CONTRIBUTIONS TO THE KNOWLEDGE OF NOCTUID MOTHS (LEPIDOPTERA, NOCTUIDAE) FROM ORHEI NATIONAL PARK

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Abstract. The paper presents the faunal diversity of moths from Noctuidae family from the Orhei National Park. As a result of the researches carried out, a total of 322 species of noctuid moths were identified in the Orhei National Park, belonging to 153 genera and 17 subfamilies: Acontiinae (4 species), Acronictinae (17), Amphipyrinae (5), Bryophilinae (4), Condicinae (2), Cuculliinae (11), Dilobinae (1), Eustrotiinae (5), Hadeninae (59), Heliothinae (9), Metoponiinae (3), Noctuinae (64), Oncocnemidinae (2), Pantheinae (2), Plusiinae (14), Psaphidinae (6) and Xyleninae (114 species). The research was carried out in various localities of the Orhei National Park (Ivancea, Vatici, Trebujeni, Romanești, Țigănești, Peresecina, Butuceni, Bravicea and Selișteе) during the years 2012-2024. As a result of the research, three genera (*Denticucullus*, *Eriopygodes* and *Opigena*) and eight new species for the fauna of the Republic of Moldova were identified.The research demonstrates that the Orhei National Park is an area of great importance for the conservation of biological diversity, and research in the reserve needs to be continued.

Keywords: Orhei National Park, Lepidoptera, noctuid moths, Republic of Moldova, diversity, new species.

Rezumat. Contribuții la cunoașterea fluturilor nocturni (Lepidoptera, Noctuidae) din Parcul Național Orhei. În rezultatul cercetărilor efectuate în Parcul Național Orhei au fost semnalate în total 322 de specii de fluturi nocturni din familia Noctuidae, care aparțin la 153 de genuri și 17 subfamilii: Acontiinae (4 specii), Acronictinae (17), Amphipyrinae (5), Bryophilinae (4), Condicinae (2), Cuculliinae (11), Dilobinae (1), Eustrotiinae (5), Hadeninae (59), Heliothinae (9), Metoponiinae (3), Noctuinae (64), Oncocnemidinae (2), Pantheinae (2), Plusiinae (14), Psaphidinae (6) și Xyleninae (114 specii). Cercetările au fost efectuate în diverse localități ale Parcului Național Orhei (Ivancea, Vatici, Trebujeni, Romanești, Țigănești, Peresecina, Butuceni, Bravicea și Selișteе) în perioada anilor 2012-2024. În rezultatul cercetărilor efectuate au fost identificate trei genuri (*Denticucullus*, *Eriopygodes* și *Opigena*) și opt specii noi pentru fauna Republicii Moldova. Cercetările demonstrează că Parcul Național Orhei este o zonă de mare importanță pentru conservarea diversității biologice, iar cercetările în această zonă necesită a fi continuate.

Cuvinte cheie: Parcul Național Orhei, Lepidoptera, noctuide, Republica Moldova, diversitate, specii noi.

INTRODUCTION

After regrouping the subfamily Catocalinae and Calpinae to the Erebidae family, the Noctuidae family, with about 12000 species is the second largest family of Noctuoidae in the world. According to the latest studies in the Republic of Moldova, the Noctuidae family consists of 430 species, taxonomically classified in 170 genera and 17 subfamilies (ȚUGULEA et al., 2021; ȚUGULEA, 2022). Given that neighboring countries recorded a much higher number of noctuid species, their number could increase in the coming years in the fauna of the Republic of Moldova (ȚUGULEA et al., 2021; ȚUGULEA, 2022).

The interest for the knowledge of Lepidoptera systematic group was manifested in Moldova from the beginning of the 20th century (ȚUGULEA & DERJANSCHI, 2015). The first catalogue for the Moldova Lepidoptera was published by Miller and Zubowsky in the first number of the journal "*Works of the Bessarabian Society of Natural Scientists and Amateurs of Natural History*" in 1908. A great value for butterfly fauna is the work of Miller and Zubowsky, later joined by Ruscinski, who published a series of articles between 1908-1937, with a major impact on the study of butterflies and moths, registering many species for the territory of Bessarabia and being the first and some of most valuable taxonomic works for this purpose from the last century (MILLER & ZUBOVSCHI, 1908; MILLER & ZUBOWSKY 1912; MILLER & ZUBOWSKY 1913; MILLER et al., 1929; MILLER et al. 1932; ZUBOWSKY & RUSCINSKI, 1937). These are some of the few works where we can find mentions of some noctuid moth species reported on the territory of the park. The fauna of butterflies has been studied over the past few years. The study of diurnal butterflies in Orhei National Park reveals a significant number, 94 species, which represent 68% of the total number of diurnal butterfly species in the fauna of the Republic of Moldova (ȚUGULEA, 2024).

The science popularization brochure "*Valori naturale ale Parcului Naţional Orhei*" mentioned species included in the Red Book of the Republic of Moldova (2015) and various Red Lists at the European and world level, such as *Callimorpha quadripunctaria, Acherontia atropos, Saturnia pyri, Dolbina elegans, Iphiclides podalirius, Parnassius mnemosyne, Zerynthia polyxena, Parnassius mnemosyne* and *Zerynthia polyxena* and 3 species included in Annexes II and IV to the European Council Directive – *Callimorpha quadripunctaria*, *Parnassius mnemosyne*, *Zerynthia polyxena* (MUNTEANU et al., 2011).

Despite the fact, that noctuid moths are most often viewed only from the point of view of pests, as a result of the large number of published works on this subject, a number of factors have contributed to the decrease of the numbers of specimens in the populations, which has led to the increase of the number of endangered noctuid species. In recent years we have witnessed an alarming decline in some species of butterflies and moths that a few decades ago were considered very common. The noctuids are as endangered as diurnal butterflies and face the same problems, such as intensification of agriculture, abandonment of traditional land use, changes in forest management and pollution of the environment.

The aim of this research was to inventory and study the species of moths identified on the territory of the Orhei National Park, especially the identification and study of rare and new species that require protection and conservation. This article contributes to the understanding of the distribution of lepidopteran species in the Republic of Moldova and even in Europe.

MATERIAL AND METHODS

The Orhei National Park is located in the central area of the Republic of Moldova, with an area of 33,792.09 ha, constitutes about 1% of the area of the Republic of Moldova, including four districts: Orhei, Străseni, Călărași and Criuleni and 18 localities. From the entire surface of the park, 18.5 thousand ha consists of forests belonging to the Orhei and Călărași forestry enterprises. The central office of the park is located in Butuceni, and the core area includes natural forest near Trebujeni, Butuceni, Donici, Curchi and Țigănești. The Orhei National Park is located in the Codrilor Plateau (90.7%) and in the silvosteppe region (9.3%). The slopes of the Codrii heights are characterized by a sandy relief, represented by narrow ridges, deep valleys and hills. The landscape of the park is hilly, partly covered with forest. The territory is crossed by valleys and the Răut River flows through the park (Fig. 1). The Orhei National Park was founded in 2022 and represents a protected natural area, which contributes to stopping the degradation of forest ecosystems, meadows and contributes to the protection of the flora and fauna characteristic of the existing habitats in the area (***. https://ecopresa.md; *Orheiul Vechi Archaeological Landscape*). Even though the territory of Orhei National Park is located in the central part of the Republic of Moldova, an area with a rich natural heritage, the diversity of insect species in this area is insufficiently studied.

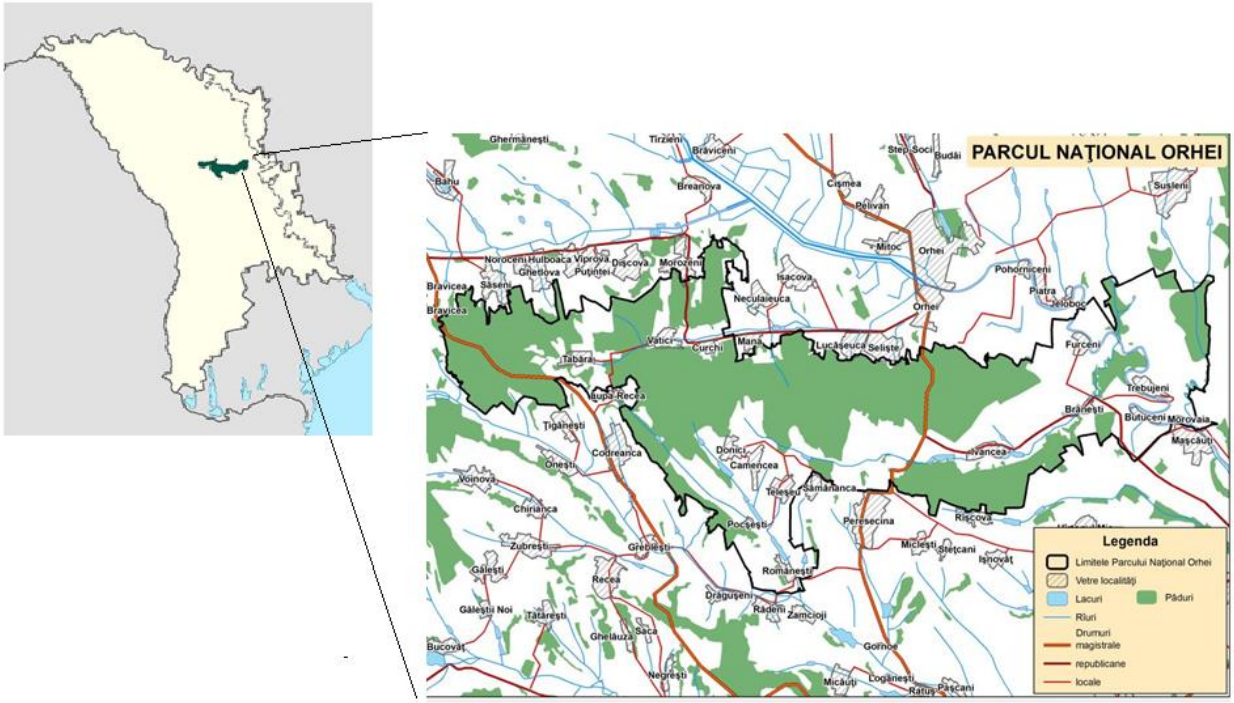

Figure 1. Location of the Orhei National Parc of the Republic of Moldova.

The forest vegetation of the Orhei National Park consists of several oak species (*Quercus petraea*, *Quercus robur*) located on the plateau and on the slopes with northern exposure. Sessile oak mixed with hornbeam (*Carpinus betulus*) are found on on the slopes with north-east and east exposure. Sessile oak with linden (*Tilia tomentosa*) and ash (*Fraxinus excelsior*) are found on the slopes with south and south-west exposure. At lower altitudes, oak forests with hornbeam and sessile with pedunculate oaks are found. Willow forests (*Salix* sp.) were formed in the meadows of the medium-sized rivers Ichel, Cula, Vatici and Răut (MUNTEANU et al., 2011).

The research was carried out during the vegetation period of 2012-2024. The entomological material was collected in different habitats of the Orhei National Park, like forests, forest edges, meadows and calcareous canyons from 9 localities on the territory of the Orhei National Park: Ivancea (Orhei district), Vatici (Orhei district), Trebujeni (Orhei district), Romanești (Străseni district), Țigănești (Străseni district), Peresecina (Orhei district), Butuceni (Orhei district), Bravicea (Călărași district) and Selișteni (Orhei district).

The moths collections were carried out from March to November. The noctuids were collected by the following methods: manual collection, with the entomological net, at the standard electric lamp (100 W) and by installing ultraviolet and white light traps (BUȘMACHIU at al., 2023). The entomological traps with white and ultraviolet light were located at a distance

of 15 m from each other. The systematic collection was carried out in Ivancea village by proffesor Valeriu Derjanschi with a periodicity of two days per week. The nomenclature and classification was given according to FIBIGER & HACKER (2005). For species identification we have used the works by RÁKOSY (1996), KLYUCHKO (2006) and the Lepiforum website (***. http://www.lepiforum.de). We have also made genitalia examination for species that are difficult to determine.

RESULTS AND DISCUSSION

The variety of landscapes, the favorable climatic conditions and the diverse spatial structure of the habitats have created optimal conditions for the existence and successful reproduction of moths populations on the territory of the Orhei National Park. As a result of the researches carried out, a total of 322 species of moths were identified in Orhei National Park, belonging to 153 genera and 17 subfamilies: Acontiinae (4 species), Acronictinae (17), Amphipyrinae (5), Bryophilinae (4), Condicinae (2), Cuculliinae (11), Dilobinae (1), Eustrotiinae (5), Hadeninae (59), Heliothinae (9), Metoponiinae (3), Noctuinae (64), Oncocnemidinae (2), Pantheinae (2), Plusiinae (14), Psaphidinae (6) and Xyleninae (114 species) (Table 1).

Table 1. Repartition by subfamilies and genera of the noctuid moths (Lepidoptera, Noctuidae) from the Orhei Natural Park.

No.	Subfamily	Genus	No. of species
1.	Acontiinae	*Acontia*	3
		Aedia	1
2.	Acronictinae	*Acronicta*	12
		Craniophora	1
		Moma	1
		Oxicesta	1
		Simyra	2
3.	Amphiryrinae	*Amphipyra*	1
4.	Bryophilinae	*Bryophila*	1
		Cryphia	2
		Nyctobrya	1
5.	Condicinae	*Eucarta*	2
6.	Cuculliinae	*Cucullia*	11
7.	Dilobinae	*Diloba*	1
8.	Eustrotiinae	*Deltote*	4
		Phyllophila	1
9.	Hadeninae	*Anarta*	1
		Anorthoa	1
		Ceramica	1
		Cerapteryx	1
		Conisania	1
		Egira	1
		Eriopygodes	1
		Hada	1
		Hadena	8
		Hecatera	3
		Lacanobia	7
		Leucania	2
		Mamestra	1
		Melanchra	1
		Mythimna	10
		Orthosia	7
		Pachetra	1
		Panolis	1
		Polia	3
		Senta	1
		Sideridis	3
		Tholera	2
10.	Heliothinae	*Helicoverpa*	1
		Heliothis	4
		Periphanes	1
		Pyrrhia	1
		Schinia	2
11.	Metoponiinae	*Aegle*	1
		Panemeria	1
		Tyta	1
12.	Noctuinae	*Actebia*	1
		Agrotis	6
		Anaplectoides	1
		Auchmis	1
		Axylia	1

		Cerastis	2
		Chersotis	3
		Diarsia	3
		Dichagyris	4
		Elaphria	1
		Epilecta	1
		Epipsilia	1
		Eugnorisma	1
		Eugraphe	1
		Euplexia	1
		Eurois	1
		Euxoa	8
		Graphiphora	1
		Lycophotia	1
		Naenia	1
		Noctua	7
		Ochropleura	1
		Opigena	1
		Papestra	1
		Peridroma	1
		Phlogophora	1
		Pseudeustrotia	1
		Rhyacia	2
		Spaelotis	1
		Xestia	8
13.	Oncocnemidinae	*Calophasia*	1
14.		*Colocasia*	1
	Pantheinae	*Panthea*	1
15.		*Abrostola*	3
		Autographa	4
		Diachrysia	3
		Euchalcia	1
		Macdunnoughia	1
		Plusia	1
	Plusiinae	*Trichoplusia*	1
16.		*Allophyes*	1
		Asteroscopus	1
		Brachionycha	1
		Lamprosticta	1
		Meganephria	1
	Psaphidinae	*Valeria*	1
17.		*Actinotia*	1
		Agrochola	9
		Ammoconia	1
		Amphipoea	2
		Antitype	1
		Apamea	12
		Aporophyla	1
		Apterogenum	1
		Archanara	1
		Atethmia	2
		Athetis	2
		Atypha	1
		Brachylomia	1
		Calamia	1
		Caradrina	4
		Charanyca	1
		Chilodes	1
		Chloantha	1
		Cirrhia	2
		Cleoceris	1
		Conistra	6
		Cosmia	4
		Denticucullus	1
		Dichonia	2
		Dicycla	1
		Dryobotodes	1
		Dypterygia	1
		Enargia	1
		Episema	1
		Eupsilia	1
	Xyleninae	*Globia*	2

		Gortyna	1
		Griposia	1
		Helotropha	1
		Hoplodrina	5
		Hydraecia	2
		Ipimorpha	2
		Jodia	1
		Lateroligia	1
		Lenisa	1
		Lithophane	2
		Luperina	1
		Mesapamea	1
		Mesogona	2
		Mesoligia	1
		Mniotype	2
		Nonagria	1
		Oligia	3
		Oxytripia	1
		Parastichtis	1
		Photedes	2
		Polymixis	1
		Polyphaenis	1
		Rhizedra	1
		Rusina	1
		Spodoptera	1
		Thalpophila	1
		Tiliacea	3
		Trachea	1
		Ulochlaena	1
		Xanthia	2
		Xylena	2
Total		**153**	**322**

Approximately 11% of all lepidopteran species reported in Orhei National Park represent diurnal butterfly species (ȚUGULEA, 2024). The other 89% are represented by moths, although some of these species can also be active during the day, such as representatives of the Geometridae, Erebidae and even some Noctuidae species.

As a result of the research, three genera (*Denticucullus*, *Eriopygodes* and *Opigena*) and eight new species for the fauna of the Republic of Moldova were identified: *Denticucullus pygmina* (Haworth, 1809), *Archanara dissoluta* (Treitschke, 1825), *Eriopygodes imbecilla* (Fabricius, 1794), *Hydraecia petasitis* Doubleday, 1847, *Opigena polygona* (Denis, Schiffermüller, 1775), *Photedes fluxa* (Hübner, 1809), *Photedes minima* (Haworth, 1809) and *Xestia ashworthii* (Doubleday, 1855). Over 300 species of those reported are new to the fauna of Orhei National Park.

The noctuid species *D. pygmina*, or the the small wainscot, from Xyleninae subfamily which represents a new genus and a new species for the fauna of the Republic of Moldova. The species was reported in Ivancea village, Orhei district. Two individuals were collected on 13.09.2024 and one specimen on 16.09.2024 by professor Derjanschi Valeriu by the ultraviolet light trap. So, the number of Xyleninae species identified on the territory of the Republic of Moldova reached 144. The species *Denticucullus pygmina* is found in most of Europe, ranging from northern Spain, through Portugal as far north as Finland. In the east it is found across the Palearctic to the Russian Far East and western Siberia. It is also found in North Africa, Turkey, the Caucasus region and northern Iran. Adults are on wing from August to October. The larvae feed on *Carex*, *Juncus* and *Iris species*. They feed internally in the stems of their host plant.

The noctuid species *Eriopygodes imbecilla* from Hadeninae subfamily is also reported for the first time in the fauna of the Republic of Moldova. Two individuals were collected on 12.08.2024 and one specimen on 16.09.2024 by professor Derjanschi Valeriu by the ultraviolet light trap. The moths colonizes herb communities, wetland edges, bushy and partially rocky slopes. The distribution extends across some mountains of Europe and Asia (Pyrenees, Alps, Balkans, Bavarian Forest). The caterpillar lives polyphagous on herbs and grasses.

The noctuid species *Opigena polygona* from Noctuinae subfamily has not been previously reported on the territory of the Republic of Moldova. Two individuals were collected on 12.08.2024 and one specimen on 16.09.2024 by professor Derjanschi Valeriu by the ultraviolet light trap. It is found from the Netherlands, Sweden and Finland, through central and south-eastern Europe to central Asia, northern Iran, the Caucasus, Transcaucasia, Armenia, Turkey, Irkutsk, western and central China, Tibet, Nepal and northern India. Adults are on wing from the end of July to the latter half of September. The larvae feed on various herbaceous plants, including *Capsella*, *Primula*, *Polygonum*, *Rumex* and *Trifolium*.

The Xyleninae subfamily is the richest in species, recording 114 species from 63 genera, which represents 35 % of the total noctuid species recorded in Orhei National Park. This is followed by the Noctuinae subfamily which includes 64 recorded species from 30 genera (20 %) and the Hadeninae subfamily with 59 species from 22 genera, which represents 18 %. The Condicinae, Oncocnemidinae and Pantheinae subfamilies are represented by two species each and the Dilobinae subfamily are represented by only one species (Fig. 2).

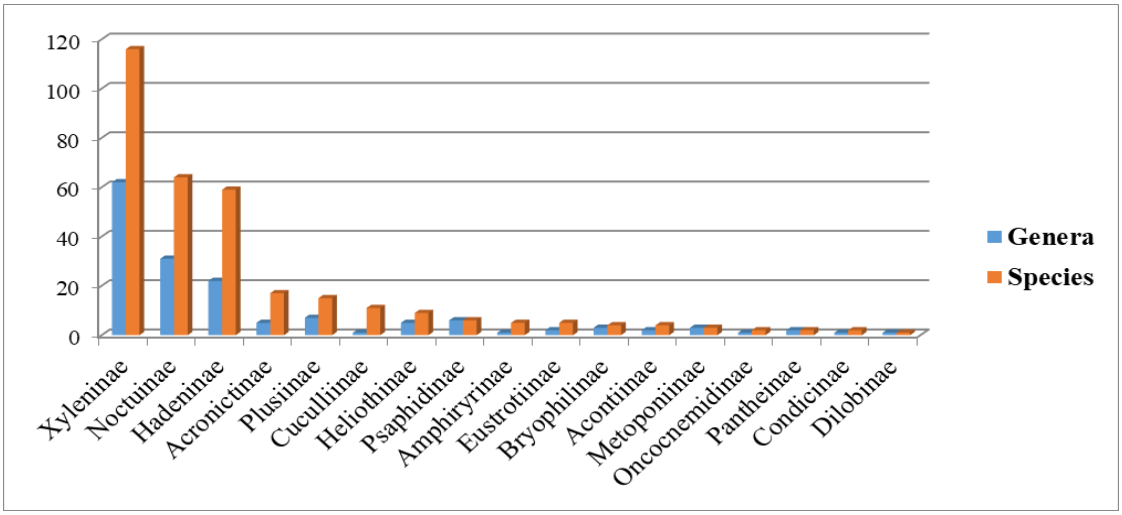

Figure 2. Repartition by subfamilies of the noctuid moths (Noctuidae) from the Orhei Natural Park.

On the territory of Orhei National Park, a large number of rare lepidopteran species that require protection and conservation have been reported, 21 of which are cited in the Red Book of the Republic of Moldova (2015): *Muschampia floccifera* (Zeller, 1847), *Zerynthia polyxena* (Denis & Schiffermüller, 1775), *Parnassius mnemosyne* (Linnaeus, 1758), *Papilio machaon* Linnaeus, 1758, *Leptidea morsei* (Fenton, 1882), *Hamearis lucina* (Linnaeus, 1758), *Lycaena virgaureae* (Linnaeus, 1758), *Phengaris arion* (Linnaeus, 1758), *Plebejus argyrognomon* (Bergsträsser, 1779), *Polyommatus daphnis* (Denis & Schiffermüller, 1775), *Euphydryas maturna* (Linnaeus, 1758), *Neptis sappho* (Pallas, 1771), *Nymphalis xanthomelas* (Esper, 1781), *Apatura ilia* (Denis & Schiffermüller, 1775), *Euplagia quadripunctaria* (Poda, 1761), *Callimorpha dominula* (Linnaeus, 1758), *Marumba quercus* (Denis & Schiffermüller, 1775), *Acherontia atropos* (Linnaeus, 1758), *Dolbina elegans* A. Bang-Haas, 1912, *Proserpinus proserpina* (Pallas, 1772) and *Saturnia pyri* (Denis & Schiffermüller, 1775) (ȚUGULEA, 2024).

The small number of noctuid species present on various Red Lists is due to the insufficient study of this group of insects, both nationally and internationally, which does not allow for risk assessment disappearance based on population distribution or status. Insufficient data and lack of information on the distribution, abundance, bioecological particularities classify many species of noctuids in an endangered category. It explains the status of extinct species (EX) attributed to many noctuids that have not been previously assessed and qualified in any category of endangered species. The same situation is attested in the Republic of Moldova. Before our investigations, there were no data on the endangered status of Noctuidae, and the Red Book of the Republic of Moldova does not mention a single species from the Noctuidae family (ȚUGULEA & RAKOSY, 2021).

We recommend adding some rare and endangered Noctuidae species to the Red Book of the Republic of Moldova and the National Operational List in order to ensure protection and the necessary information for the population and authorities. The species: *Periphanes delphinii* (Linnaeus, 1758), *Eucarta amethystina* (Hübner, 1803), *Oxytripia orbiculosa* (Esper, 1799), *Euxoa cos* (Hübner, 1824) and *Meganephria bimaculosa* (Linnaeus, 1758) needs protection and conservation, so it is recommended according to IUCN criteria to be included in the next edition of the Red Book of the Republic of Moldova. Habitat fragmentation, intensive agriculture, deforestation, pollution, mechanical mowing, overgrazing, fires are the main causes of population decline or even the disappearance of some diurnal butterfly species from the studied area. The study demonstrated that Orhei National Park has a rich and valuable lepidopteran fauna.

CONCLUSIONS

As a result of the research carried out, a total of 322 species of moths from Noctuidae family were reported in the Orhei National Park, which belong to 153 genera and 17 families: Acontiinae (4 species), Acronictinae (17), Amphipyrinae (5), Bryophilinae (4), Condicinae (2), Cuculliinae (11), Dilobinae (1), Eustrotiinae (5), Hadeninae (59), Heliothinae (9), Metoponiinae (3), Noctuinae (64), Oncocnemidinae (2), Pantheinae (2), Plusiinae (14), Psaphidinae (6) and Xyleninae (114 species).

Of these, three genera (*Denticucullus*, *Eriopygodes* and *Opigena*) and eight new species for the fauna of the Republic of Moldova were identified: *Denticucullus pygmina* (Haworth, 1809), *Archanara dissoluta* (Treitschke, 1825), *Eriopygodes imbecilla* (Fabricius, 1794), *Hydraecia petasitis* Doubleday, 1847, *Opigena polygona* (Denis, Schiffermüller, 1775), *Photedes fluxa* (Hübner, 1809), *Photedes minima* (Haworth, 1809) and *Xestia ashworthii* (Doubleday, 1855).

This study demonstrates that Orhei National Park has a rich and valuable lepidopteran fauna. The relatively large area of the reserve and the rich diversity of biotopes favour the presence of many moths species with various ecological preferences. The significant number of registered species, to which the large number of rare species for the fauna of the

Republic of Moldova is added, proves that the Orhei National Park is an area of particular importance for the conservation of biological diversity.

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