

Contribution to the Hawk Moths (Sphingidae: Lepidoptera) of Jordan

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ABSTRACT

Hawk moths (Sphingidae) have been collected from different parts of Jordan by light traps from 2007 to 2014. Unidentified specimens preserved at the University of Jordan Insects Museum were examined. The following nine species are recorded from 38 localities across Jordan: *Acherontia atropos* (Linnaeus, 1758), *Agrius convolvuli* (Linnaeus, 1758), *Marumba quercus* (Denus & Schiffermuller, 1775), *Daphnis nerii* (Linnaeus, 1758), *Macroglossum stellatarum* (Linnaeus, 1758), *Hyles euphorbiae conspicua* (Rothschild & Jordan, 1903), *Hyles livornica* (Esper, 1779), *Hippotion celerio* (Linnaeus, 1758) and *Theretra alecto cretica* (Boisduval, 1827).

Key words: Jordan, hawk moths, Sphingidae, Lepidoptera.

INTRODUCTION

Hawk moths are stout-bodied moths with long narrow front wings. The family Sphingidae Latreille 1802, contains 1450 species after the adults of which are often seen feeding in front of flowers. Their larvae or caterpillars are large and have a distinctive horn at their rear. As a group they are widely distributed across the world except in Antarctica (Kitching et al. 2014).

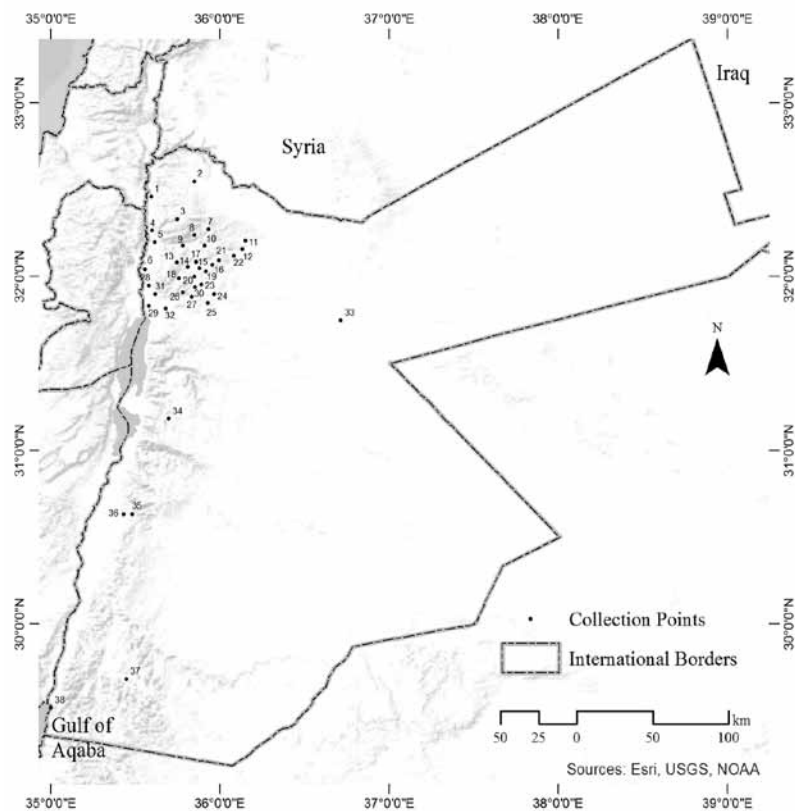
A number of studies have been carried out on hawk moths in the Middle East although few of these refer to Jordan. For example, several papers were published on the Sphingidae of Saudi Arabia

(Pittaway, 1979; Pittaway, 1981; Wiltshire, 1980a; Wiltshire, 1986; Wiltshire, 1990). Wiltshire (1957; 1980b) recorded 18 species of hawk moth from Iraq and provided notes on those of Lebanon, Syria and Sinai. Talhouk (1997) recorded 16 species of hawk moth from Lebanon with colour photographs. Müller, et al. (2005b) recorded 21 species from Palestine. In Jordan, Müller et al. (2005a) recorded 21 species and described their distribution, phenology and ecology. A general review of the ecology and biogeography of hawk moths of the Western Palaearctic is provided by Pittaway (1995). A definite account of the species of the region including their nomenclature, biogeographical affiliations, descriptions, biology, photos of adults and immatures, host plants, parasitoids and geographical distribution can be found in his website (<http://tpittaway.tripod.com/sphinx/list.htm>).

Given the limited information available on the hawk moths of Jordan, the main aim of this work is to document recent records obtained from trapping and identified with those in national museum collections.

MATERIALS AND METHODS

A survey of the moths of Jordan, including the Sphingidae began in 2007. Light traps were placed in localities across the Jordan Valley, Highland and the Desert (Fig. 1). In addition, specimens of hawk moths collected previously from Jordan (preserved at the University of Jordan Insects Museum) were examined and identified. For those species caught, the scientific name, common name, specimens examined, biogeographical affiliation, world distribution, remarks and colour photographs are given. The world distribution patterns follow those of (Pittaway, 1997-2014). Localities in Jordan (Fig. 1) were arranged alphabetically and dates were arranged chronologically according to the month. The number of specimens was placed after the date between brackets which was followed by the collector. Unless otherwise mentioned, the museum staff or the author of this article was the collector. All specimens were deposited at the University of Jordan Insects Museum.



1 Al Mashre	11 Al Hashimeyyah	21 Taburbawr	31 As Shounah Al Janoubiyah
2 Irbid	12 Az Zarqa	22 Ar Rusayfah	32 Hisban
3 Ajloun Reserve	13 As Salt, As Salalem	23 Amman	33 Ash Shawmari
4 Al Kurayyimah	14 Abo Nusayr	24 Abo Alandah	34 Al Karak
5 Dayr Alla	15 University of Jordan Farm	25 Jawah	35 Dana Reserve
6 Ain Ghazal	16 Shafa Badran	26 Marj Al Hamam	36 Finan
7 Jarash	17 University of Jordan	27 Naur	37 Rumm
8 Old Jarash Road	18 Suwayleh	28 Wadi as Sayr	38 Al Aqabah
9 Al Mastabah (Near Jarash)	19 Al Jubayhah	29 Al-Rameh Farm	
10 Al Qasabat (Al-Qasabah)	20 Khildah	30 Jabal Amman	

Fig. 1: Map of collecting sites

RESULTS

A total of 169 specimens of hawk moths from 38 localities were examined during this study. They were identified and allocated to one of nine species as follows.

Acherontia atropos (Linnaeus, 1758)

Death's Head hawkmoth, (Plate 1)

Specimens: n = 3 specimens. Univ. of Jordan, X.2009, (1), Univ. of Jordan Farm 27.XII.200? (1); Amman 29.IV.1998 (1).

Biogeographical Affiliation: Palaeotropical; Afrotropical region. Has become part of the present-day Holomediterranean faunal element.

Distribution: An Afrotropical species which extends north to the Mediterranean (including the whole of North Africa and the Middle East) and across Cyprus, Turkey, the Republic of Georgia to north-eastern Iran, the Ukraine, Turkmenistan, Mesopotamia, Kuwait and western Saudi Arabia. It is also found in the Canary Islands, Madeira and on the Azores, and throughout Europe as a migrant, including Iceland. Recorded as a vagrant as far north as Izvail' in European Russia, and as Far East as Pavlodar in north-eastern Kazakhstan.

Remarks: Only three specimens were caught during this study which agrees with the findings of Müller et al. (2005) who described it as rare although it could be found in all phytogeographical zones of Jordan, including the desert. The specimens from the Jordan Valley were from a vegetable farm containing some fruit trees. Caterpillars were observed in large numbers within small-untreated sweet potato and tomato fields. Adults were recorded from early June to November; most specimens were collected from July to October (Müller et al., 2005).

Agrius convolvuli (Linnaeus, 1758)
Convolvulus hawkmoth (Plate 2)

Specimens: n = 4. Al Mashre'a, Irbid Gov. 9.XI.1995 9(1); Al Masta bah (Near Jarash), 20.XI.1997(1); Rumm 30.X.2010 (1); Univ. of Jordan Farm 12-14.IX.2008 LT(1).

Biogeographical Affiliation: Palaeotropical and Australasian.

Distribution: Resident in only the warmest areas of the western Palaearctic, but as a migrant to almost the entire region. Recorded as far north as Yaksha in European Russia and as far west as Ireland and the Azores. It is one of only three species of sphingid recorded from Iceland.

Remarks: The collected specimens come from the Jordan Valley, the highlands and the desert. Müller et al. (2005) stated that it was common in the Mediterranean zone and uncommon in the Irano-Turanian grasslands and few specimens were collected in the desert or in oases. Large numbers of caterpillars were seen in *Ipomoea* fields (Convolvulaceae). Other food plants include *Convolvulus* and *Zygophyllum dumosum* (Zygophyllaceae). Records were from early May through November. There were two flight peaks, one in June and a more pronounced one from August to September. All records from the desert were from September to October.

Marumba quercus (Denus & Schiffermuller, 1775)
Oak Hawkmoth (Plate 3)

Specimens: One specimen from Ajloun Reserve, 18.VIII-1IX.2009.

Biogeographical Affiliation: Holarctic; western Palaearctic region.

Pleistocene refuge: Polycentric – Holo-mediterranean refugia.

Distribution: From the Rif and Atlas Mountains of Morocco, Portugal and Galicia, Spain, across southern and central Europe to Turkey, Transcaucasia, the Republic of Georgia, western Kazakhstan, Lebanon, Palestine, western and northern Jordan, northern Iraq and

south-west Iran (Shiraz). Also from northern Iran to the lower Volga River and southern Turkmenistan.

Remarks: The only specimen was collected from Ajloun reserve in which oak trees are abundant. Pittaway (1997-2014) stated that this species occurs at low population densities so its presence may go undetected for long periods. However, Müller et al. (2005) found that the species was common in oak forests in the Northern Highlands and the Western Mountain range as far south as the Dana Nature Reserve. Jordan is considered the southern limit of this species in the East Mediterranean. The parasitic fly, *Drino (Palexorista) imberbis* (Wiedemann), was reared from one caterpillar. Adults fly from late April to late September with a peak from May to June and another one from August to early September. This suggests that the species has two generations in Jordan (Müller et al., 2005).

Daphnis nerii (Linnaeus, 1758)
Oleander Hawkmoth (Plate 4)

Specimens: n = 6. Abo Nusayr, 15.X.2002(1), Adnan Khateeb; Al Aqabah, larva pupated on 24.X.2009(1), emerged 18.XI.2009 reared by Wafa Naser; As Salt 7.V.2007(1); Finan 9.IX.2010 (1), Malek Awaji; no data (1), Wadi Shuaib, 8-9.VI.2013(1).

Biogeographical Affiliation: Palaeotropical.

Distribution: The southern Mediterranean region, North Africa and the Middle East to Afghanistan and Turkmenistan. Along the Mediterranean, there is no clear distinction between resident and migrant populations. Permanent populations exist in suitable locations in Sicily, Crete and Cyprus; however, over a number of favorable years further colonies may be established in those islands and in southern Italy and southern Greece, all of which may die out during a hard winter.

Remarks: This species was common on oleander (Apocynaceae) in the Mediterranean zone and in wadis within the Irano-Turanian area. However, in the desert, it occurred in irrigated settlements. In the Jordan valley, it is common but subject to large annual fluctuations.

Records from southern oasis and the Jordan Valley are from March to December. In the Mediterranean Hills, it was found from April to October with a pronounced peak in July and August (Müller et al., 2005). It probably feeds on *Ipomoea* (Convolvulaceae) and other plants.

***Macroglossum stellatarum* (Linnaeus, 1758)**
Hummingbird Hawkmoth (Plate 5)

Specimens: n = 39. Abo Alandah 21.III.1993(1), on flower; Al Jubayhah, 8.I.1977(1), 15.III.1978(1), 31.I.1983(1), 10.III.1993(1), 12.X.1983(1), 18.X.1977(1), 25.XII.1979(1); Al Qasabat 16.IV.1997 Akram Quay(1); Amman 8.III.2014(1), 12.XII.1987(1), 26.IX.1991(1), 8.X.1997(1), 10.XII.1992(1), 17.VIII.1990(1); As Salt, As Salalem, B. Gneimat, 13.VIII.1993(1), 17.IV.1993(1); As Shoumari, 3145N 3643E, 18-24.V.2010(6); As Shounah Al Janoubiyah 7.XI.1985(1); Az Zarqa'a 25.X.1992(1); Irbid, 4.VIII.1992(1); Jawah 9.I.1993; Marj Al Hama, 14.XI.1992(1); 2.V.1992(1); Old Jarash Raod 18.IV.1979(1), Suwayleh 25.X.1992(2), 16.V.1981(1), 24.III.1983(1); Tabarbour, 19.III.2010(1); Univ. of Jordan, 8.II.1982(1), 30.II.1993(1), 10.III.1993(1), 15.X.1993(1), 19.IV.1992(1).

Biogeographical Affiliation: Holarctic; Palaearctic (both eastern and western subregions).

Pleistocene refuge: Polycentric – probably several refugia, from the Mediterranean to the Sinopacific.

Distribution: From southern Europe and North Africa to Central Asia, the Altai Mountains, the Middle East and Pakistan. A summer migrant to the north, with one example recorded from Syktyvkar in European Russia. In the southernmost part of its normal range, confined to mountains, as in Iran, Oman and the Hoggar of Algeria. This is only one of two species of sphingid to have reached the Azores.

Remarks: It was abundant in the Mediterranean, Irano-Turanian and in the Ethiopian zones while in the desert, it was fairly common in wadis. It may be seen hovering over flowers at sunset. Several thousand specimens were seen in late August, 1999, moving

within two hours in the Southern Mountain Desert in a north-westly direction. The species was found all year but with peaks from March to May and August to September (Müller et al., 2005). Larsen (1976) reported that this species in Lebanon spent the time from October to November until February and March hibernating in caves and crevices, though a few specimens were on the wing in the winter months. Often specimens were found dead on the windows of disused houses in spring. However, scores of hibernating *M. stellatarum* were found between the layers of stored goat-skins.

***Hyles euphorbiae conspicua* (Rothschild & Jordan, 1903)**

Spurge Hawkmoth (Plate 6)

Specimens: n = 23. Ain Ghazal, 10.VII.1975(2), 31.V.1977(1), 10.VII.1975(1), 10.VII.1975(1); Al Jubayhah, collected 4.IX.1988 emerged 1.VI.1989(1), 4.VIII.1979(1); Amman, reared in museum, emerged 17.VII.1981 (1) R. Jado, 18.VII.1981 (2), 29.VI.1980(1), 20.VI.1981(1), 30.VIII.1980(2), 2.VII.1980(1), 7.VII.1980(2), 12.VII.1980(1), 21.VI.1988(3); Na'ur, 15.VII.2009(1); Old Jarash Road, 12.IV.1980(1).

Biogeographical Affiliation: Holarctic; western Palaearctic region.

Pleistocene refuge: Monocentric – Syrian and/or Syroeremic refuge.

Distribution: Palestine, Jordan, Lebanon, Syria, southern Turkey, Armenia and northern Iraq into northwestern Iran.

Remarks: All of our records come from the highlands mostly collected between June and August. However, Müller et al. (2005) found this species to be common in the Mediterranean and the Irano-Turanian grassland, uncommon above 1000 m in the Mediterranean Hills but rare in the desert and in Wadi Arabah. Caterpillars occur on *Euphorbia* sp. (Euphorbiaceae). The parasitic fly *Spoggosia aegyptiaca* (Tachinidae) was recorded from larvae collected near Irbid. Records were from late March to early November, with the highest numbers during late June to mid-September. The species has at least in two generations in Jordan.

Hyles livornica (Esper, 1779)
Striped Hawkmoth (Plate 7)

Specimens: n = 69. Abo Alandah, 3-5.IV.2009(1); As Salt 26.VII.1994(1); Al Hashimeyyah 21.V.1980(1); Al Jubayhah IV. 1997(1) Taymeyyah Dwood , 23.V.1990(1), 1.IV.1997(1); Al Kurayyimah 27.III.1994(1); Al-Rameh Farm 15.IV.2009 (1); Amman 4.V.1980(1), 6.V.1980(3), 29.IV.1996(1), 20.III.1997(1), 1.V.1997(1); Ash Shawmari, 14.IV.-6.V.2009(5), 10-16.V.2009(2), 18-24.V.2010(1), 24.V.2010(1); Az Zarqa , 15.V.2010(1) Met'eb Al-Khalayleh, 19.IV.1993(1), 21.V.1980(10), 10.VII.92(1), 27.V.1994(1); Dana Reserve, 20.IV.1997(1), H. Quattous; Dayr Alla 12.IV.1997(1), 30.III.1997(1); Hisban, no date, Rami (3); Irbid 12.V.1992(1); Jabal Amman 16.V.1980(1); Nau'r 25.VI.2007(1) Rana Jado; Rumm 2941N 3527E, 27.III.2010(2) Dr. Luma Al Banna; Shafa Badran, 8-10.III.2009(1), 20.III.2009(1), 30.III-2.IV. 2009(1), 23.IV.2009(2), 2-4.IV.2009(1), 25-28.IV.2009(1); Tabarbawr 23.III.2009(1); Univ. of Jordan Farm 5.III.1995(1); 27.III.1994(1) M. Khawaldeh, 9.II.2009(1), 23-24.III.2009(2), 4-11.V.2008(1), 13-20.V.2008(1), 15.III.?(1), 15.XII.1997(1), 27.II.1995(1), 4.III.1997(1), 22.III.1997(1); Wadi as Sayr 1.III.1997(1), 14.V.1993(1).

Biogeographical Affiliation: Palaeotropical (but not rainforest areas of Africa and Asia), Holomediterranean and Saharo-Arabian.

Pleistocene refuge: probably the Afrotropical region.

Distribution: Occurs throughout the region, but resident only in the south; a migrant elsewhere. Often found in very large numbers, except the extreme north. Recorded several times from Novosibirsk in western Siberia, Russia.

Remarks: Our records come from the Jordan Valley, the highlands and the eastern and southern deserts. Most of the specimens were obtained from March to May. Müller et al. (2005) found this species to be common throughout the country and abundant in the Irano-Turanian zone. The highest numbers were observed in Wadi Arabah and the Central Plateau. Large numbers of emergent larvae was observed in the spring of 1999 in Al Azraq Wadi. During the third

instar the larvae consumed most of the natural food plants available including *Rumex*, *Emex*, Euphorbia in an area of several square kilometers. Later the caterpillars migrated and invaded bushes of *Prosopis farcta* and *Atriplex halimus*. Local Bedouins said that they had observed this kind of mass development at intervals of about 10 years, especially after years with heavy rains and thick vegetation. More than 80% were parasitized by the flies *Spoggonia aegyptiaca* and *Nemorilla maculosa* (Tachinidae). Recorded all year round with a strong peak from late March to May.

***Hippotion celerio* (Linnaeus, 1758)**

Silver-striped Hawkmoth (Plate 8)

Specimens: n = 6. Amman 12.IV.1997(1); Shafa Badran 23.IV.2009(1); Univ. of Jordan Farm 27.X.2008(1), 4-7.IX.2008(1), 18.II.2009(1), Reared in museum, emerged 9.XI.1988(1).

Biogeographical Affiliation: Palaeotropical.

Distribution: A notable migrant in most years from tropical Africa and India to the western Palaearctic region. In warm years, new colonies may even be established in North Africa and Europe, so the delineation between resident and migrant ranges cannot be clearly defined. It is resident in the Canary Islands, and probably also in the Azores and along the Atlantic coast of Morocco. It is certainly resident in many areas of the Levant and the Arabian Peninsula, and Egypt.

Remarks: Our specimens were collected from the highland and the Jordan Valley. Müller et al. (2005) reported that this species was very common in the Irano-Turanian and Saharo-Arabian zone and less common in the Mediterranean parts of the country. The highest numbers were regularly seen in Wadi Arabah, and central Plateau. Numerous caterpillars were observed in the southern Mountain desert, especially in wadis with *Emex* and *Rumex* (Polygonaceae). From 10 caterpillars collected in a grape vineyard near Amman, one was parasitized by the fly *Drino* (*Zygobothria*) *atropivora* (Robineau-Desvoidy) (Tachinidae). Adults were found all year round with

a well-pronounced peak in April and May. Populations fluctuated highly from year to year and it was not clear if this was because of migration or local mass developments.

Theretra alecto cretica (Boisduval, 1827)

Levant Hawkmoth (Plate 9)

Specimens: n = 22. Al Fuhays, collected 2.VI.1978(1) pupated 6.VI.1978 emerged 18.VII.1978(1); Al Hashimeyyah 13.IV.1980(1); Al Jubayhah 28.VII.2008(1), 12.V.2008(1), 28.VII.2008(1) Riyad Zumar, 18.VIII.2008, 2.V.1991(1), 4.V.1991(1) Rana, 15.IX.2008 Riyad Zumar, 25.V.2008(1); Al Karak 2.IX.? Amman 14.V.1979(1), 6.VII.1979 larva, pupa 9.VII.1979, adult 29.VII.1979(1), 16.V.1980(1); Ar Rusayfah reared in Museum emerged 23.VI.1997(1); Irbid 14.VI.1993(1); Az Zarqa'a 6.X.1987(1); Jarash, no date, Dr. Luma Al Banna; Khildah 3.XI.2010(1); Marj Al Hamam 2.V.1992(1); Suwayleh 1.X.1975(1), 12.VIII.1981 larvae, emerged 7.IX.1981(1), 26.VII.1993(1), 1.X.1975(1), larva 22.VIII.1981 emerged 12.IX.1981; Univ. of Jordan Farm 7.V.1988(1).

Biogeographical Affiliation: Palaetropical; Oriental region. Penetrates the warmest areas of the western Palaearctic region.

Distribution: A species which is partially migrant, individuals having been found as far west as Sicily and north to Romania; resident in south-western Bulgaria. It is regularly found in Corfu, where it may be a resident. It is a rarity in Romania. The main distribution stretches from Greece across southern and eastern Turkey, Cyprus to Transcaucasia, the Republic of Georgia, Daghestan and most of Iran, Turkmenistan, Uzbekistan, Kyrgyzstan and Afghanistan, and south to Iraq, Lebanon, Palestine, Jordan and the more fertile areas of Egypt.

Remarks: All of our records come from the highlands with two locations close to the eastern desert. Müller et al. (2005) found that the species was common in the Mediterranean Hills and the Irano-Turanian grassland and rare in the Saharo-Arabian zone in the south although some specimens were collected in Aqaba. Caterpillars are

pests in vineyards in the Jordan Valley. Records were from the end of March to December, depending on the year with an occasional spring and regular well-pronounced summer peak. Spring peaks, generally occur during May and summer peaks were from June to December.

DISCUSSION

This is the second published paper about the Sphingidae of Jordan after that of Müller et al. (2005). Nine species are recorded from Jordan collected from 38 different localities across the country. This number is less than half the number of species recorded from Jordan by Müller et al. (2005) (21 species) during a seven years project aimed to study the Middle East Lepidoptera from 1998-2004. They used a total of 850 nights of mobile light traps and several permanent light traps moved annually. The traps used in this study were 6-8 fixed light traps, which were also moved annually. Therefore, the study of Müller et al. (2005) was much more extensive in time and space. However, nine of their recorded species were recorded from Jordan for the first time, more than half of all species were rare, and the majority was found in three or fewer localities. This may explain the low number of species collected in our study.

All of the recorded species in this study occurred in the Mediterranean zone, though some of them were not restricted to this zone and occurred in the Jordan Valley, Eastern or Southern Desert or as far south as Aqaba. This agrees with the previous results of Müller et al. (2005) who also found almost all the species in Mediterranean Zone of Jordan.

Several species of Jordanian hawk moths have their limit of distribution in Jordan. The southern distribution limit is Jordan for *Akbeisia davidi*, *Marumba quercus*, *Smerinthus kindermanni kindermanni*, *Sphingonaepiopsis gorgoniades pfeifferi* and *Proserpinus proserpina proserpina*. *Acheronia styx styx*, which is mainly found in the Oriental Region, was collected in the Al Azraq Oasis (Müller et al. 2005). This is currently the most westerly record for this species in Jordan. Its occurrence in Jordan may be as a migrant. Such outlying 'populations' may be of interest especially for molecular studies concerned with population variation or expansion.

Six species were recorded in Jordan from one or two specimens only, namely (*Acheronia styx styx*, *Dolbina elegance*, *Akbesia davidi*, *Hemaris alaiana*, *Hemaris (Cochrania) croatica croatica* and *Rethera komarovi drilon*) (Müller et al. 2005). The status of such rare species needs further research regarding their habitat or migration.

The species described in Eitschberger et al. (2005) as *Hemaris molli* from a single female from near Irbid looks superficially like *Hemaris fuciformis*, although the illustrated example lacks the dividing line of scales in the forewing cell. Intriguingly, the corresponding genitalial preparation appeared to be similar to that of *Hemaris radians* (Walker, 1856) from the eastern Palaearctic. Further studies, including DNA barcoding, have demonstrated that *Hemaris molli* appears to be an example of *Hemaris alaiana*. This raises an interesting question. The individual could be a mislabeled specimen from Central Asia or represent an isolated population resident in the Levant which requires further investigation (Pittaway, 1997-2014).

The study of the migration of *Macroglossum stellatum*, population fluctuations of *Agrius convolvuli* and *Hyles livornica*, and the host plant for the larvae and adults of many species could be interesting aspects of studying the Sphingidae of Jordan in the future. All parasitic flies that were found on the Jordanian Sphingids belonged to Tachinidae (Diptera). These were *Drino (Palexorista) imberbis* (Wiedemann), *Drino (Zygobothria) atropivora* (Robineau-Desvoidy), *Spoggosia aegyptiaca* and *Nemorilla maculosa* (Müller et al., 2005). The study of the parasitization of such flies, their host range and the presence of other species in Jordan may provide new and interesting data.

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Plate 1: *Acherontia atropos* (Linnaeus, 1758)
Wing span: 10.5 cm



Plate 2: *Agrius convolvuli* (Linnaeus, 1758)
Wing span 11.2 cm



Plate 3: *Marumba quercus* (Denus & Schiffermuller, 1775)
Wing span: 6.5 cm



Plate 4: *Daphnis nerii* (Linnaeus, 1758)
Wing span: 8.7 cm



Plate 5: *Macroglossum stellatarum* (Linnaeus, 1758)
Wing span: 5.5 cm



Plate 6: *Hyles euphorbiae conspicua* (Rothschild & Jordan, 1903)
Wing span: 7.7 cm



Plate 7: *Hyles livornica* (Esper, 1779)
Wing span: 6.3 cm

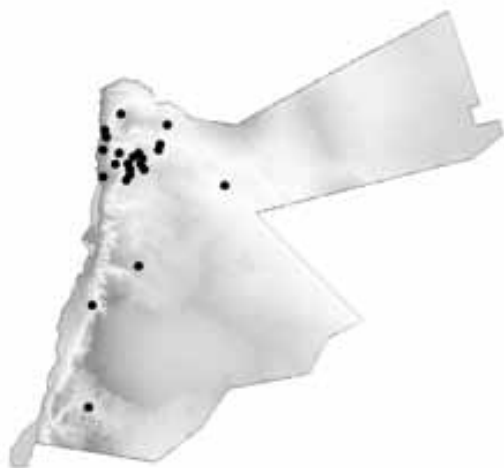


Plate 8: *Hippotion celerio* (Linnaeus, 1758)
Wing span: 6.5 cm



Plate 9: *Theretra alecto cretica* (Boisduval, 1827)
Wing span: 8 cm

