separate species.

Family Dericorythidae

Dericorythidae is a new family proposed by Eades (2000), which was previously considered as a subfamily of Acrididae. Three subfamilies are recognized (Conophyminae, Dericorythinae and Iranellinae). In the East Mediterranean, it is represented by two genera *Dericorys* and *Pamphagulus*.

Subfamily Dericorythinae

Dericorys millierei Bonnet and Finot, 1884; Figure 4g.
Material examined: Nabi Mousa (PMNH7933, 20 July 2016). Wadi Ta'amrah' (PMNH6906, 3 June 2015; PMNH6908, 3 June 2015).
Notes: This species is distributed across North Africa to SW Asia (Dirsh 1965). It was reported from Jericho and Wadi Kelt (= Wadi Al Qult) (Buxton and Uvarov 1923).

Family Pamphagidae

Presa and García (1983) revised species of the Palearctic Pamphagidae, listing all known species of this family along with their synonyms. Some species listed by Fishelson (1985) in the family Acrididae were attributed to the Pamphagidae. A more detailed revision with the most updated names was published by Otte (1994).

Subfamily Pamphaginae

Orchamus hebraeus Uvarov, 1942; Figure 4h.
Material examined: Mar Saba (PMNH4272, 31 January 2014).
Notes: So far, this species has been known from Palestine and Jordan (Fishelson 1985; Katbeh-Bader 2001). Massa (2009) considers *Orchamus hebraeus* rather than *Acinipe hebraeus* as a valid species for our area. It is related to *O. yersini*, which is known to occur in Lebanon, Cyprus, Greece, Syria and Turkey. Katbeh-Bader (2001) and Fishelson (1985) recorded this species as *Acinipe hebraeus* in Jordan and northern Palestine. Descamps and Mounassif (1972) suggested that this species should be considered as a subspecies of *Orchamus yersini*.

Prionosthenus galericulatus (Stål, 1876); Figure 7d.
Material examined: Al Aqaba (PMNH4043, 18 April 2014). Al Auja (PMNH1710.17, 27 March 2013). Bethlehem (PMNH7528–30, 6 March 2016; PMNH7535, 6 March 2016; PMNH 7544–45, 6 March 2016). Sulaiman Pools (PMNH5708, 16 February 2015). Em El Tout (PMNH7557–58, 10 March 2016). Kufr Zibad (PMNH1755.7, 18 May 2013). Nabi Saleh (PMNH1736.1, 3 May 2013). Salfit (PMNH6866, February 2015; PMNH6874, September 2014). Wadi Al Quff (PMNH3885, 21 March 2014; PMNH3957, 11 April 2014; PMNH3954, 11 April 2014; PMNH3931, 22 March 2014; PMNH3795, 15 March 2014; PMNH3817, 16 March 2014; PMNH3894, 21 March 2014; PMNH3968, 11 April 2014). Wadi Fukeen (PMNH7531–32, 7 March 2016; PMNH7534, 7 March 2016). Wadi Al Haramiya (PMNH7514–16, 13 March 2016; PMNH7518, 13 March 2016; PMNH7519–27, 13 March 2016; PMNH1730.3, 18 April 2013). Wadi Qana (PMNH5615, 26 November 2015). Zababda (PMNH7499–500, 3 March 2016).
Notes: This species is endemic to Jordan, Lebanon, Palestine, and Syria (Fishelson 1985; Katbeh-Bader 2001). It was previously recorded in Merj Sanor and Jerusalem (Buxton and Uvarov 1923). Massa (1995) revised the genus *Prionosthenus* and ascribed the specimens that were previously identified by Giglio-Tos (1893) as *P. galericulatus* to *Ocnerosthenus kneuckeri*. Later, Massa (2010) assigned Syrian specimens to *Ocnerosthenus verrucosus.* Because of the raised pronotum, Massa and Fontana (1998) listed Palestinian specimens as *Prionosthenus syriacus* (Brisout 1855) pending more detailed study of the *Ocnerosthenus* forms from nearby countries. All the specimens reported in this study were collected from forested or densely vegetated Mediterranean areas.

Subfamily Thrinchinae

Eremotmethis carinatus (Fabricius, 1775); Figure 4i.
Material examined: Al Rashaydah (PMNH6562–63, 5 May 2015).
Notes: This species is distributed throughout North Africa to the east of Pakistan, across south west Asia (Presa and García 1983; Garai 2010). In the West Bank, it was reported from the Dead Sea area (Massa and Fontana 1998) and west and southwest of Hebron (Fishelson 1985). Uvarov (1943) reported a specimen from Egypt, southern Palestine, Arabia and Kuwait. Popov (1997) listed localities for this species in Palestine. Dirsh (1961) placed the genus *Eremotmethis* under the subfamily Akicerinae. This subfamily includes several species known from South Africa (Dirsh 1965). Species of the subfamily Thrinchinae are distributed across Asia, North Africa and Europe (Massa 2013).

Tmethis pulchripennis asiaticus Uvarov, 1943; Figures 4j, 6i.
Material examined: Ain Hijla (PMNH4018, 18 April 2014; PMNH4003, 18 April 2014; PMNH4020–21, 18 April 2014). Al Aqaba (PMNH4041–42, 18 April 2014). Auja (PMNH5859, 9 March 2015; PMNH5865, 9 March 2015). Battir (PMNH6673, 27 May 2015). Beni Neim (PMNH1714.1, 7 April 2013). Bethlehem (PMNH6087, 2 April 2015). Marah Rabah (PMNH3783, 15 March 2014). Mar Saba (PMNH5976, 13 March 2015). Nahaleen (PMNH1735.14, 2 May 2013; PMNH1735.15, 2 May 2013; PMNH1735.2, 2 May 2013). Nuwaima (PMNH6514, 24 April 2015). Tarqumia (PMNH 1712.25, 4 April 2013; PMNH 1712. 20, 4 April 2013; PMNH1713.6, 4 April 2013). At Tayba (PMNH1734.21, 12 April 2013; PMNH1734.20, 12 April 2013; PMNH1734.24, 12 April 2013). Wadi Abu Sai'd (PMNH7765, 3 February 2016; PMNH7767, 3 February 2016). Wadi Mikhmas (PMNH3873, 20 March 2014; PMNH3877–78, 20 March 2014). Wadi Fukeen (PMNH6678, 27 May 2015). Wadi Al Qult (PMNH6119, 4 May 2015; PMNH6146, 4 April 2015). Za'tara (PMNH6080, 22 October 2014).
Notes: The distribution range of this subspecies extends from the Sinai Peninsula across Palestine, Jordan to Iran (Fishelson 1985). Massa (2013) referred to the specimens collected from Palestine, Lebanon and Jordan. Uvarov (1943) listed several localities from the West Bank and Gaza including Bittir (= Batir), Jerusalem, Jericho, the Jordan valley, East of Hebron to Ein Jedi and Wadi Gaza. Massa and Fontana (1998) included a record near the Dead Sea area. Massa (2013) stated that the North African form of *T. pulchripennis* is smaller than the one occurring in the Middle East, and attributed the nominated species to a subspecific level, which is not justified due to its high variability within its distribution range. The specimens examined in this study are heavily sculptured and resemble those described by Uvarov (1943). Specimens collected from the southern deserts of Palestine are mostly of smooth (laeviuscula) and mildly sculptured (incristata) forms, while specimens from hilly areas are strongly sculptured (Uvarov 1943). He attributed these variations to geographical or ecological factors.

Family Pyrgomorphidae

Acridoid grasshoppers of the family Pyrgomorphidae are widely distributed in tropical and sub-tropical regions of the world. The taxonomy of the family Pyrgomorphidae was revised based on its phallic structures (Dirsh 1961; Akbar 1963). Fishelson (1985) and Katbeh-Bader (2001) listed this family under Subfamily Pyrgomorphinae within the family Acrididae.

Subfamily Pyrgomorphinae

Pyrgomorpha* (*Pyrgomorpha*) *conica (Olivier, 1791)
Material examined: Abu Dis (PMNH1728.3, 22 April 2013). Wadi Al Haramiya (PMNH1730.2, 18 April 2013). At Tayba (PMNH1734.7, 12 April 2013). Beit Lid (PMNH3430, 1 February 2014). Wadi Al Quff (PMNH3820–21, 16 March 2014; PMNH3930, 31 March 2014; PMNH4347, 3 May 2014). Sulaiman Pools (PMNH4962, 17 August 2014).

Mar Saba (PMNH5995, 13 March 2015). Wadi Al Qult (PMNH6136, 4 April 2015). South Hebron Hill (PMNH6603, 13 May 2015). Salfit (PMNH6870, April 2015).

Notes: This species was reported from Jerusalem (Swinton 1899) and Jericho (Buxton and Uvarov 1923) and is known from the Iberian Peninsula, North Africa, Middle East, southern states of the former Soviet Union reaching as far as India (Fishelson 1985). Five subspecies have been described for *P. conica,* of which the nominal *P. c. conica* is known from our area. Massa, Buzzetti, and Fontana (2010) summarized different views on the status of *P. conica* vs. *P. cognata* Krauss, 1877. Some authors had assigned the taxa of *P. conica* and *P. bispinosa* Walker, 1870, under the species *cognata* (Buzzetti et al. 2005), while Popov (1980, 1997) treated all species of the genus as valid species.

Discussion

The present study updated the taxonomic treatment of the Orthoptera of the Palestinian Territories based on recent literature. The subfamily Catantopinae was revised and many of its genera were redistributed to other subfamilies (Eades 2000; Bidau 2014; Chapco 2015; Song et al. 2015). Species endemic to the Levant (historical Palestine, Jordan, Syria and Lebanon) include *O. hebraeus, H. syriaca, C. peneri, D. curvicercus*, *C. hirtipes*, *P. ebneri,* and *P. galericulatus*. Several species such as *A. insubricus*, *C. peneri*, *D. hauensteini*, *D. laticornis*, *N. anatolicus*, *O. aurea*, *O. caerulescens*, *P. conica*, and *P. galericulatus* are considered to be strictly Mediterranean. On the other hand, as mentioned by Fishelson (1985, 1987), some species are associated with certain vegetation types, e.g. *E. plorans* association with bushes. Other species such as *A. bicolor*, *T. eximia*, *T. procera* and *T. grandis* are associated with dense *Typha* and *Phragmites* vegetation around water resources. Typical Irano-Turanian species include *C. b. palaestinensis* and *P. armata* around the south eastern parts (i.e. Mar Saba) of the Palestinian territories, characterized by arid regions with scarce scattered vegetation. The highest diversity of orthopterans is recorded within the Dead Sea area and the Jordan Valley. Most species of the genus *Sphingonotus* and *M. fasciata* were more common around the Dead Sea area.

Further studies could be performed, e.g. on chromosomes and DNA, which could resolve the taxonomy of some difficult species and help better understand evolutionary relationships, and on habitat association with various ecotypes in Palestine. Such baseline studies are being carried out at our museum. They are important for gaining the understanding of how ecosystems are protected in this part of the world even in a difficult political situation (Qumsiyeh et al. 2017).

Disclosure statement

No potential conflict of interest was reported by the authors.

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Annex 1. List of sampling localities

Location	N	E
Abu Dis	31°45′ 41.565″	35°15′ 36.918″
Ain Deouk	31°52′ 24.8376″	35°27′ 42.8148″
Ain Hijla	31°49′ 13.461″	35°30′ 8.5026″
Ain Kenia	31°55′ 33.6324″	35°8′ 57.7818″
Ain Samia	31°59′ 20.3166″	35°20′ 1.0278″
Ain Sinia	31°58′ 17.8068″	35°13′ 40.1982″
Ain Yabroud	31°57′ 7.3836″	35°15′ 3.006″
Ajul	32°1′ 21.2736″	35°10′ 49.3248″
Al Aqaba	32°21′ 4.6326″	35°20′ 54.6396″
Al Aroub	31°37′30.4284″	35°7′ 57.2196″
Al Auja	31°56′ 45.0054″	35°27′ 52.2396″
Al Rashaydah	31°33′ 47.2098″	35°14′ 16.9692″
Al Walaja	31°43′ 48.8208″	35°9′ 37.332″
Al Zawya	32°5′ 34.0404″	35°2′ 26.5992″
Artas	31°41′ 17.1018″	35°11′ 20.1474″
At Tayba	31°57′ 25.1166″	35°18′ 2.685″
Battir	31°43′ 43.827″	35°8′ 6.7956″
Beir Zeit	31°58′ 30.3744″	35°11′ 36.6792″
Beit Bassa	31°41′ 32.2368″	35°13′ 18.876″
Beit Jala	31°42′ 32.5974″	35°10′ 28.3146″
Beit Lid	32°15′ 37.6992″	35°7′ 49.8036″
Beni Neim	31°30′ 44.9238″	35°9′ 44.748″
Bethlehem	31°43′ 2.3016″	35°12′ 12.4452″
Bettein	31°55′ 35.3856″	35°14′ 15.2694″
Deir Ballout	32°3′ 43.0308″	35°1′ 32.217″
Deir Jareer	31°57′ 53.0352″	35°17′ 41.3658″
Dura	31°30′ 19.7136″	35°1′ 39.0144″
Hebron Hills	31°26′ 26.6712″	35°5′ 31.3764″
Hindaza	31°41′ 18.8262″	35°15′ 17.3766″
Ithna	31°33′ 44.082″	34°59′ 3.591″
Jenin	32°27′ 52.5348″	35°18′ 12.2646″
Jericho	31° 6′ 43.2852″	35°27′ 46.7526″
Jiftlik	32°7′ 59.9988″	35°28′ 59.9988″
Kufr Zibad	32°13′ 23.325″	35°4′ 12.8922″
Mar Saba	31°42′ 14.2992″	35°19′ 53.7666″
Marah Rabah	31°38′ 3.1518″	35°11′ 9.5634″
Nabi Mousa	31°47′ 13.4838″	35°25′ 52.5072″
Nabi Saleh	32°0′ 55.4364″	35°7′ 29.4096″
Nablus	32°12′ 39.8406″	35°16′ 26.7456″
Nahaleen	31°41′ 20.6268″	35°7′ 2.2188″
Nuwaima	31°52′ 50.3502″	35°27′ 35.0892″
Sa'ir	31°34′ 40.425″	35°8′ 35.5338″
Salfit	32°4′ 59.9988″	35°10′ 0.0006″
Suleiman Pools	31°41′ 19.089″	35°10′ 10.5492″
Tal Al Asour	31°58′ 37.6752″	35°16′ 43.428″
Tarqumia	31°34′ 45.4224″	35°0′ 57.9168″
Tubas-Sirees	32°19′ 34.2402″	35°17′ 39.9732″
Ubaidiah	31°41′ 44.1954″	35°15′ 8.1066″
Umm al Tut	32°26′ 10.356″	35°20′ 22.5024″
Wadi Abu Sai'd	31°23′ 34.6194″	34°59′ 13.7898″
Wadi Al Abyad	31°55′ 23.0196″	35°23′ 47.0538″
Wadi Al Darajeh	31°36′ 382″	35°21′ 267″
Wadi Al Hakeem	32°1′ 12.5796″	35°4′ 30.1182″
Wadi Al Haramiya	31°58′ 59.9982″	35°13′ 59.9988″
Wadi Al Makhrour	31°43′ 9.3972″	35°9′ 32.6946″
Wadi Al Qarin	31°37′ 9.6414″	35°7′ 34.6614″
Wadi Al Quff	31°34′ 41.59″	35°03′ 38.71″
Wadi Al Qult	31°49′ 59.9982″	35°23′ 59.9994″
Wadi Fukeen	31°42′ 19.7166″	35°6′ 9.3816″
Wadi Mikhmas	31°52′ 29.8842″	35°16′ 40.029″
Wadi Qana	32°10′ 01.30″	35°08′ 43.07″
Wadi Qumran	31°44′ 4.776″	35°26′ 19.698″
Wadi Ta'amrah'	31°39′ 39.3264″	35°17′ 9.3834″
Yabroud	31°58′ 27.5988″	35°14′ 40.1418″
Zababda	32°22′ 56.3334″	35°19′ 31.8282″
Za'tara	31°40′ 29.8164″	35°15′ 20.9304″