

Research of Lepidoptera fauna as one of the basis for the biodiversity management in the Kozjanski Park

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Abstract

In the Kozjanski Park, a total of 1027 Lepidoptera species, including 25 protected species, 38 red list species and 7 Natura 2000 species have been recorded since 2003. As these were more or less just occasional observations we estimate that the Lepidoptera fauna is presented here with more than 1,500 Species. Already this number indicates the importance of Kozjanski Park for the protection of rare and protected species, although their scope is relatively small protected area of 260 km², but very important and rich on the biodiversity. The area is a kind of refugee for many rare and endangered species of plants and animals. Park is also a part of Unesco Biosphere Areas (Kozjansko and Obsotelje). As many butterflies and moths species are strictly seasonal and prefer only a particular set of habitats, they are good indicators in terms of anthropogenic disturbance and habitat quality. They are also represented with many ecologically specialized species, which are highly sensitive even on the smallest ecological changes in habitats. As the Lepidoptera fauna can represent the past and current status of the preservation and use of the habitats, we used this knowledge, in combination of species ecology, food plants and the life cycle in combination of represented species and also other groups, to prepare the most suitable management plan for long term preservation of biodiversity in the Kozjanski Park. The management plans will cover the most important types of habitats represented in the area of Kozjanski Park and its surroundings.

Keywords

Lepidoptera, Fauna, Slovenia, Kozjanski Park, Biodiversity, Protected areas, Research, Protected species.

Introduction

Kozjanski Park is the largest regional park in Slovenia, situated in the south east of Slovenia, north of Zagreb. The largest, and with Kozjanski Park the oldest one in Slovenia, is Triglav National Park, which covers Julian Alps with the highest peaks, where nature is in this sense more or less protected from direct human impact. Kozjanski Park covers an area of 206 sq. km, with an extensive area of typical ecosystems and landscape where a large part of the original nature has been preserved (KOZJANSKI PARK 2013). The human influence in the area is still traditional extensive agriculture, mostly dry meadows, partly pastures and old traditional meadow orchards on the hills and slopes, with the leaf forests on the edges. This traditional maintained grassland vegetation is very rich, with many interesting floristic elements. Interesting are also climate elements, which influence the area. Three different climate characters are connected in the area: Alpine, Pannonian and partly Sub Mediterranean, which additionally enrich the biodiversity of the small area.

According to the national zoogeographical regionalization the area belongs to two big zoogeographical regions: subalpine and subpannonian zone. The area is characterized by the hilly, wooded, grassy, agricultural area with a relatively small settlement. The highest peak is Oslica in the north, with 860 m and the lowest Figarjev Bridge at Sotla River with 151 m a.s.l in the south. The percentage of forests is 48 %. The average annual rainfall is 1060 mm, and the average annual temperature is 9.5^o C (KOZJANSKI PARK 2013).

According to BARBORIČ & ZMRZLIKAR (2010) the land use hasn't changed significantly from the 18th century till now. There were some fluctuations in land use according to the different periods where it was more forest or meadows, depending on different importance of livestock or agriculture and the last two world wars. In general the area of grassland and the vineyards has increased all the time. The area of forests has decreased, except the last two decades, when the livestock is again in the crisis. The area of orchards increases or decreases in different time periods. These facts show that the nature was maintained more or less in the same way during the last 3 centuries.

Since the Lepidoptera are very good adapted and specialized group of insects on different habitats and plants, we can use them as bioindicators from different perspectives. On the composition of Lepidoptera fauna, we can reconstruct the composition of plant species from the area, the habitat types, the climate conditions and the preservation of the area on the long term scale.

The aim of our study was the overview of Lepidoptera biodiversity in Kozjanski Park as such and to estimate the qualitative diversity on different localities and habitat types, to identify the best-preserved sites inside the park according to present fauna. On this sites the long term preservation management, suitable for vegetation and

fauna should be applied. This means the same extensive use of meadows and forest glades, with one mowing yearly, without heavy machinery and rotation machines. Parts of clearings, forest edges and old forest stand should also apply more restrictive protection measures, especially parts in Natura 2000 areas. Habitats with the highest biodiversity are particularly important in terms of preserving this treasure with the long-term sustainable management of the area, which cannot remain without human management. Since the whole area, from an economic point of view cannot be strictly protected, we want to identify the best-preserved areas of the park, based on flora and Lepidoptera fauna in which more strict and sustainable management should be implemented. In other parts of meadows and extensive old orchards sustainable land use should be applied, supported by agricultural subsidies. Such areas, with preserved nature will be interesting for nature lovers and tourists, from which the locals may have an additional source of income to keep the locals in the area and preserved nature on the long term.

Methods

Day and night time observation of Lepidoptera fauna were carried out from 2003 till 2012. The observations lasted from early spring until late autumn at different intensity, depending on resources and time. The research cost was partly financed by Kozjanski Park, the other part were voluntary observations.

For the monitoring we selected representative habitat types from the area, in which we applied the same kind of monitoring: transect method for the day time observations and the UV light collecting. Nocturnal fauna usually represents 90 % of Lepidoptera fauna living in the area, so our monitoring was mainly focused on the night active Lepidoptera species. For the nocturnal active moths we used specially designed UV light tents with the halogen super actinic UV TLD light source inside the pyramidal shape tents and sugar baits in spring and the autumn. As species came to the light tents, we identified them and estimated the specimens number of each species. The majority of all species were identified in the field. Species, which could not be identified on the spot, were collected in few specimens for later identification and setting for the collection. The number of the day flying species and their abundance we estimated with the transect method. Some species were also focused searched according to their special behavior or living niches (Psychidae, Gracillariidae, Tineidae, Coleophoridae and others). Species were identified based on long-term experience, comparative collection, different literature and partly with barcoding and other setting techniques. Literature data were also considered if they were available (MAČEK 1999).

Field and literature data were entered in the specially designed database for estimation of faunistical and other ecological data. We used the database to monitor the species composition for different habitats, abundance of the groups and each species, population dynamics of each species, host plants of the fauna and each species and the special ecological needs of each species. The data evaluation was prepared by the same database and application called Popis (GOMBOC & SELIŠKAR 2009).

Systematics, species names and statistics in the article follow FAUNA EUROPAEA (2006).

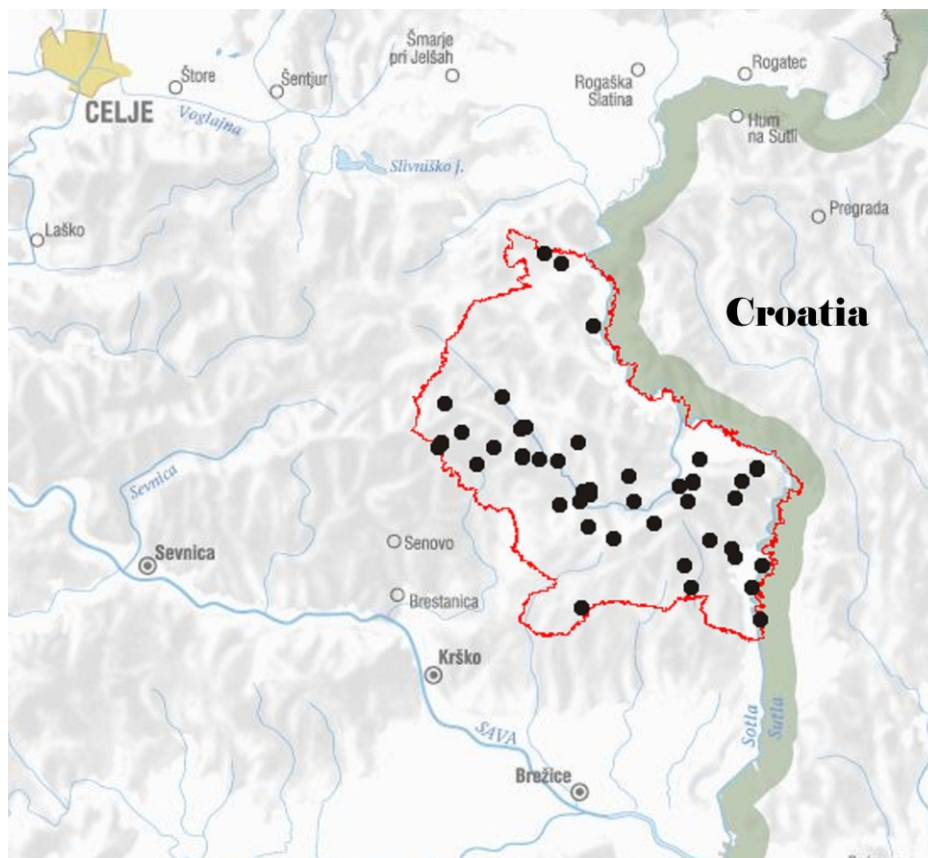


Figure 1: The area of Kozjanski Park, with Lepidoptera monitoring localities.

Results

The Lepidoptera fauna of Kozjanski Park is very rich on species and diverse according to different habitats. Already in the first year of monitoring 542 Lepidoptera species were recorded in 7 observation days (19.6.-28.6.2003). The maximum species numbers during night observation were recorded on 16th of August 2011 – 214 species (Podsreda, W slope, forest clearing, succession) and on 23th of June 2003 – 186 species (Bistri Graben, valley of the stream), 24th of June 2003 – 185 species (Vetrnik, dry meadows), 17th of August 2012 – 177 species (Gradišče, sand pit). These numbers show that the fauna is very rich in different habitat types and during the whole summer season.

All together 1027 Lepidoptera species were observed and identified in Kozjanski Park until the end of 2012. Smaller part of the material has not been estimated yet. This is 29 % of all known Slovenian Lepidoptera fauna, with 3600 known species (CARNELUTTI 1992a, 1992b, GOMBOC & LASAN 2006, LESAR & GOVEDIČ 2010). 85 species belong to butterflies and 942 to moths. All together 149 field observations were carried out, where all together 5129 field records were collected of 28874 specimens observed in the field. Figure 1 shows the localities where field observations were carried out.

The family with the highest species number was Noctuidae, with 226 species. Follows Geometridae, with 214 species, Tortricidae 114, Crambidae 66, Nymphalidae 46, Pyralidae 40, Gelechiidae 32. More detailed proportions are shown on figure 2.

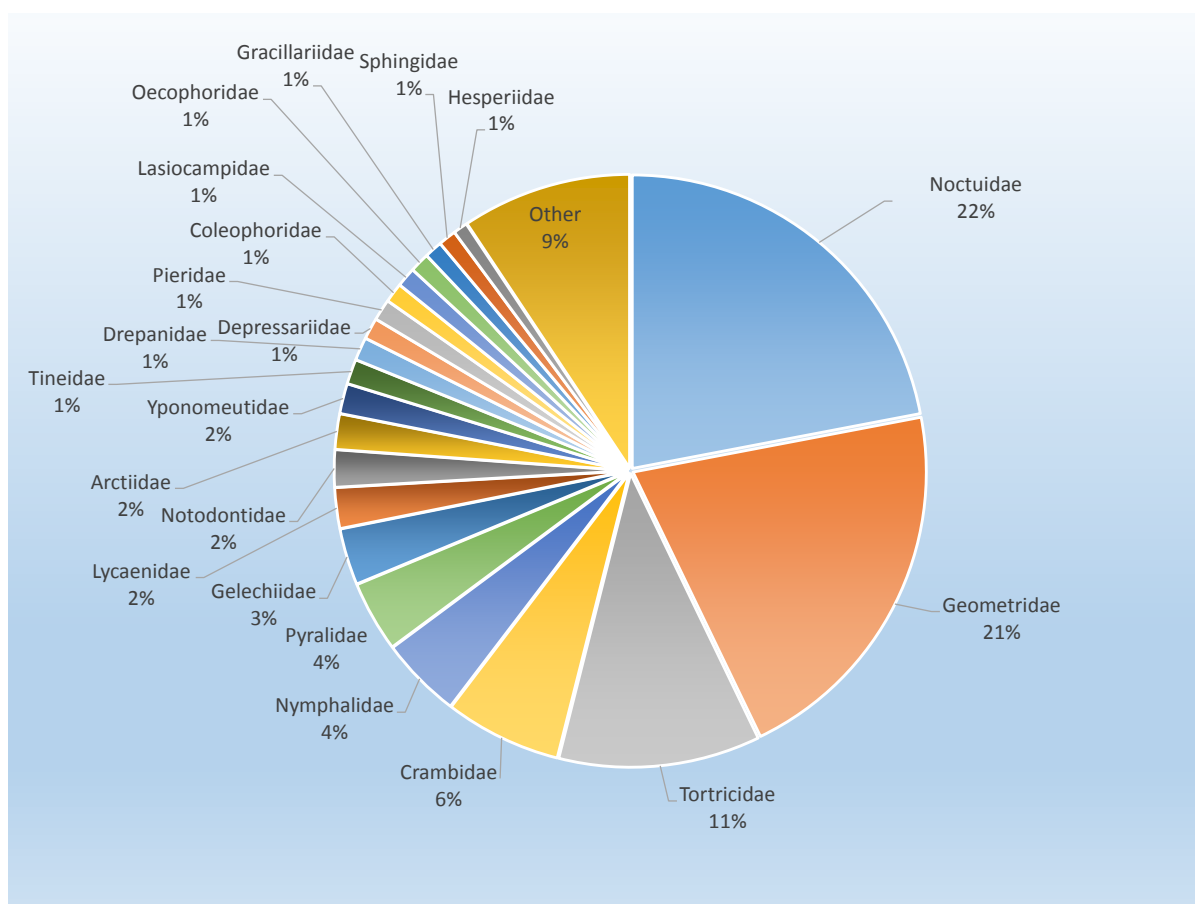


Figure 2: The proportion of Lepidoptera species shown by families.

The area of Kozjanski Park is also important for protection of protected and endangered species. Since 2012 7 of 13 in Slovenia present (ČELIK et. al. 2005) Natura 2000 Lepidoptera species have been confirmed in the area. Most of these species are well preserved in the area and builds strong populations, as *Euplagia quadripunctaria* and *Euphydryas aurinia*. 25 protected species of 196 present in Slovenia (Uradni list RS 2004) have been found in the area, mostly dry grassland and wetland species. Also 38 of 219 (Uradni list RS 2002) endangered red list species have been confirmed till now.

Very interesting were some findings of rare and unexpected species even in higher numbers, like *Atethmia ambusta* (Denis & Schiffermüller, 1775), *Euchalcia modestoides* Poole, 1989, *Dichagyris nigrescens* (Hofner, 1888), *Dichagyris signifera* (Denis & Schiffermüller, 1775), *Agapeta largana* (Rebel, 1906), *Fulvoclysia nerminae* Koçak, 1982, *Scardia boletella* (Fabricius, 1794), *Eilema lutarella* (Linnaeus, 1758), *Eupithecia alliaris* Staudinger, 1870, *Eupithecia gueneata* Millière, 1862, *Macaria artesiaria* (Denis & Schiffermüller, 1775) and many others even Mediterranean species. Some alpine-coline species have been found on the lowest altitudes in Slovenia, as for example *Euchalcia variabilis* (Piller & Mitterpacher, 1783) and *Hepialus humuli* (Linnaeus, 1758) at 160 m a.s.l. at the Bistrica and Sotla river.

Table 1: List of protected Lepidoptera species found in Kozjanski Park (in bold are Natura 2000 species)

Species	Family
<i>Atethmia ambusta</i> (Denis & Schiffermüller, 1775)	Noctuidae
<i>Atethmia centrago</i> (Haworth, 1809)	Noctuidae
<i>Catachysta lemnata</i> (Linnaeus, 1758)	Crambidae
<i>Dichagyris signifera</i> (Denis & Schiffermüller, 1775)	Noctuidae
<i>Eilema pseudocomplana</i> (Daniel, 1939)	Arctiidae
<i>Eriogaster catax</i> (Linnaeus, 1758)	Lasiocampidae
<i>Eucarta amethystina</i> (Hübner, 1803)	Noctuidae
<i>Euphydryas aurinia</i> (Rottemburg, 1775)	Nymphalidae
<i>Euphydryas maturna</i> (Linnaeus, 1758)	Nymphalidae
<i>Euplagia quadripunctaria</i> (Poda, 1761)	Arctiidae
<i>Eurhodope rosella</i> (Scopoli, 1763)	Pyralidae
<i>Hemaris tityus</i> (Linnaeus, 1758)	Sphingidae
<i>Leptidea morsei</i> (Fenton, 1882)	Pieridae
<i>Limnaecia phragmitella</i> Stainton, 1851	Cosmopterigidae
<i>Luperina testacea</i> (Denis & Schiffermüller, 1775)	Noctuidae
<i>Lycaena dispar</i> (Haworth, 1802)	Lycaenidae
<i>Metachrostis dardouini</i> (Boisduval, 1840)	Noctuidae
<i>Metachrostis velox</i> (Hübner, 1813)	Noctuidae
<i>Parnassius mnemosyne</i> (Linnaeus, 1758)	Papilionidae
<i>Perizoma lugdunaria</i> (Herrich-Schäffer, 1855)	Geometridae
<i>Phengaris alcon</i> (Denis & Schiffermüller 1775) = <i>Maculinea rebeli</i> (Hirschke, 1904)	Lycaenidae
<i>Scopula subpunctaria</i> (Herrich-Schäffer, 1847)	Geometridae
<i>Xanthocrambus lucellus</i> (Herrich-Schäffer, 1848)	Crambidae
<i>Zerynthia polyxena</i> (Denis & Schiffermüller, 1775)	Papilionidae
<i>Zygaena ephialtes</i> (Linnaeus, 1767)	Zygaenidae

As the area is open to the corridor of migrant species, not far from the Sava River, many migratory species can be found in the area. Migrant species were especially common during the long heat season 2012 that lasted from end of June until September. Migrants which were recorded in the area are *Helicoverpa armigera* (Hübner, 1808), *Heliopsis peltigera* (Denis & Schiffermüller, 1775), *Nomophila noctuella* (Denis & Schiffermüller, 1775), *Rhodometra sacraria* (Linnaeus, 1767), *Spodoptera exigua* (Hübner, 1808), *Trichoplusia ni* (Hübner, 1803), and *Euchromius ocella* (Haworth, 1811), which was for the first time observed in Slovenia (GOMBOC & KLENOVSEK, 2013). In addition, non-native alien species were observed in the area, mainly Gracillariidae.

According to the results the most important sites for Lepidoptera fauna in Kozjanski Park are dry meadows on Oslica and Vetrnik Plato, south dry slopes of Kozje Peč near Orešje and Svete Gore, western slope of Stare Svete Gore near Podsreda, and some succession habitats as sand pit near Gradišče, forest clearing near Podsreda and even some extensive used agricultural habitats as extensive orchards and vineyards, where also almost 200 species can be recorded during one night observation.

Discussion and conclusion

Monitoring results of Lepidoptera fauna in Kozjanski Park were surprising in the number of species found in the area and species richness of different habitats even in not very intensive monitoring and rather few field datasets. As shown in figure 2 the proportion of some families is rather low according to the expectations, like Tortricidae, Gelechiidae and others, therefore much more species are expected in the area of Kozjanski Park. We estimate that at least 1500 Lepidoptera species are present in the area of Kozjanski Park. We can confirm this also with the field observations as each observation brings additional species to the known fauna. We expect further findings of protected and red list species, especially with more focused monitoring of these species. Until now, these records have been only occasional findings during the random monitoring.

As shown in numbers the area of Kozjanski Park is very rich in Lepidoptera diversity even in agricultural areas like orchards and vineyards if they are extensively used. The area is already a part of the Unesco Biosphere areas (Kozjansko and Obsotelje). According to our long-term experience of Lepidoptera monitoring in whole Slovenia, our opinion is, that this is one of the richest areas in Lepidoptera fauna, like some other hot spot areas on south slopes of Trnovski Forest, Nanos, Slavnik and Julian Alps.

Monitoring results show that fauna here is still well preserved and can remain preserved on the long term if extensive sustainable use of land will continue. The problem is that the agriculture in the area gets intensified on one hand or land is left to nature when old people die without successors. The problems are intensive pastures of cattle and wild deer, which in short grazed vegetation and causes terracing of steep terrain, thus accelerating soil erosion. Also use of heavy machinery for hay harvesting became more critical in the last years. All these problems are consequences of bad economic situation in today agriculture in Slovenia, where small farms cannot survive on long term. This should be taken in to the account that the management of the park area should be a compromise of economic survival of resident population and long term preservation of biodiversity. There are a few possibilities how this can be achieved even with low cost if there will be a compromise on site of agricultural subsidies for protected areas, Park management staff on management plan and promotion of the area and

touristic possibilities of the area in sense of complementary business on farms and other local tourist facilities. This strategy has already been partly implemented, so tourists are already discovering the charms of Kozjanski Park and this trend seems to increase significantly in the near future. The park should be ready also for these new trends to help local residents to benefit also from this point of view.

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