

V.S. Abukenova, A.G. Kaptyonkina\*

Karagandy University of the name of academician E.A. Buketov, Kazakhstan  
(\*E-mail: alyonakaptyonkina@gmail.com)

## Lepidopteran fauna of the city of Karaganda

In the article the results of investigation of the species composition of *Lepidoptera* in city of Karaganda are presented. Studies were conducted in urban parks, squares, courtyards and areas around Karaganda city. Representatives of 11 families, 35 species were identified. The bio indication value of *Lepidoptera* in monitoring researches is due to their significant role and large biomass in the natural communities, rapid change of the generation, high fecundity and sensitivity to a big number of anthropogenic impact. According to preliminary data, the butterflies of the families *Nymphalidae*, *Satyridae* were the most numerous. Background species are *Nymphalis urtical* L., *Melitaea didyma*, *Hyponphele lycaon* Rott. Small and decorating nature species have been identified. In result was made the booklets, which called «Rare and endangered butterflies of the Central Kazakhstan» for the Museum of Nature of E.A. Buketov Karaganda State University. These species must be monitored in the Karaganda city. Refined data on species are pests. Some species are recommended for collecting and training in summer subject schools or at Universities in entomology classes. Further, it is planned to study the distribution of *Lepidoptera* in the city.

**Keywords:** fauna of the city, *Nymphalidae*, *Satyridae*, urban ecosystem, species adorning nature, insects, *Lepidoptera*, butterflies.

### Introduction

The study of urban fauna is important for the complex assessment of biological diversity, assessment of the current state of faunal complexes and the identification of trends in their future development and variability. The importance of such research is growing in connection with the realization of regional and national sustainable developing programs, as well as global strategies, programs and plans for the conservation and sustainable use of biodiversity.

One of the most important aspects is to study of modern ecological status, especially to the influence of the anthropogenic factor on natural communities [1]. To determine the characteristics of the distribution of fauna in urban ecosystems in different countries, animals of various taxonomic rank are studied.

*Lepidoptera* are an important part of many terrestrial ecosystems, including urban communities. Representatives of this systematic group have great practical importance for plants, as pollinators. Some species may also be a pest of forestry and agriculture [2]. It is obvious that day butterflies (*Lepidoptera*) are one of the most noticeable representatives of insects in various natural zones, while many regions of Kazakhstan are not sufficiently studied from an ecological and entomological point of view. The *Lepidoptera* of Kazakhstan is most studied due to the work of employees of the Institute of Zoology (Almaty city) and Russian specialists [3, 4], but problems remain in identifying the local distribution of species.

It is known that day-flying butterflies — *Lepidoptera* are a popular object for monitoring the ecological state of the wild. The bio indication value of *Lepidoptera* in monitoring studies is due to their significant role and large biomass in the natural communities, rapid change of the generation, high fecundity and sensitivity to a big number of anthropogenic impact, and visual visibility [5]. Data on the species composition of *Lepidopteran* Karaganda have not been published previously. The purpose of this work was to study the species composition and biotopic distribution of *Lepidoptera* in the city.

### Materials and methods

The object of study were day-flying insects — *Lepidoptera*. We used materials from field practices of Karaganda state university's students and our own collections of the authors, conducted in the summer of 2019 in the natural environment and in the urban areas of Karaganda. To determine the species, the key anatomical and morphological characters of the group were studied [6, 7]. Identification was carried out using reference keys [8, 9] and relevant manuals [10]. The dates of collection of adults, as well as the occurrence of other stages of development of *Lepidoptera* were recorded. Butterflies were taken into account on 1×1 km routes. An approximate transect method was used, modified for monitoring purposes [11]. The total number of routes is 19, the number of registered butterflies is 625.

The study of *Lepidoptera* was carried out in three sections of the city. Section 1 — the Central Park of the city in Karaganda. Section 2 — the Victory Park (located in the southeast of the city). Section 3 — KSU District (territory adjacent to the Karaganda State University).

#### Results and discussion

Observations and gatherings during the growing season made it possible to register the following *Lepidoptera* families: *Arctiidae*, *Hesperiidae*, *Pieridae*, *Lycaenidae*, *Nymphalidae*, *Sphingidae*, *Notodontida*, *Zygaenidae*, *Lymantriidae* [12].

The summation of data on routes was carried out using phonological tables [13]. Table 1 presents the option of processing data on families and their representatives, the place of their collection, and the registration period.

Table 1

#### Registration of observations of *Lepidoptera* in the city

№	Representatives	Observation area	Date and time	Weather	The number of meetings
1	2	3	4	5	6
1	Family Skipper butterfly ( <i>Hesperiidae</i> ) a) <i>Thymelicus lineola</i> O. Adopaea	Karaganda KSU district (territory adjacent to the Karaganda State University)	4.06.2017 11:00–15:00	Fair, windless weather t = 24 °C	7
2	Family <i>Pieridae</i> a) Cabbage butterfly ( <i>Pieris brassicae</i> L.) b) <i>Pieris rapae</i> ( <i>Pieris rapae</i> L.) c) <i>Pontia daplidice</i> L. ( <i>Sinchloe</i> )	Karaganda, KSU district	4.06.2017 11:00–15:00	Fair, windless weather t = 24 °C	1 3 2
3	Family <i>Lycaenidae</i> a) <i>Polyommatus icarus</i> Rott. ( <i>Lycaena</i> ) b) <i>Heodesdisparritulus</i> Wern. ( <i>Cupido</i> )	Karaganda KSU district	4.06.2017 11:00–15:00	Fair, windless weather t = 24 °C	2 1
4	Family <i>Nymphalidae</i> a) <i>Nymphalis io</i> L. ( <i>Vanessa</i> )	Karaganda, KSU district	4.06.2017 11:00–15:00	Fair, windless weather t = 24 °C	1
5	Family <i>Satyridae</i> a) <i>Lasiommata maera</i> L. ( <i>Pararge</i> ) b) <i>Coenonympha amyntas</i> Poda ( <i>iphis</i> )	Karaganda KSU district	5.06.2017 16:00–18:00	Clear, breeze is gentle, gusty (after rain) t = 23 °C	
6	Family <i>Hesperiidae</i> a) <i>Thymelicus lineola</i> O. ( <i>Adopaea</i> )	Karaganda, KSU district	5.06.2017 16:00–18:00	Clear, breeze is gentle, gusty (after rain) t = 23 °C	8
7	Family <i>Pieridae</i> a) <i>Pieris rapae</i> L. b) <i>Pontia daplidice</i> L. ( <i>Sinchloe</i> )	Karaganda, KSU district	5.06.2017 16:00–18:00	Clear, breeze is gentle, gusty (after rain) t = 23 °C	1 3
8	Family <i>Lycaenidae</i> a) <i>Lycaena phlaeas</i> L. ( <i>Chrysophanus</i> , <i>Cupido</i> ) b) <i>Polyommatus icarus</i> Rott. ( <i>Lycaena</i> )	Karaganda, KSU district	11.06.2017 9:00–10:00, 13:00–14:00	Clear, breeze is gentle, gusty (after rain) t = 23 °C	2 5

Continuation of Table 1

1	2	3	4	5	6
9	Family <i>Pieridae</i> a) <i>Pieris brassicae</i> L. b) <i>Pieris rapae</i> L. c) <i>Pontia daplidice</i> L. ( <i>Sinchloe</i> )	Karaganda, the Central Park	05.07–07.07 2017	Fair, windless weather t = 26 °C	24 17 30 5
10	Family <i>Lycaenidae</i> a) <i>Polyommatus icarus</i> Rott. ( <i>Lycaena</i> ) b) <i>Heodes dispar rutilus</i> Wern. ( <i>Cupido</i> )	Karaganda, the Central Park	09.07. - 11.07.2018	Fair, windless weather t = 25 °C	30 10
11	Family <i>Nymphalidae</i> a) <i>Nymphalis io</i> L. ( <i>Vanessa</i> ) b) Red admiral butterfly ( <i>Vanessa atalanta</i> L. ( <i>Pyrameis</i> ) c) <i>Nymphalis urtical</i> L. ( <i>Vanessa</i> )	Karaganda city	4.05.18 3.07.18 25.06.18 11.06.18	Fair, windless weather t = 22–25 °C	5 12 3 7
12	Family <i>Nymphalis antiopa</i> L. ( <i>Vanessa</i> ) a) <i>Polygonia vau-album</i> Schiff. ( <i>L-album Esp.</i> ) b) <i>Voloria euphrosyne</i> L. ( <i>Brenthis</i> )	Karaganda city	20.04.18	Fair, windless weather t = 15 °C	7 11 2
13	Family <i>Satyridae</i> b) <i>Melanargia galathea</i> L. c) Hermit ( <i>Chazara briseis</i> ) d) <i>Hyponephele jurtina</i> L. ( <i>janira</i> L.) e) <i>Hyponephele lycaon</i> Rott. f) <i>Lasiommata maera</i> L. ( <i>Pararge</i> )	Karaganda city	20.07.19 20.07.19 20.07.19 20.07.19 20.07.19	Fair, windless weather t = 25 °C	15 10 6 7
14	Family <i>Arctiidae</i> a) <i>Arctia caja</i> L.	Karaganda city	28.05.19 15.07.19		8 5
15	Family <i>Sphingidae</i> a) <i>Hyles euphorbiae</i> b) <i>Deilephila porcellus</i> c) <i>Macroglos sumstellatarum</i>	Karaganda city	29.07.19 22.07.19 15.10.19		1 1 3

The observations showed that the abundance of species of the family *Pieridae* accounts for 31.3 % of the total number of *Lepidoptera* we collected. Species of the *Nymphalidae* family are also numerous (29.8 % of all recorded). The *Lycaenidae* family and the *Satyridae* family include 15.9 % and 15.6 % of urban day-flying butterflies. The species of the families *Arctiidae*, *Sphingidae*, *Hesperiidae*, *Papilionidae*, *Notodontidae*, *Lymantriidae*, *Zygaenidae*, respectively, their share is 3.9 %; 1.4 %; 1.4 %; 0.3 %; 0.2 %; 0.1 % *Lepidoptera* urban coenosis. For *Lymantriinae* and *Zygaenidae*, the data need to be clarified. The diagram (Fig. 1) is compiled according to the percentage of the abundance of species of the family of *Lepidoptera* in the examined areas of the city.

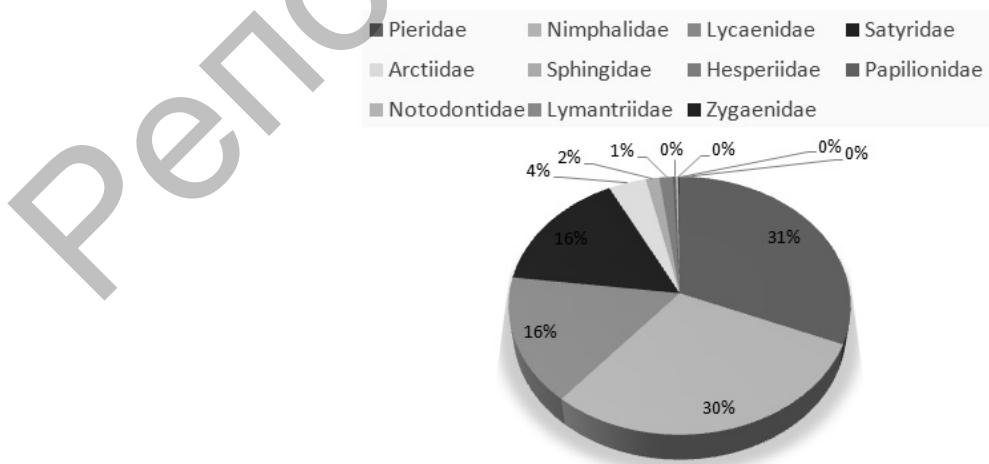


Figure 1. The ratio of the abundance of species of *Lepidoptera* families in the studied areas of the city of Karaganda

The *Pieridae* family includes large or medium sized butterflies, white, yellow or orange, with normally developed legs. In the steppe cenoses of the region, the genera *Aporia* Hb., *Pieris* Schrank, *Anthocharis* L., *Colias* F., *Leptidia* Billb. The main representatives of this family are *Aporia crataegi* L.; *Pieris brassicae* L.; *Pieris napi* L.; *Pieris rapae* L.; *Colia serate* Esp. There usually meet around 70–76 individuals per one transect.

Caterpillars of *Aporia crataegi* mainly damage fruit trees: apple, pear, plum, apricot, as well as hawthorn and some other hardwoods. In the research area, it is usual, even dominates among the occurring whites. The species *Colias hiata* L. is distinguished by pronounced sexual dimorphism: the male is lemon yellow, the female is yellowish white. Fore wings with black, hind wings with orange spot in the middle; black border of the front wings with bright spots. It is a widespread and common butterfly.

Butterflies of the *Nymphalidae* family are also characterized by frequent occurrence on route transects (43–48 specimens), which can be associated with a variety of food preferences of the species. *Nymphalids* feed on nectar of flowers, sugary juice of damaged trees or fruits, and sometimes even liquid manure and other strongly smelling substances. The most noticeable are hives, drafts, parsley and mother of pearl. In parks and lawns of the city, common urticaria *Aglais urticae* (Linnaeus, 1758) is a large or medium sized butterfly. Caterpillars live on nettles: blackish, more or less covered with yellow-green stripes. In all areas of observation, urticaria fly singly and in pairs [14].

*Neptis rivularis* Sc. (*Lucilla* Den. Et. Schiff) is recorded in May–July. Caterpillars live on meadowsweet, honeysuckle and anemone.

*Vanessa cardui* L. (*Pyrameis*) has front wings red, their apical half black with white spots; hind wings somewhat darker with black spots. In May 2019, mass reproduction of the species was noted, especially on flowering shrubs, whereas in other years the butterfly was rare. During the phased flowering of lilac bushes there was a flight of flocks of butterflies from the city to the suburbs [15].

*Nymphalis io* L. (*Vanessa*) is a beautiful large butterfly. Caterpillars are black, with frequent white dots and black spikes; they live on nettles, hops, blackberries, raspberries. The butterfly itself prefers to eat on the *Cirsium* flowers. In the city, mainly single individuals were observed; the abundance was low everywhere.

Admiral butterfly (*Vanessa atalanta* L. (*Pyrameis*) is a large bright butterfly. After wintering, it can fly out in April during the warm spring. It met usual in July in the city center [16].

The most common and widespread species of the *Lycaenidae* family is *Polyommatus icarus* Rott. (*Lycaena*). The male is blue above (somewhat lilac), and the female is dark brown, with a blue coating at the wing root and red marginal holes. The view is common for highways, vacant lots, gardens, parks, urban areas. Caterpillar feed plants: *Astragalus* sp., *Coronilla varia*, *Fragaria vesca*, *Fragaria* sp., *Medicago* sp., *Melilotus* sp., *Onobrychis* sp., *Trifolium pratense*.

From the second decade of July to the end of August it was noticed in the study area. Butterflies eat on different flowers, prefer *Scabiosa ochroleuca*, and often sit on the ground. Caterpillars feed plant — cereals from genus *Festuca*, *Stipa*, *Poa*, *Sesleria*.

*Maniola jurtina* (Linnaeus, 1758) is widespread. The species is common for the cultural landscape in areas with ruderal vegetation, in pastures. Summer from late June to early August. Forage plants of caterpillars are cereals from genus *Roa*, *Bromus*, *Festuca*, *Brachipodium*, *Milium*, *Lolium*, *Alopecurus*, *Anthoxanthum*, and etc.

In the city, closer to the country house, it is possible to observe the large-eyed small-*Hyponephele lycaon* (Rottentburg, 1775). Caterpillars live on bluegrass and other cereals. The number of marigolds on the transect is 30–36 individuals.

*Papilio machaon* L. is a butterfly of the family *Papilionidae*, is protected in many European countries. The species was registered by the authors within the city, but gravitates to suburban areas and gardens. Caterpillars of butterflies are found on flowering umbrellas — dill, carrots.

*Hesperia comma* (Linnaeus, 1758) is a species of the *Hesperiidae* family. Butterflies fly from mid-July to mid-August. Adult nutrition is noted on the flowers of *Trifolium*, *Prunella*, *Solidago dahurica*. Caterpillar fodder plants are *Coronilla varia*, *Elytrigia* sp., *Festuca* sp., *Holcus* sp., *Lotus* sp., *Poa* sp. The species disappears with continuous mowing, overgrazing, and strong trampling of meadows. It is included in the Red Books of a number of European countries (2–4 category) [17]. The study area was a common species with moderate occurrence in dry areas along the outskirts of the city.

*Arctia caja* L. from the *Arctiidae* family lives in gardens, urban wastelands and other open places. The feed plant of caterpillars is a variety of undersized plants (like plantain and dandelion). Shaggy caterpillars

with light shaggy warts. Butterflies fly in July and August, often can be caught in the light. The area is ubiquitous. The number of individuals in some years is high with an abundance of plantain and dandelion.

From *Sphingidae* family, the wide spreads is the *Hyles euphorbiae*, flies in May and June and is seen in various garden flowers and in various species of *Euphorbia*. Rare species in the city on flowering plants is *Macroglossum stellatarum*. The species is capable of long-distance migrations; we have it from the beginning of May to the end of October and, possibly, represent two migrating generations. Caterpillars develop on bedstands and sprockets.

Thus, during the observation period, 625 *Lepidopteran* specimens belonging to 35 species and 11 families were registered in the landscape gardening zone of the city. All identified species are representatives of the European-Siberian fauna. Background species belong to the families of *Pieridae* (5 genera, 7 species) and *Satyridae* (6 genera, 6 species). According to preliminary data, they need protection: *Hesperia comma* and a *Papilio machaon* (as species listed in the Red Books of European states and neighboring countries).

### Conclusion

The study is showed, that allegedly vulnerable native species of *Machaon Linnaeus*, *Parnassius apollo*, *Iphiclides podalirius*, *Laothoe populi Linnaeus*, *Smerinthus ocellatus*, *Zegheria antea zheris*, *Arctia caja Linnaeus* compiled information booklets «Rare and endangered butterflies of the Central Kazakhstan» to familiarize schoolchildren, students and other visitors to the Museum of Nature of Karaganda State University. Dangerous pests at the caterpillar stage include almost all types of *Pieridae* family: *Aporia hippie*, *Pieris brassicae*, *Pieris rapae*, *Pieris napi*.

Almost all butterflies are pollinators of plants, wild-growing and cultivated, provide seed sets for many species; occupy a certain ecological niche. This is one of the most important values of their stay in urban ecosystems. Many butterflies are quite beautiful, and the aesthetic perception of the world around people is important, especially when relaxing in gardens, parks, squares and boulevards.

The following types of city *Lepidoptera* possess the best aesthetic features: *Lycaenidae* — *Polyommatus icarus* (*Lycaena*), *Nympha lisis* (*Vanessa*), red admiral butterfly (*Vanessa atalanta* (*Pyrameis*)), *Nympha liserata* (*Vanessa*), *Melitaea didyma*, *Argynnis pandora*, *Neptis rivularis*, *Nymphalis antiopa* (*Vanessa*), *Polygonia va-album* (*L-album* Esp.), *Melanargia russiae* (*Suwarovius* Hbc.), *Melanargia galathea*, *Chazara briseis*, (*Hyponenphele jurina* (*janira* L.), *Hyponenphele lycaon*), *Lasiommata maera* (*Pararge*), *Arctia caja*, *Deilephila porcellus*, *Macroglossum stellatarum*, *Hyles euphorbiae*, white harpy *Cerura ermine* [18].

One of the results of many years of work by specialists of the Department of Zoology in KSU is to study the species diversity of butterflies in Karaganda was the site butterflies.kz — Butterflies [17], which contains partial materials about the lepidopteran region. Further work is required for a comparative study of the biotopic distribution of *Lepidoptera* and changes in the fauna during urban processes.

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В.С. Абуkenова, А.Г. Каптёнкина

### Қарағанды қаласының лепидоптер фаунасы

Мақалада Қарағанды қаласының лепидоптер түрінің құрамын зерттеу нәтижелері келтірілген. Зерттеу қалалық саябақтар, алаңдар, аулалар және Қарағанды қаласының іргелес аумақтарында жүргізілген. 11 тұқымдастық өкілдері, 35 түр анықталды. Лепидоптер қоршаған ортаның экологиялық жағдайын бақылаудың танымал объектісі екені белгілі. Мониторингтік зерттеулердегі лепидоптердің биоиндикациялық мәні олардың табиғи қауымдастықтардағы маңызды рөлі мен үлкен биомассаға, ұрпақтарының тез өзгеруіне, жоғары ұрықтылығына, антропогендік әсердің бірқатар түрлеріне, сезімталдыққа және көрнекілікке байланысты. Қарағанды лепидоптерінің түрлік құрамы туралы мәліметтер бұрын жарияланған жоқ. Алдын-ала мәліметтер бойынша *Nymphalidae* және *Satyridae* тұқымдастарының көбелегі ең көп болды. Фондық түрлері — *Nymphalis irtative* L. (*Vanessa*), *Melitaea didyma* Esp., *Hyponephele lycan* Rott. Саны аз және табиғатты әсемдеуші түрлері анықталған. Академик Е.А. Бөкетов атындағы Қарағанды университетінің Табиғат мұражайы қала аумағындағы санын мониторингтік бақылау үшін көбелектің түрлері туралы (Орталық Қазақстанның сирек кездесетін және жойылып бара жатқан көбелектері) ақпараттық буклет құрастырды. Зиянкес түрлері бойынша мәліметтер нақтыланған. Кейбір түрлерін жазғы пәндік мектептерде энтомология сабақтарында жинауға және оқуға ұсынылған. Болашақта лепидоптердің қала аумағы бойынша таралуын зерттеу жоспарлануда.

*Кілт сөздер:* қала фаунасы, күндізгі лепидоптер, *Nymphalidae*, *Satyridae*, табиғатты безендіретін түрлері, қалалық эокожүйе, көбелектер, *Lepidoptera*.

В.С. Абуkenова, А.Г. Каптёнкина

### Фауна чешуекрылых города Караганды

В статье представлены результаты исследования видового состава чешуекрылых города Караганды. Исследования проводились на территории городских парков, в скверах, дворах и прилегающих территориях г. Караганды. Определены представители 11 семейств, 35 видов. Известно, что булавоусые чешуекрылые являются популярным объектом для мониторинга экологического состояния среды. Биоиндикационное значение чешуекрылых в мониторинговых исследованиях обусловлено их значительной ролью и большой биомассой в природных сообществах, быстрой сменой поколений, высокой плодовитостью, чувствительностью к ряду видов антропогенного воздействия, визуальной заметностью. Данные о видовом составе чешуекрылых Караганды ранее не были опубликованы. По предварительным данным наиболее многочисленными были бабочки семейств Нимфалиды (*Nymphalidae*) и Бархатницы (*Satyrinae*). Фоновыми являются виды Крапивница (*Nymphalis urtica* L. (*Vanessa*)), Шашечница (*Melitaea didyma* Esp.), Ликаон (*Hyponephele lycan* Rott.). Определены малочисленные и украшающие природу виды. Для Музея природы Карагандинского университета им. академика Е.А. Букетова составлены информационные буклеты о видах («Редкие и исчезающие бабочки Центрального Казахстана»), нуждающихся в мониторинге численности на территории города. Часть видов рекомендована для коллекционирования и обучения в летних предметных школах на занятиях по энтомологии. В дальнейшем планируется изучение распределения чешуекрылых по территории города.

*Ключевые слова:* фауна города, дневные чешуекрылые, *Nymphalidae*, *Satyridae*, украшающие природу виды, урбозкосистема, бабочки, *Lepidoptera*.

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