



## Taxonomic analysis of hawk moths (*Lepidoptera, Sphingidae*) of samarkand region

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### Abstract

The districts of the Samarkand region are of particular importance due to the richness of plant and animal species. From this point of view, it is a very rich area in terms of the number of species of hawk moths. As a result of specially conducted research, it was found that 16 species of hawk moths belonging to 12 genera and 3 subfamilies can be found in the area. This scientific article provides information on the biological and ecological characteristics of 16 species of hawk moths.

**Keywords:** samarkand oasis, hawk moths (*Sphingidae*), species composition, lepidoptera, mountain and mountainside areas, larva, imago, pupal stage

### Introduction

Hawk moths are nocturnal insects and include more than 1,500 species worldwide [2, 8, 9, 11]. There are also much larger species among them, reaching 130-140 mm when spreading their wings [11, 13, 14]. Most species of hawk moths are active at night, and among them we can find species that are also active during the day. The bodies of hawk moths are covered with butterfly scales. Their front wings are slightly larger than their hind wings. When standing still, the hindwings are hidden under the forewings. The front wings are covered with relatively dark (dark gray, brown, brown, etc.) scales. The hind wings are covered with pale and brightly colored scales in most species. Hawk moths fly much faster than other insects due to the very fast movement of their wings. When they fly, they can reach a speed of 140-150 km/h [2]. Due to the high speed, the migration of some of their species is several thousand km. The body is long conical and gives a beautiful appearance to the arrangement of hairs with colorful rings, borders and spots.

Hawk moths feed mainly on flower nectar. The mouthpiece is designed as a sucker and consists of a mouthpiece that is assembled on the lower part of the head. In feeding, the funnel spreads and reaches the very bottom of the flower, where nectar is present. Some hawk moths have a reduced chrysalis and do not feed during the imago stage [6, 12, 13]. In many species of hawk moths, sexual dimorphism is manifested in morphological characters. They have different sexes, male butterflies have a thinner abdomen compared to females, and the last part of the abdomen, that is, the part where the reproductive organs are located, is enlarged. Females have an enlarged abdomen and the part where the reproductive organs are present is thinned and sharpened. Fertilization in all species is carried out by internal fertilization.

Hawk moths are insects that develop through complete metamorphosis, exhibiting egg, larva, pupa, and imago life forms. It lays its eggs under the leaves of food plants. The larva of the ghost butterfly differs from the larvae of other insects in that it has a branch located on the last joint of the body [13, 14, 18, 19]. After hatching, the larva feeds on the leaves and young branches of that plant. Most hawk moths

are monophagous, feeding on only one type of plant and laying their eggs under the leaves of that plant. The larval period includes four hibernation periods. During each hibernation period, the larvae molt. Each time the larvae hatch, they increase in size. After the fourth hibernation period, the fed larvae fall from the plant to the soil and enter the mushroom stage in the humus pore layers of the soil. When the pupal stage falls in the summer months, the second generation of hawk moths emerge from it. If it falls on the last months of summer and fall, then the bulbous stage lasts until April-May of the following spring. Accordingly, the condition of wintering is observed in the bulbous stage. *Macroglossium sillitutum*, which has an active life form during the day, has been shown to hibernate in the imago stage in the winter when the air temperature is warm [1, 2, 14]. Most species of hawk moths reproduce two or three times a year. Some species give birth once.

In our research on hawk moths, fauna and ecology of hawk moths (*Lepidoptera, Sphingidae*) of the middle reaches of the Samarkand region were studied for the first time.

### Research materials and methods

Scientific research on the study of hawk moths in 2021-2022 will be conducted in several regions of Samarkand region (Urgut (39°18'17.26"N, 67°00'46.32"E), Tayloq, Jomboy (N 39°57'21.53,"E66°21'01.9"), Akdarya, Ishtikhon (39°57'06.38"N, 66°22'10.4E), Kattakurgan, Narpay (39°57'09.07"N,65°43'20.3E), Pakhtachi) districts [Picture 1].

The collection of materials was carried out in the evening, after sunset. Catching hawk moths was done between 20:00 and 03:00. The insect-attracting effect of light depends on the daily climatic conditions of the environment (temperature, humidity, precipitation, wind speed, etc.) and the state of moonlight. Currently, there are modern methods of attracting and catching insects using various devices (light, aromatic, hormonal). Among such devices are light traps of various designs based on the attraction of insects through light. In our research, we used ELSU-3 electric light trap, which we modernized, to collect material. In this device, the light source is a lamp, which is located in the center line of the electric light holder. Two pairs of mutually

perpendicular metal planes are arranged radially around the light source. The upper part of the cylindrical container is attached to the device to collect insects at the bottom. To anesthetize the insects, a piece of cotton soaked in chloroform and filter paper to prevent mechanical damage to the insects are placed in a corrugated container. The method of operation of the electric light trap is that insects attracted by the light rotate around the light source and collide with a radially located plane, losing direction. Then he falls into the funnel and faints under the influence of chloroform<sup>[12]</sup>. Mainly LED lamps with a voltage of 500 W were caught by holding the white fabric screen. At the same time, material collection was carried out using a special

device based on the design of ESLU-3 (Golubu *et al.*, 1980) [Picture 2]<sup>[5, 10]</sup>.

The material collected in this way was sorted, put into paper envelopes and labeled the next day. Some of the samples were corrected in the raspravilka<sup>[12]</sup>. Collections were made from imago stage butterflies. The development of the larvae of hawk moths in laboratory conditions was studied.

## Results

16 species of hawk moths were found in the research area. Below is a description of their distribution, biology and ecology.

**Table 1:** Taxonomic analysis of hawk moths.

Family	Subfamilies	Genus	Species
Sphingidae	Macroglossinae	Macroglossum (Giovanni Antonio Scopoli, 1777)	<i>Macroglossum stellatarum</i> (Linnaeus, 1758)
	Smerinthinae	Smerinthus (Pierre André Latreille, 1802)	<i>Smerinthus kindermannii</i> (Lederer, 1853)
	Sphinginae	Agrius (Hübner, 1819)	<i>Agrius convolvuli</i> (Linnaeus, 1758)
		Marumba (Moore, 1882)	<i>Marumba quercus</i> (Denis Schiffermüller, 1775)
		Dolphin (Staudinger, 1877)	<i>Dolbina grisea</i> (Hampson, 1893)
		Hyles (Hübner, 1819)	<i>Hyles livornica</i> (Esper, 1780)
		Hyles (Hübner, 1819)	<i>Hyles gallii</i> (Rottemburg, 1775)
		Hyles (Hübner, 1819)	<i>Hyles euphorbiae</i> (Linnaeus, 1758)
		Hyles (Hübner, 1819)	<i>Hyles centralasiae</i> (Staudinger, 1887)
		Hyles (Hübner, 1819)	<i>Hyles hippophaes</i> (Esper, 1789)
		Sphinx (Linnaeus, 1758)	<i>Sphinx privet</i> (Linnaeus, 1758)
		Laothoe (Fabricius, 1807)	<i>Laothoe populi</i> (Linnaeus, 1758)
		Hemaris (Dalman, 1816)	<i>Hemaris ducalis</i> (Staudinger, 1887)
		Manduca (Hübner, 1807)	<i>Manduca quinquemaculata</i> (Haworth 1803)
		Proserpinus (Hübner, 1819)	<i>Proserpinus proserpina</i> (Pallas, 1772)
	Macroglossinae	Theretra (Hübner, 1819)	<i>Theretra alecto</i> (Linnaeus, 1758)

### Family: Sphingidae

#### Subfamily: Macroglossinae

**Generation:** *Macroglossum* (Giovanni Antonio Scopoli, 1777)

**Species:** *Macroglossum stellatarum* (Linnaeus, 1758)

**Determined place and period.** 18 copies of acacia (*Acacia*) trees and basil (*Ocimum*) planted as ornamental trees in Jomboy, Okdarya, Ishtikhon and Narpay districts of Samarkand region: 11♀, 7♂ (8.06.2022, 15.06.2022, 22.06.2022, 5.07.2022, 10.09.2022, 17.09.2022, 24.09.2022, 10.10.2022).

**Spreaded.** Europe, the Crimean Peninsula, North Africa, Central Asia, the southern and northern regions of India, the southern regions of the Far East. In the European part of Russia, the Caucasus, the Urals, Eastern Siberia<sup>[1, 8, 9, 11]</sup>.

**Genus:** *Theretra* (Hübner, 1819)

**Species:** *Theretra Alecto* (Linnaeus, 1758)

**Determined place and period.** 16 copies in the natural and cultural landscapes of Urgut, Tayloq, Bulung'ur, Jomboy, Okdaryo, Ishtikhon, Kattakurgan and Narpay districts of Samarkand region: 11♀, 5♂ (24.04.2022, 1.05.2022, 8.05.2022, 21.05.2022, 28.05.2022, 5.06.2022, 11.07.2022, 18.07.2022, 25.07.2022, 26.08.2022, 4.09.2022, 11.09.2022, 24.09.2022, 2.10.2022, 9.10.2022) it was determined that he met,<sup>9</sup><sup>[1, 8, 11]</sup>.

**Spreaded.** Distributed in southeastern Europe, East Asia, Central Asia, India, the Philippines, Taiwan, and Russia<sup>[1, 8, 9, 11]</sup>.

#### Subfamily: Smerinthinae

**Genus:** *Smerinthus* (Pierre André Latreille, 1802)

**Species:** *Smerinthus kindermannii* (Lederer, 1853)

**Determined place and period.** 13 specimens from the thickets of the banks of the Zarafshan River, the territory of the Zarafshan State Reserve: 8♀, 5♂ (7.07.2022, 14.07.2022, 21.07.2022, 4.08.2022, 11.08.2022, 18.08.2022, 4.09.2022, 12.09.2022, 12.09.2022, 19.09.2022) was determined to meet<sup>[1, 8, 9, 11]</sup>.

**Spreaded.** Turkey, Cyprus, Lebanon, Iraq, Iran, Afghanistan, Pakistan. In Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, and Kazakhstan, in northwestern China-Xinjiang (Ningxia, Gansu). There are also reports of meetings in Israel and Kuwait.

#### Subfamily: Sphinginae

**Genus:** *Agrius* (Hübner, 1819)

**Species:** *Agrius convolvuli* (Linnaeus, 1758)

**Determined place and period.** 17 copies in all districts of Samarkand region: 8♀, 9♂ (22.04.2022, 29.04.2022, 5.05.2022, 28.05.2022, 7.06.2022, 14.06.2022, 30.06.2022, 6.07.2022, 13.07.2022, 25.07.2022.2022, 2.08.2022, 9.08.2022) was determined to meet.

**Spreaded.** The range of the ivy ghost butterfly is very wide, it is found in all the polar arctic regions. In addition, it can be found in Russia, Scandinavia and even in Iceland<sup>[1, 8, 9, 11]</sup>.

**Genus:** *Marumba* (Moore, 1882)

**Species:** *Marumba quercus* (Denis & Schiffermüller, 1775)

*Determined place and period.* It was found that 3 copies: 2♀, 1♂ (28.05.2022, 7.06.2022, 14.06.2022, years) were found in the territory of the Zarafshan State Reserve.

*Spreaded.* It is distributed in Central and Southern Europe, Northern Morocco, the Mediterranean Sea, Asia Minor, Iran, Iraq and CIS countries <sup>[1, 8, 9, 11]</sup>.

**Genus:** Dolbina (Staudinger, 1877)

**Species:** *Dolbina grisea* (Hampson, 1893)

*Determined place and period.* It was found that 2 copies: 2♀ (29.05.2022, 5.06.2022, 15.06.2022, y.) were found in the southern part of the village of Amonko'ton, Urgut district, Samarkand region.

*Spreaded.* In Pakistan, Kashmir, Eastern Afghanistan, Tajikistan and the Hisar mountain range of Uzbekistan <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hyles (Hübner, 1819)

**Species:** *Hyles livornica* (Esper, 1780)

*Determined place and period.* 14 copies in Urgut district of Samarkand region: 6♀, 8♂ (27.04.2022, 3.05.2022, 12.05.2022, 4.06.2022, 11.06.2022, 18.06.2022, 22.06.2022, 30.06.2022, 6.07.2022). ) was found to meet.

*Spreaded.* North Africa, Southern Europe, Crimea, Russia, Caucasus, Central Asia, Mongolia, China, India <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hyles (Hübner, 1819)

**Species:** *Hyles gallii* (Rottemburg, 1775)

*Determined place and period.* 11 copies in the territory of Ettiuyli Soy village, Urgut district, Samarkand region: 9♀, 2♂ (27.04.2022, 3.05.2022, 12.05.2022, 4.06.2022, 11.06.2022, 18.06.2022, 22.06.2022, 30.06.2022, 6.06.2022.2022) was determined to meet.

*Spreaded.* Distributed in the Palearctic region <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hyles (Hübner, 1819)

**Species:** *Hyles euphorbiae* (Linnaeus, 1758)

*Determined place and period.* 14 copies in the territory of Ettiuyli stream, Amonqo'ton village, Urgut district, Samarkand region: 9♀, 5♂ (29.04.2022, 5.05.2022, 15.05.2022, 7.06.2022, 14.06.2022, 21.06.2022, 29.06.2022, 2.07.2020, 15.07.2022) was determined to meet.

*Spreaded.* Southern and Central Europe, Asia Minor, Iran, Eastern Afghanistan. European part of Russia, Central Asia <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hyles (Hübner, 1819)

**Species:** *Hyles centralasiae* (Staudinger, 1887)

*Determined place and period.* 19 copies in the territory of Ettiuyli stream, Amonqo'ton village, Urgut district, Samarkand region: 12♀, 7♂ (28.04.2022, 4.05.2022, 14.05.2022, 6.06.2022, 13.06.2022, 20.06.2022, 28.06.2022, 28.06.2022, 2.07.2022, 14.07.2022) was determined to meet.

*Spreaded.* Turkey, Armenia, Iraq, Iran, Turkestan, Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, Afghanistan, China's Xinjiang region <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hyles (Hübner, 1819)

**Species:** *Hyles hippophaes* (Esper, 1789).

*Determined place and period.* 12 copies in the territories of Sanchiquil village, Urgut district, Samarkand region: 17♀, 5♂ (26.04.2022, 2.05.2022, 11.05.2022, 4.06.2022, 9.06.2022, 17.06.2022, 21.06.2022, 5.07.2022, 12.07.2022) was determined to meet.

*Spreaded.* Afghanistan, Armenia, Azerbaijan, China, Europe, Iran, Iraq, CIS, Mongolia, Pakistan, Romania, Serbia, Turkey, Turkmenistan countries <sup>[1, 8, 9, 11]</sup>.

**Genus:** Sphinx (Linnaeus, 1758)

**Species:** *Sphinx ligustri* (Linnaeus, 1758)

*Determined place and period.* 4 copies in Zarafshan State Reserve: 3♀, 1♂ (26.04.2022, 2.05.2022, 11.05.2022, 4.06.2022, 9.06.2022, 17.06.2022, 21.06.2022, 5.07.2022, 12.07.2022 ) was found to meet.

*Spreaded.* Western regions of Europe, Asia Minor, Mongolia, northern regions of China, Japan, CIS, Far East <sup>[1, 8, 9, 11]</sup>.

**Genus:** Laothoe (Fabricius, 1807)

**Species:** *Laothoe populi* (Linnaeus, 1758)

*Determined place and period.* 7 copies in Narpay, Pakhtachi, Kattakurgan, Ishtikhon, Okdarya districts of Samarkand region: 3♀, 4♂ (26.06.2022, 2.07.2022, 10.07.2022, 17.07.2022, 24.07.2022, 17.08.2022, 21.08.2022, 5.09.2022.2022, 12.09.2022) was determined to meet.

*Spreaded.* Europe, Mediterranean regions, Northern Iran, Northwestern part of China, CIS, Russia <sup>[1, 8, 9, 11]</sup>.

**Genus:** Hemaris (Dalman, 1816)

**Species:** *Hemaris ducalis* (Staudinger, 1887)

*Determined place and period.* 11 copies in the southern regions of Urgut district, Samarkand region: 8♀, 3♂ (26.05.2022, 2.06.2022, 11.06.2022, 4.07.2022, 9.07.2022, 17.07.2022, 21.07.2022, 5.08.2022, 12.08.2022 y.) was found to meet.

*Spreaded.* Southern and eastern Kazakhstan, the northern part of Afghanistan, Mongolia, Kyrgyzstan, China (Xinjiang), Korea, Pakistan, Tajikistan, Uzbekistan <sup>[1, 8, 9, 11]</sup>.

**Genus:** Manduca (Hübner, 1807)

**Species:** *Manduca quinquemaculata* (Haworth, 1803)

*Determined place and period.* The upper part of the mountainous regions of Urgut district of Samarkand region 3 copies: 1♀, 2♂ (27.05.2022, 3.06.2022, 13.06.2022, 6.07.2022, 11.07.2022, 19.07.2022, 23.07.2022, 7.08.2022, 14.08.2022.2022) was determined to meet.

*Spreaded.* North America and Australia <sup>[1, 8, 9, 11]</sup>.

**Genus:** Proserpinus (Hübner, 1819)

**Species:** *Proserpinus proserpina* (Pallas, 1772)

*Determined place and period.* The upper part of the mountainous regions of Urgut district of Samarkand region 3 copies: 1♀, 2♂ (27.05.2022, 3.06.2022, 13.06.2022, 6.07.2022, 11.07.2022, 19.07.2022, 23.07.2022, 7.08.2022, 14.08.2022.2022) was determined to meet.

*Spreaded.* In the central and southern regions of Europe, Crimea, Iran, Afghanistan, Africa, China, Caucasus, Russia, CIS countries <sup>[1, 8, 9, 11]</sup>.

This species is protected and included in the Red Book of Uzbekistan.

## Conclusion

Conducted scientific 16 species *Macroglossum stellatarum* (Linnaeus, 1758), *Smerinthus kindermannii* (Lederer, 1853), *Agrius convolvuli* (Linnaeus, 1758), *Marumba quercus* (Denis & Schiffermüller, 1775), *Dolbina grisea* (Hampson, 1893), *Hyles livornica* (Esper, 1780), *Hyles gallii*

(Rottemburg, 1775), *Hyles euphorbiae* (Linnaeus, 1758), *Hyles centralasiae* (Staudinger, 1887), *Hyles hippophaes* (Esper, 1789), *Sphinx ligustri* (Linnaeus, 1758), *Laothoe populi* (Linnaeus, 1758), *Hemaris ducalis* (Staudinger, 1887), *Manduca quinquemaculata* (Haworth, 1803), *Proserpinus proserpina* (Pallas, 1772), *Theretra alecto* (Linnaeus, 1758) hawk moths were identified. The mountain and mountain slopes of the region are species-rich regions. Butterflies distributed in the mountainous region depending on the food, we do not find in the plains and low plains. Because it is possible to determine the distribution regions of hawk moths based on the area where the species of plants are distributed. For example, species belonging to the genus *Hyles*, *Proserpinus proserpina*, *Hemaris ducalis* are found only in mountainous areas. *Theretra alecto*, *Agrius convolvuli*, *Macroglossum stellatarum* species are found in all regions of the region.

*Sphinx ligustri*, *Theretra alecto* species are the most harmful species in agriculture and horticulture.

*Proserpinus proserpina* (Pallas, 1772) and *Dolbina grisea* (Hampson, 1893) are included in the Red Book of Uzbekistan.

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