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Implementation of active conservation for butterflies in the faunistic nature reserves of the Białowieża Forest in 1995–2023

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Abstract

The article deals with the problem of the active conservation of butterflies in the faunistic nature reserves of Białowieża Forest. Białowieża Forest is an extremely valuable and diverse area in which two approaches to nature conservation are used. The first one is passive conservation, a conservative approach whose purpose is to protect natural processes by reducing human intervention. The other one is active conservation, which aims to take steps to protect nature, including by maintaining areas in certain successional stages. Faunistic nature reserves in the Białowieża Forest fit perfectly into this type of consideration. These include four nature reserves: Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa. The aim of their conservation was to preserve the places of occurrence of rare species of butterflies (Lepidoptera, Rhopalocera) for scientific and educational reasons. Butterflies are important flagship taxa for invertebrate conservation. Conservation tasks for nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa) were issued twice, in 2002 and 2003. Currently, there are conservation plans in force for faunistic nature reserves. A total of seven agreements were concluded between the Regional Directorate for Environmental Protection in Białystok and the Białowieża and Hajnówka forest districts. Through the analysis of documentation from 1995 to 2023, the implementation of active protection in these unusual and valuable areas is presented. The analysis was presented both in terms of material and financial aspects. As a result of the agreements, 13 conservation measures were carried out in four nature reserves for a total gross amount of PLN 38.9 thousand. Despite the undeniable needs of active protection in the faunistic nature reserves of the Białowieża Forest, appropriate methods and permanent sources of funding have still not been developed that would enable the protection of these extremely valuable and unique objects. Therefore, the functioning of faunistic nature reserves in the Białowieża Forest in their current form does not bode well for achieving the conservation goal for which they were created.

Key words

butterflies, conservation measures, butterfly decline, nature conservation

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Introduction

For many years, there has been a lively discussion, or rather a dispute, concerning the management of the Białowieża Forest. Various arguments are raised and different points of view are presented, referring to the manner and degree of use of the natural resources of the Białowieża Forest. Environmental organisations and the representatives of the world of science who support them are of the opinion that any economic activities of humans are unacceptable in the Białowieża Forest (Wesołowski et al. 2016). However, according to foresters and scientists who share their view, it is necessary to take active measures to preserve the full natural wealth of the Białowieża Forest. In the opinion of this group, sustainable forest management and active protection activities in part of the Białowieża Forest, for example, grazing, raking litter, removal of undesirable plant and animal species, are conducive to the preservation of biodiversity in this area, as it is a necessary complement to strict protection. These opposing points of view are part of a broader discussion on the main goal of nature conservation, which would be naturalness or diversity, and in terms of the way they are implemented, either passive protection or active protection (Matuszkiewicz and Tabor 2022).

Faunistic nature reserves in the Białowieża Forest fit perfectly into this type of consideration. The justification and motivation for the establishment of these nature reserves were (Dąbrowski 1983):

1. The immense value and uniqueness of the Białowieża Forest, which is an exceptional refuge for lepidopterofauna, not only in the country but also on a European scale and
2. The conviction that there is a need for territorial protection of lepidopterofauna in the southern part of the Białowieża Forest.

In May 1987, the Department of Environmental Protection, Water Management and Geology of the Provincial Office in Bialystok submitted an order under the title 'Project of butterfly reserves in the Białowieża Forest'. In November 1988, a technical ruling (document) with the same title as the order was produced (Witkowski 1988). As a result, four nature reserves were created (Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa). They were recognised on 27 June 1995 based on orders of the Minister of Environmental Protection, Natural Resources and Forestry (Orders of the Ministry of Environmental Protection, Natural Resources and Forestry 1995).

The potential number of butterfly species within the established faunistic nature reserves was estimated to be 76 species (Dąbrowski et al. 1992). Monitoring surveys conducted in 2005–2007 revealed 56 butterfly species in the faunistic nature reserves, including those not observed and estimated potentially in earlier surveys (Ginszt 2011). Butterfly species richness on the faunistic nature reserves was not limited to the number of species present. The occurrence of nine endemic butterfly forms (*Rhopalocera*) of the Białowieża Forest was indicated in the faunistic nature reserves (Krzywicki 1986), such as moorland clouded yellow (*Colias palaeno* ssp. *pruefferi* Krzyw.), northern wall brown (*Pararge petropolitana* ssp. *bialoviensis* Krzyw.), false ringlet (*Coenonympha oedippus* ssp. *magnoocellata* Krzyw.), marsh fritillary (*Euphydryas aurinia* ssp. celina Krzyw.), scarce fritillary (*Euphydryas maturna* ssp. *adamczewskii* Krzyw.), *Boloria alethea* ssp. *nigrofasciata* Krzyw., bog fritillary (*Proclossiana eunomis* ssp. *gieysztori* Krzyw.), scarce tortoiseshell (*Nymphalis xanthomelas* ssp. *anna* Krzyw.) and Arctic skipper (*Carbocephalus palameon* ssp. *tolli* Krzyw.). Most of the above-mentioned species are receding or have already receded from the Białowieża Forest. The habitat requirements of the aforementioned butterfly species are related to the maintenance of habitats in an unchanged state. Threats to the aforementioned species include vegetation succession, overgrowing of peatlands with willow and birch thickets, overgrowing of mid-forest meadows, clearings and open areas with trees and shrubs.

The nature reserves were established in Hajnówka and Białowieża forest districts. The aim of their conservation was to preserve the places of occurrence of rare species of butterflies for scientific and educational reasons. The defined direction indicated the need to implement active conservation measures to improve habitat quality for butterflies, that is, to prevent vegetation succession and to maintain the sites in an unchanged state.

Despite this, after the creation of nature reserves, protection plans for the Berezowo, Przewłoka and Podcerkwa nature reserves were created after 12 years and for the Olszanka Myśliszcze reserve after 13 years. Previously, no protective measures were carried out in their area to improve the conditions for the occurrence of butterfly fauna. The developmental dynamism of some plant communities has been so strong that the

maintenance of certain host plant species, and therefore also rare and endangered butterfly species, has become problematic (Ginszt 2011).

The example of faunistic nature reserves, which have as their aim conservation of species with use of active methods, has, therefore, become a bit of a controversy, as the need for decisive active conservation measures was in opposition to the priorities of nature reserves protection in Poland, where the 'norm' is the least possible interference or rather the lack of it. Therefore, the motivation to write this article was the desire to summarise and present the extent to which active protection was implemented in nature reserves in the years 1995–2023. The aim of the article is also to indicate the problems and dissonance that occurs between the needs of active protection and the approach to the vision of the protection of the Białowieża Forest presented by some scientific circles, non-governmental organisations and ecological activists.

Material and methods

The materials for this study were obtained based on requests for access to environmental information from Regional Directorate for Environmental Protection (RDEP) in Białystok and the Hajnówka forest districts. In addition, data were obtained from the Białowieża and Hajnówka forest districts to complete the information. The documentation and information obtained from the databases of the Information Systems of the State Forests of the Białowieża and Hajnówka forest districts from 1995 to 2023 were analysed. The entire documentation concerning the implementation of active protection in four faunistic nature reserves – Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa – has been compiled. A detailed assessment and analysis in terms of material and financial aspects was also carried out for the protection activities carried out under the agreements concluded between RDEP in Białystok and the Białowieża and Hajnówka forest districts.

Results

Four faunistic nature reserves in the Białowieża Forest are located in the Hajnówka and Białowieża forest districts (Fig. 1). Their total area is about 690 ha (Berezowo – 115.41 ha, Olszanka Myśliszcze – 276.76 ha, Przewłoka – 78.52 ha, Podcerkwa – 228.12 ha).

Since the establishment of the nature reserves in 1995, conservation tasks for the nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa) have been issued twice, based on decrees of the Podlaskie Voivode of 16 December 2002 (Podlaskie Voivode Decrees 2002) and decrees of the Podlaskie Voivode of 10 December 2003 (Podlaskie Voivode Decrees 2003). Conservation measures were implemented in 2003 and 2004. Detailed conservation measures are presented below by individual faunistic nature reserves and year of implementation (Tab. 1).

The proposed conservation measures were not intended to protect the subject of protection, which was the butterflies. In fact, it was a continuation of the forest conservation, silviculture and hunting management work previously carried out in the area.

It should be mentioned that, in addition to the locations for the individual conservation measures indicated in the conservation tasks, it was also possible to carry them out in other places within the nature reserves. Forest protection, silviculture and hunting management works were carried out based on consents (decisions) of the Podlaskie Voivodeship Nature Conservator. In view of the above, conservation measures for the benefit of butterflies in terms of mowing mid-forest meadows, maintaining open areas in an unchanged state through de-bushing, were carried out as part of forest management on the initiative of foresters from the Białowieża and Hajnówka forest districts, and not based on conservation measures for faunistic nature reserves.

Currently, there are conservation plans in force for the faunistic nature reserves, which were established based on decrees of the Podlaskie Voivode's Ordinances in 2007 for the nature reserves Berezowo, Przewłoka and Podcerkwa (Podlaskie Voivode Decrees 2007) and in 2008 (Podlaskie Voivode Decree 2008) for the Olszanka Myśliszcze nature reserve. The detailed scope of conservation measures is presented in Table 2.

A total of seven agreements were concluded between the RDEP in Białystok and the Białowieża and Hajnówka forest districts. As a result of the agreements, 13 conservation measures were carried out in four nature reserves for a total gross amount of PLN 38.9 thousand (Tab. 3).

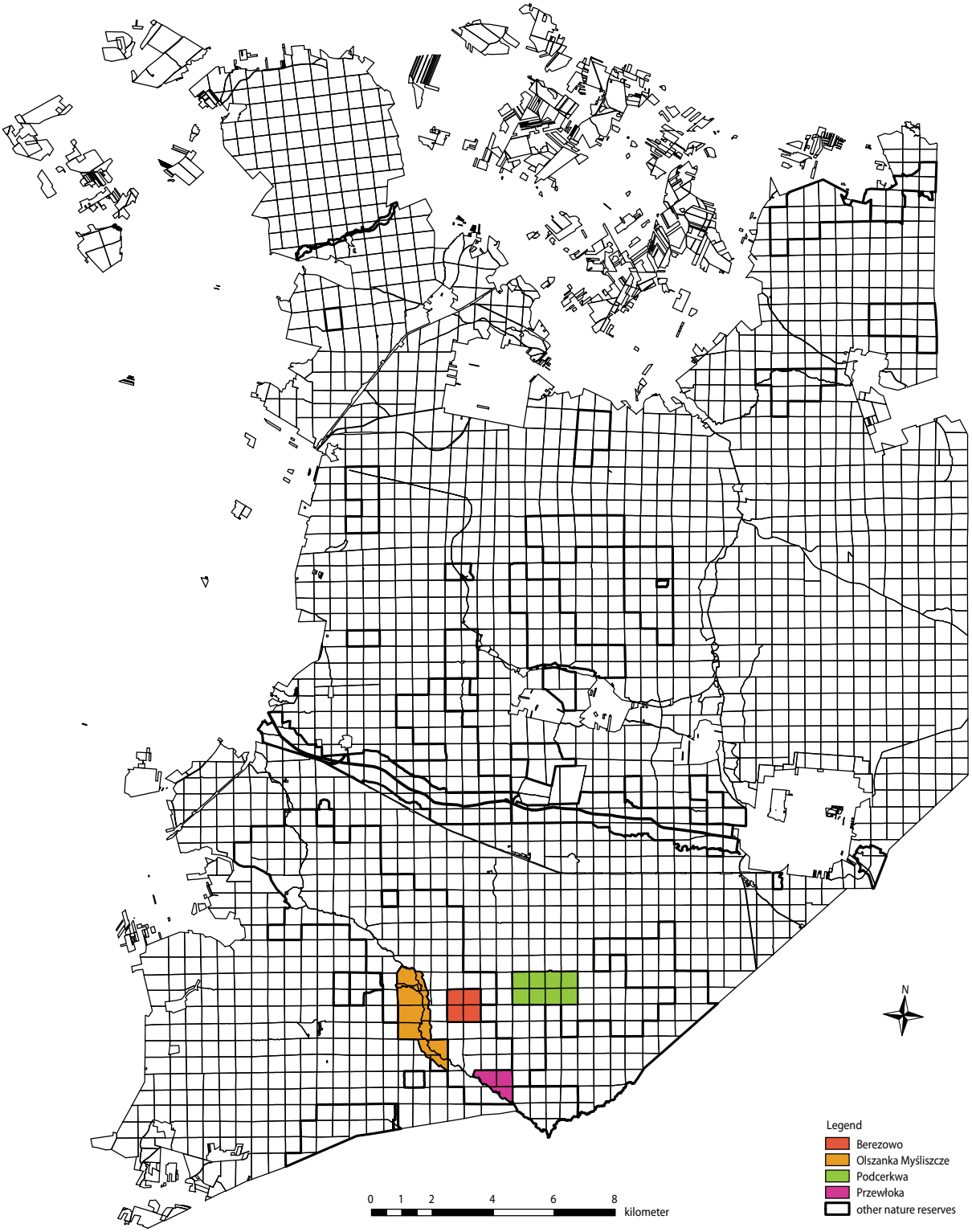

Figure 1. Map of the Białowieża Forest showing faunistic nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka and Podcerkwa) and other nature reserves

Table 1. Planned conservation measures for faunistic nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka, Podcerkwa) in the Białowieża Forest included in the 2003–2004 conservation tasks

No.	Conservation measures	Nature reserve			
		Berezowo	Olszanka Myśliszcze	Przewłoka	Podcerkwa
2003					
1	Regulation of species composition and density of trees in young forest (late cleaning)	+	+	+	+
2	Removal of trees infested with insects and fungi, broken and fallen (salvage and sanitation cutting), debarking of spruces colonised by the spruce bark beetle	+	+	+	+
3	Loosening the soil by hand with a hoe for natural regeneration of the stand				+
4	Clearing trees and shrubs, mechanical mowing leaving a swath		+	+	+
5	Repair of information boards (if needed)	+	+	+	+
2004					
1	Removal of trees infested with the spruce bark beetle, in accordance with the forest protection instruction, leaving 10% of the debarked tree mass on the surface				+
2	Exposing scent traps (pheromones) to secondary pests (if needed)	+	+	+	+
3	Repair of information boards (if needed)	+	+	+	+
Number of planned tasks		5	6	6	8

Table 2. Planned conservation measures for faunistic nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka, Podcerkwa) in the Białowieża Forest included in the conservation plans

Nature reserve	No.	Type of conservation measures	Scope of conservation measures
1	2	3	4
Berezowo	1	Stopping the succession of trees and shrubs on both sides of the Olemburska Road, causing disappearance of the hemp agrimony	Once in every 3 years, cutting and mowing roadside trees and shrubs
	2	Protection of hollow trees and old-growth forests	Leaving hollow, dying and dead trees and old-growth trees in the nature reserve for their natural decomposition
Olszanka Myśliszcze	1	Inhibiting the succession of trees and shrubs in the valley of Leśna River	Mowing herbaceous vegetation 50–100 m wide from the forest wall on the west side of the river (the treatment should be carried out once in every 2 years), after 15 September, collect the swath Removal of shrub vegetation
	2	Prevention of wetland overgrowth	Removal of shrub vegetation
	3	Road cleaning	Removal of roadside trees damaged as a result of crooks and obstructing the passage of fire brigade and forest service vehicles, if needed
	4	Protection of hollow trees, dead trees and old-growth trees	Leaving hollow and dead trees in the reserve for their natural decomposition
	5	Allowing butterflies to move Enabling the regeneration of hemp agrimony	Clearing the forest compartment line of trees and shrubs over a length of about 3 km (logging about 10 m^3 birch, willow, alder, spruce, aspen, ash)

1	2	3	4
Przewłoka	1	Inhibiting the succession of trees and shrubs in the valley of Leśna River 7.32 ha	Mowing herbaceous vegetation (treatment should be carried out once in every 2 years) Removal of trees and shrubby vegetation
	2	Protection of hollow trees, dead trees and old-growth trees	Leaving hollow and dead trees and old-growth trees in the reserve for their natural decomposition
	3	Road cleaning	Removal of roadside trees obstructing the passage of fire brigade and forest service vehicles, if needed
Podcerkwa	1	Inhibiting the succession of trees and shrubs on the former timber yard and unused hunting plots – area 3.54 ha	Mowing herbaceous vegetation in the second half of August (the treatment should be carried out once in every 2 years) Removal of shrub vegetation
	2	Prevention of overgrowing of gaps – area of 3 ha	Clearing of gaps Removal of shrub vegetation
	3	Road cleaning	Removal of roadside trees damaged as a result of snow damage and obstructing the passage of fire brigade and forest service vehicles, if needed
	4	Protection of hollow trees, dead trees, old-growth trees	Leaving hollow and dead trees in the reserve for their natural decomposition

Table 3. A list of conservation measures carried out in faunistic nature reserves based on agreements concluded between the Regional Directorate for Environmental Protection in Białystok and the Białowieża and Hajnówka forest districts in the years 2007–2023

No.	Nature reserve	Date of concluding the agreement and acceptance of the works	Type of conservation measures and its scope	Forest compartment or subcompartmet	Cost (PLN)
1	2	3	4	5	6
1	Podcerkwa	14.11.2012 20.12.2012	Clearing roads by removing roadside trees damaged by the snowstorm and obstructing the passage of fire and forestry service vehicles – as required	577A, 577B, 578A, 578B, 577C, 578D	9500
2	Olszanka Myśliszcze	12.11.2012 20.12.2012	Clearing roads by removing roadside trees damaged by the snowstorm and obstructing the passage of fire and forestry service vehicles over a length of 0.4 km	635A	320
3	Olszanka Myśliszcze	12.11.2012 20.12.2012	Clearing the surface dividing line of trees and shrubs over a distance of 1.5 km to allow for butterfly movement and the regeneration of hemp agrimony	573D/601B; 601A/601B; 601C/601D	750
4	Berezowo	12.11.2012 20.12.2012	Felling of trees and shrubs along a 1-km length to stop their succession on both sides of the Olemburska Road, causing the disappearance of the nectariferous hemp agrimony	575C; 575D; 603AB	800
5	Przewłoka	12.11.2012 13.12.2012	Clearing of 1 km of roads obstructing the passage of fire and forest service vehicles	670BC	800
Total – 2012			Five conservation measures (four reserves)		12,170

1	2	3	4	5	6
6	Podcerkwa	01.10.2014 23.12.2014	Preventing overgrowth of established gaps by de-bushing and removal of shrub vegetation – 3 ha	577Aa; 577Bb,c; 577Ca,c; 578Ab; 578Bb; 578Da,f	12,000
7	Olszanka Myśliszcze	01.08.2014 21.10.2014	Clearing roads by removing roadside trees damaged by the snowstorm and obstructing the passage of fire and forestry service vehicles over a length of 0.5 km	635A	250
8	Olszanka Myśliszcze	01.08.2014 21.10.2014	Clearing the surface dividing line of trees and shrubs over a distance of 0.8 km to allow for butterfly movement and the regeneration of hemp agrimony	573D/601B	400
9	Przewłoka	01.08.2014 21.10.2014	Clearing of 1 km of roads obstructing the passage of fire and forest service vehicles	670BC	500
Total – 2014			Four conservation measures (three reserves)		13,150
10	Berezowo	24.03.2015 30.11.2015	Cutting and mowing roadside trees and shrubs over a length of 1 km	575CD/603AB	540
Total – 2015			One conservation measure (one reserve)		540
11	Podcerkwa	04.04.2019 29.08.2019	Control of the succession of trees and shrubs on the former timber yard and disused hunting fields by mowing herbaceous vegetation in the second half of August (treatment to be carried out once in every 2 years) and removing shrubs – 3.54 ha	577Ck; 577Dg; 578Ad; 578Bg; 578Bi	1700
Total – 2019			One conservation measure (one reserve)		1700
12	Podcerkwa	08.08.2023 06.09.2023	Control of the succession of trees and shrubs on the former timber yard and disused hunting fields by mowing herbaceous vegetation in the second half of August (treatment to be carried out once in every 2 years) and removing shrubs – 3.54 ha	577Ck, 577Dg, 578Ad, 578Bg, 578Bi	11,340
13	Podcerkwa	08.08.2023 06.09.2023	Prevention of overgrowth of gaps by de-bushing and removal of shrub vegetation – 0.5 ha	577Bc, 577Cc; 578Ab	
Total – 2023			Two conservation measures (one reserve)		11,340
Total – 2012–2023			13 conservation measures (four reserves)		38,900

Pursuant to Article 54 (Targeted subsidies [point 5] of the Forest Act, 1991), State Forests receive targeted subsidies from the state budget for tasks commissioned by the government administration for the development of protection plans for nature reserves under the management of the State Forests, their implementation, protection of plant and animal species and supervision of areas included in Natura 2000.

In accordance with the 2021 guidelines of State Forests (Letter from Director General of State Forests 2021), if it is not possible to obtain funding for tasks commissioned by the government administration in the field of nature conservation tasks, as stipulated in the above-mentioned Article 54 of the Forest Act, activities may be financed under certain exceptions:

a) as an own contribution to projects implemented with external funding,
b) if the non-implementation of active protection works for species and habitats would cause irreversible, adverse changes and
c) if the cost of carrying out the work in nature reserves recorded in conservation plans or conserva-

Table 4. Summary of the conservation measures carried out in four faunistic nature reserves from external sources in the years 2016–2023

No.	Nature reserve	Year of realisation	Type of conservation measures and its scope	Forest location	Cost (PLN)
1	Przewłoka	2016	Stopping tree and shrub succession in the Leśna River valley by mowing herbaceous vegetation and removing trees and shrub vegetation – 1.92 ha	670Ci	1555
2	Olszanka Myśliszcze	2016	Stopping tree and shrub succession in the Leśna River valley by mowing herbaceous vegetation and removing trees and shrub vegetation – 25.04 ha	573Dm; 601Ba; 601Da; 634Fa	12,846
3	Przewłoka	2017	Stopping tree and shrub succession in the Leśna River valley by mowing herbaceous vegetation and removing trees and shrub vegetation – 1.92 ha	670Ci	1888
4	Olszanka Myśliszcze	2018	Stopping tree and shrub succession in the Leśna River valley by mowing herbaceous vegetation and removing trees and shrub vegetation – 12.55 ha	573Dm; 601Ba; 601Da; 634Fa	12,425
5	Olszanka Myśliszcze	2020	Stopping tree and shrub succession in the Leśna River valley by mowing herbaceous vegetation and removing trees and shrub vegetation – 12.55 ha	573Dm; 601Ba; 601Da; 634Fa	14,909
6	Podcerkwa	2021	Control of the succession of trees and shrubs on the former timber yard and disused hunting fields by mowing herbaceous vegetation in the second half of August (treatment to be carried out once in every 2 years) and removing shrubs – 3.54 ha	577Ck, 577Dg, 578Ad, 578Bg, 578Bi	4202
Total					47,825



Figure 2. Polana Berezowo (577Ck) in the Podcerkwa Nature Reserve (Białowieża Forest District) after realisation of the conservation measure in 2023 (photo: T. Ginszt, 04.09.2023)



Figure 3. Meadow (578Ad) in the Podcerkwa Nature Reserve (Białowieża Forest District) after realisation of the conservation measure in 2023 (photo: T. Ginszt, 04.09.2023)

tion tasks will be offset by the income generated (e.g. thinning).

Therefore, in the absence of funding from the state budget (RDEP in Białystok), the Białowieża and Hajnówka forest districts undertook initiatives and carried out some of the tasks as part of projects financed from external funds. The works were carried out as part of the following projects:

1. 'Protection of the lesser spotted eagle in selected Natura 2000 areas' – is co-financed by the European Union as part of the LIFE + Nature Programme and by the National Fund for Environmental Protection and Water Management (NFEP&WM) in Warsaw.
2. The project 'Complex conservation of European bison in Poland' is co-financed by the European Union from the programme 'Infrastructure and Environment' under the Cohesion Fund. The co-financing amounted to 85% of the eligible costs of the project. The remaining 15% of the costs were financed by the Forest Fund.

These were projects not related to butterfly conservation. However, during their implementation, it was possible to carry out works beneficial to butterflies in the faunistic nature reserves in the Białowieża Forest through the protection of other species, such as the bison and the lesser spotted eagle.

In total, as part of the works carried out with external funds, six conservation actions were carried out in the years 2016–2021 in three nature reserves (Olszanka Myśliszcze, Przewłoka and Podcerkwa) worth PLN 47.8 thousand. The detailed scope of work and implementation is presented in Table 4.

An example of a conservation measure implemented in the Podcerkwa reserve in 2023 is presented below (Fig. 2, 3).

Discussion

Unique in the scale of the Białowieża and Polish forests, faunistic nature reserves created in 1995 to protect the habitats of rare species of butterflies were left for 7 years without documents enabling the implementation of conservation activities. It was not until 2002 that the first annual conservation tasks were issued,

which were to be in force in 2003. The tasks were dictated mainly by the needs of forest protection and silviculture. In 2004, the conservation tasks were limited only to the repair of information boards and forest protection actions (setting up pheromone traps and removing infested trees). Therefore, the conservation tasks were not directed in any way to the needs of the object of conservation.

After 12 years, in the case of the Berezowo, Przewłoka and Podcerkwa reserves, and after 13 years, in the case of the Olszanka Myśliszcze reserve, conservation plans were created, the role of which was to precisely define threats and protective actions for a period of 20 years.

It was puzzling that after such a long break (several years), no attempt was made to carry out even a 1-year, full inventory to check whether such a way of protecting this area was still justified (Ginszt 2011).

The conservation tasks were limited to a few points, among which the prevailing tendency was 'interfere as little as possible...'. For example, in the Berezowo Nature Reserve, it was recommended to mow and cut down trees and shrubs along the Olemburska Road once in every 3 years and to leave hollow, dying and dead trees for their natural decomposition. An additional disadvantage, not to mention the form in which the protection plans were created, was the lack of precision and detail in the performance of certain conservation measures. The main drawback was the lack of indication of the width to which the bush removal and tree felling procedures were to be carried out along the road. Individual and specific issues for the areas of nature reserves, to which special attention should be paid (e.g. characteristic features of the nature reserve, spatial arrangement, plant communities), were also not indicated (Ginszt 2011). Issues related to maintaining the mosaic of different environments that affect species diversity have been trivialised.

It was puzzling to recommend the protection of hollow, dying and dead trees through the creation of a special conservation task in the nature reserve to protect rare species of butterflies. An action of this type is very important in the context of protecting species diversity, but in the context of the object of protection in the nature reserves analysed, it was not relevant (Ginszt 2011).

Similarly, puzzling recommendations in the form of conservation measures were made for the Przewłoka reserve, which were not related to the protection of butterflies. They concerned the clearing of roadside trees to facilitate the passage of fire brigade and forest service vehicles (Ginszt 2011).

As part of the conservation plans in force since 2007 and 2008, it was not until 2012 that the first agreements for their implementation were concluded. Therefore, one can get the impression that the fauna reserves in question have been treated for a period of 4–5 years as if they had the status of 'strict reserves'. Also, while in the years 2012–2014, a number of conservation actions were carried out, in later years, from 2015 onwards, individual actions were carried out, mainly in the Podcerkwa nature reserve. In total, about 39,000 PLN from the state budget was allocated for protective activities. It should also be mentioned that only a part of the conservation measures was implemented and financed. In recent years, despite requests for funds for the implementation of conservation measures, the responses have not always been positive.

So, should we create nature reserves for butterflies? If so, is it in this form? If not, how should butterflies and their habitats be protected? It is difficult to answer these questions unequivocally. Depends, what is the priority? Or adherence to the principles of conservation of nature? Is the object of protection, which in this case is butterflies, more important? (Ginszt 2011).

Therefore, it is possible to consider whether it made sense to create them and whether they fulfilled their role, that is, preserved the places where rare species of butterflies occur. The last detailed inventory research in the fauna reserves in the Białowieża Forest was carried out in the years 2005–2007 (Ginszt and Laskowska-Ginszt 2021). A 3-year study showed that 28 species of butterflies previously recorded (Krzywicki 1967) were not observed in the nature reserves. The establishment of fauna reserves in the Białowieża Forest did not contribute to maintaining the species richness of butterflies (Ginszt 2011). Currently, the situation in terms of butterfly species diversity in nature reserves may be even worse. It is caused by progressive successional processes and the failure to fully implement conservation measures. This is caused by a lack of financial resources and the failure of the authorities

responsible for nature conservation in faunistic nature reserves to agree to all tasks.

Previous statements and facts clearly indicate that in this, as well as in many other cases related to attempts at protection, a wider range of treatments and activities have not been developed in the field of active conservation, which would take into account the individual specificity of a particular object and also their plant and animal components, as well as elements of inanimate nature. Nor have any methods been developed to preserve the condition of the objects, or to restore them to their previous state, or to carry out restitution or rehabilitation. Therefore, the created faunistic nature reserves did not fulfil their role (Ginszt 2011).

Nature conservation as an idea has a long history, but as a science, it is a relatively young field. In the absence of sufficient arguments, supported by scientific research, we are too often guided in nature conservation by individual experiences or intuition, which can fail, as evidenced by numerous examples. An example of incompetent protection is that of the Apollo butterfly (*Parnassius apollo*) in the Pieniny National Park, where a lack of active conservation has led to succession and habitat loss for the butterfly species. Restoration measures had to be taken to restore the population (Adamski 2016). In addition, positive results from experiments in one place do not guarantee success elsewhere (Kapuściński 2009).

The need to protect insects (including butterflies) is an issue that is considered in many aspects and discussed in various publications (Nowacki 2000; Buszko and Nowacki 2000; Dąbrowski 2004). The example of butterflies in the Białowieża Forest shows that conservation for most species should only take place in an active way. As a result of changes in butterfly habitats, lack of active measures to maintain biotopes at early stages of succession, and overgrowing of meadows, clearings and open areas, many species having isolated sites in the faunistic nature reserves became extinct. Due to the lack of active conservation measures and probably climate change, the following species have become extinct in the faunistic nature reserves in the Białowieża Forest (Jaroszewicz 2010): false ringlet (*Coenonympha oedippus*), Scotch argus (*Erebia aethiops*), northern wall brown (*Lasiommata petropolitana*), false eros blue (*Polyommatus eros eroides*), violet copper (*Lycaena helle*), Danube clouded yellow (*Colias myrmidone*) and marsh fritillary (*Euphydryas aurinia*).

Mention should be made here of the active conservation project carried out in the Knyszyn Forest under the name 'Forest management for endangered species: protection of *Colias myrmidone* in the Knyszyn Forest'. The project is carried out on behalf of the General Directorate of State Forests by a consortium of the Forest Research Institute and the University of Białystok in 2021–2025 (Decision of the General Director of State Forests 2021).

Many butterfly species conservation projects are carried out in various European countries. One example of species conservation programmes is the restoration and protection of *P. apollo*. In Poland, the programme was co-financed by the EU LIFE programme and NFEP&WM. The project, which has a cross-border, international character, is also being implemented in the Czech Republic and Austria until March 2028. Its total cost will be PLN 22.3 million, of which the cost of activities in Poland is PLN 11.1 million (NFEP&WM 2023). Many projects are also underway in the UK. Conservation efforts are targeting key regions where the decline of endangered butterfly species can be halted and reversed. Examples of butterfly species conservation national projects in UK include Farmland Butterfly and Moth Initiative, Species Recovery Programme (Butterflies) and Forestry Commission Strategy (Butterfly Conservation 2023).

There are many different forms of insect conservation, which can be considered in Poland and against the background of the experience of other countries and the recommendations of the European Union (Pawłowski and Witkowski 2000). The ecological point of view creates four forms of insect conservation: conservation through the protection of ecosystems, conservation through the protection of habitats that insects occupy, conservation of insects by umbrella species and direct conservation (passive or active). Almost all these forms of conservation are suitable for butterflies. By protecting ecosystems, it is possible to create reserves with partial protection, where a whole range of conservation treatments can be applied. By protecting habitats, it is possible, for example, to mow and clear shrubs of meadows and thus keep the places where butterflies occur in a suitable condition.

Through direct active protection, restitution and reintroduction projects or species protection projects can be carried out.

Summarising the issues related to conservation plans for nature reserves and conservation tasks, it is important to state that emotions should not guide and rush in this matter. There is no doubt that protective actions will only be successful when the needs of individual species in the natural space are thoroughly recognised (Szyszko 2002). Aspects of butterfly ecology are discussed in relation to sound management of species (...) and exemplify increasing global interest in butterfly conservation (New et al. 1995).

Effective protection of butterflies is a complex procedure, as it requires actions to protect biotopes, save selected species, shape public opinion and take legal action. Given the uniqueness of the Białowieża Forest and the value represented by its species diversity, it is necessary to develop legal possibilities that will enable the implementation of conservation measures aimed at the fauna of butterflies. Despite the legal restrictions on reserve conservation, a UNESCO World Heritage Białowieża Forest, it is necessary to provide funding and opportunities for scientific research and active protection in the faunistic nature reserves (Berezowo, Olszanka Myśliszcze, Przewłoka, Podcerkwa).

Necessary activities that should be carried out in faunistic nature reserves include the following:

1) maintaining conditions for butterfly-forming populations in open areas, facilitating their ability to migrate over long distances to seek and select more favourable biotopes with a more abundant food base of herbaceous plants;
2) maintaining migratory corridors, which are all forest roads and subdivision lines in a state of high sunlight, favouring the existence of a rich set of herbaceous vegetation on and adjacent to roadsides and facilitating the free movement of migrating butterflies; application of protective treatments, clearing roadsides, lines and their immediate vicinity of trees and shrubs that contribute to the deterioration of light conditions and shade;
3) maintaining the mosaicity of biotopes by preserving the development status of plant communities at appropriate successional stages; de-bushing, mowing, cutting of trees in all open spaces in reserves, mid-forest clearings, meadows and
4) implementation of periodic monitoring of the occurrence and threats to the butterfly fauna on selected transects using a linear taxa method refined as required.

Conclusions

1. The formulation of formal regulations enabling the realisation of active protection in faunistic nature reserves has been subject to long delays. The first conservation tasks for fauna reserves were defined 8 years after their establishment, and the conservation plans were established only after 12 years (Berezowo, Przewłoka and Podcerkwa) and 13 years (Olszanka Myśliszcze).
2. Delays in the preparation of conservation plans for the above reserves, amounting to several years, resulted in the progress in vegetation succession being so significant that it undoubtedly had a major impact on the disappearance of certain host plants, and thus limited the occurrence of some species of butterflies, which is confirmed by recent detailed inventory studies (Ginszt 2021).
3. Conservation measures and plans are insufficiently focused on the conservation objective, which is the preservation of habitats of rare species of butterflies. Some of the indicated conservation measures in the faunistic nature reserves in the Białowieża Forest are highly questionable because they are not related to the object of protection.
4. There is a noticeable lack of sufficient funding from the state budget for conservation actions specified in conservation tasks or protection plans for nature reserves. The implementation of the necessary works was possible thanks to the initiative of foresters from the Białowieża Forest District, using other species protection projects and financing from external funds and the Forest Fund. In the analysed years, the state budget financed protective measures for an amount PLN 38.9 thousand, and works amounting PLN 47.8 thousand were carried out from external funds.
5. Despite the undeniable needs of active conservation in the faunistic nature reserves of the Białowieża Forest, appropriate methods and permanent sources of funding have still not been developed that would

enable the protection of these extremely valuable and unique objects.

6. Therefore, the functioning of faunistic nature reserves in the Białowieża Forest in their current form does not bode well for achieving the conservation goal for which they were created.

Conflict of interests

The authors declare no conflicts of interest.

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