Bulletin of the Museum and Institute of Zoology PAS, supplement to Annales Zoologici
Warszawa 1999, No 2: 1–11

Investigations of the Museum and Institute of Zoology in the Puszcza Sandomierska

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Abstract. In 1996–1999 regional faunistic investigations were carried out in the Puszcza Sandomierska (the Sandomierz Forest), an area located in the fork of the rivers: Wisła and San within bounds of the macroregion Kotlina Sandomierska (the Sandomierz Basin). All principal natural and seminatural environments were taken into consideration namely: pine coniferous forests, oak-hornbeam forest, mixed forest, riverside carr and alder carr, moors and meadows, riverine bush, xerothermic and psammophytic grasslands. A great part of material was collected by means of traps: Barber trap, Moericke and Malaise ones.

Key words. Fauna of Poland, regional investigations, Puszcza Sandomierska.

INTRODUCTION

Regional faunistic studies have been traditionally carried out by our institution for many years. In the fifties the investigations were carried out in the region of the lower Nida located in the Wyżyna Małopolska (the Małopolska Upland) and one of the most interesting areas in terms of nature resources. Then there was a series of Carpathian research, i. e. in late 60s and early 70s in the Bieszczady Mountains, and in 1972–76 in the Pieniny Mountains. During the next decade upland areas were investigated again, i.e. the Góry Świętokrzyskie (the Świętokrzyskie Mountains) in 1981–1985 and the Roztocze in 1986–1990.

During a collective studies in the Góry Świętokrzyski e aprogram of regional investigation for dozen years was drawn up for the first time. Allowing for opinions of participants it was suggested that next investigations should be concentrated in south-eastern and eastern Poland. A knowledge about fauna of these areas has always been extremely poor. During research in the Roztocze another opinion poll was carried out among zoologist. After that, while an annual meeting, a program of future explorations was discussed. It turned out that the Kotlina Sandomierska (the Sandomierz Basin) was the first area to be studied. It is located in subcarpathian depression and forms a link between the Carpathians and upland areas. Almost nothing was known about most of the systematic groups that occur in that area. Information about them would be necessary to explain migration routes of mountain species and boreal-mountainous ones to lowland areas in Poland.

The period in early 90s was not too favourable for conducting collective faunal investigations. Efforts of our institutions to receive financial support of research of the first stage in the Puszcza Sandomierska (the Sandomierz Forest) had not given any positive result for a few years. At last in 1996 the Department of Environmental Protection and Water Economy of Voivodeship Office in Tarnobrzeg proposed a financial support of three-year research project. The investigations were carried out only in northern part of the Puszcza Sandomierska, belonging to the former voivodeship of Tarnobrzeg. At the end of 1998 and in 1999 southern part was also included into the project.

The investigations will also be continued there probably in 2000.

STUDIED AREA

The Puszcza Sandomierska is one of the biggest compact forest complexes in Poland. It is located in the fork of rivers Wisła and San. In the south it borders with a valley of the river Wisłok. The location of the Puszcza Sandomierska in Poland is shown on the map (Fig. 1). Its surface is calculated to be ca. 10 thousand ha. In the past, however, the Sandomierska Puszcza also included some areas located on the right bank of San, e. g. the Lasy Sieniawskie (the Sieniawa Forests) (Nowiński 1928, 1929). Some of these areas still belong to left-bank Forest Inspectorates: Leżajsk and Rudnik (Forest Districts Glinianka, Ulanów, and Brzyska Wola). A history of the Puszcza Sandomierska complex and of a decrease of its area associated with development of settlement lasting for centuries was described by Dobrowolska (1965).

According to the regionalization of Kondracki (1994) the Puszcza Sandomierska consists of two mesoregions: its whole northern part is approximately equivalent with so called Równina Tarnobrzeska or Równina Rozwadowska (the Tarnobrzeg Plain or Rozwadów Plain), and southern part with Płaskowyż Kolbuszowski (the Kolbuszowa Plateau). Each of these mesoregions has different geomorphology, composition of basal geological complex, and soil characteristics. Each of them has its own somewhat different plant cover. There is a slight difference between their climatic conditions too.

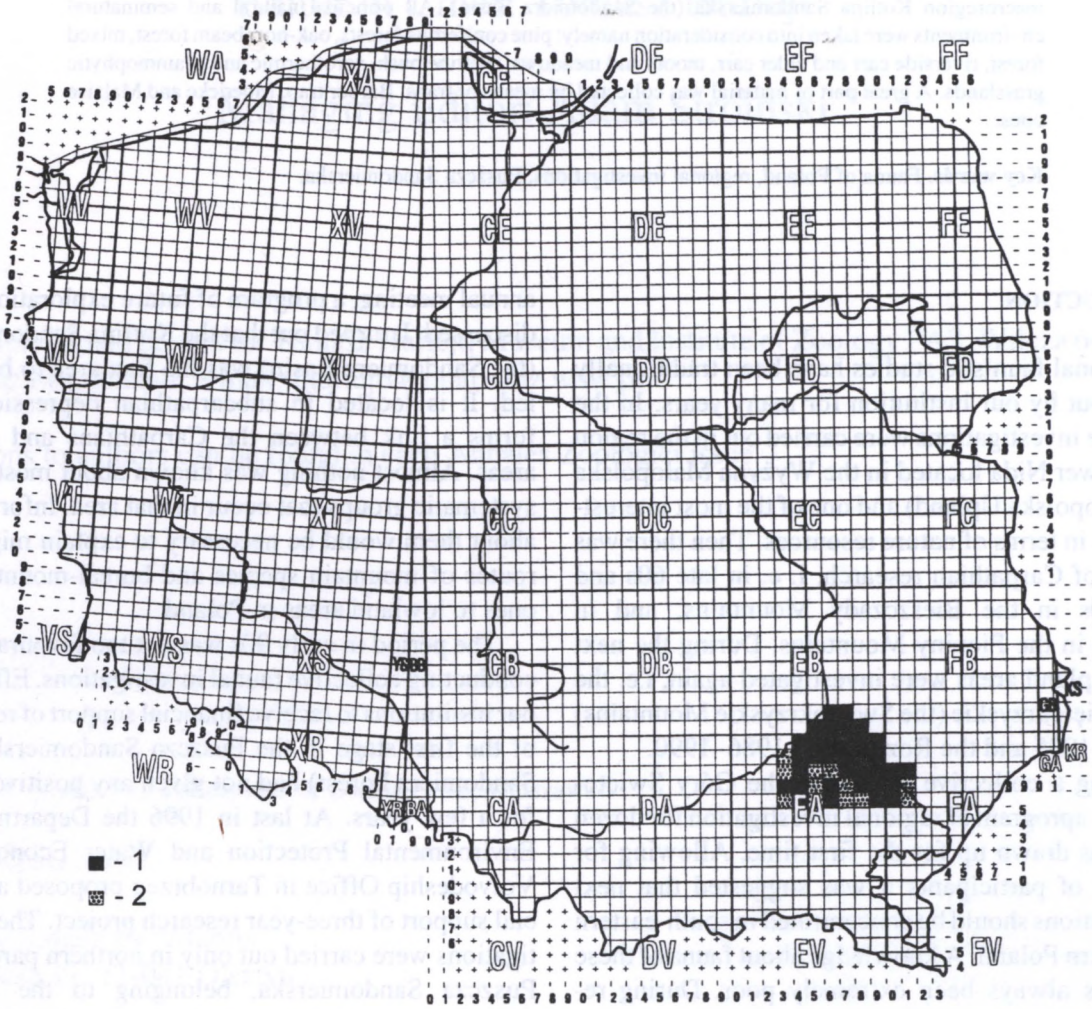

Fig. 1. A situation of the investigated area in Poland: 1 – area studied in 1996–1999, 2 – area planned to studying in 2000

The Równina Tarnobrzeska is situated 140–160 m above the sea level. It is covered with fluvial sand under which there are miocene, sulphur bearing after-gypsum deposits. The sand gave rise to real systems of dunes whose height is up to 25 m. Between the strips of sand-dunes there are swampy areas. The forest consists here mainly of various types of pinewood, alder carr, mixed coniferous forests and — along of rivers — riverside carrs. Oak-hornbeam forests occur in a relatively small area. There are many open areas such as psammophytic grasslands and heathlands, and in depressions we can find lowmooors, transitional moors, and, less frequently highmoors. Majority of open areas exists thanks to man activity. The plant cover is typical of lowland regions but contains also both boreal and southern plant species: the northern element *Linnaea borealis* occurs in coniferous forests, *Daphne cneorum* and *Rhododendron flavum* belong to the southern elements and grow on sand-dunes.

The Płaskowyż Kolbuszowski is situated at a height up to 200 m above the sea level. Its folded area is made of miocene clays covered with a layer of preglacial gravel and sand whose thickness ranges from 2 to 20 m. Deforested and agricultural areas predominate in a landscape due to relatively fertile soil. Most of the forests that grow in this area are mixed ones, with pine, fir, beech, oak and hornbeam but beech forest of Carpathian type *Dentario glandulosae-Fagetum* is a very important and characteristic element for regional plant cover.

State of a Knowledge about Fauna

The earliest stage of natural history studies, which took place in XIX century, was initiated by Komisja Fizjograficzna (The Physiographical Committee) in Cracow. The first researchers such as Wincenty Jabłoński and Jan Jachno collected information about flora of this area as so as about fauna. Apart from that in a second half of XIX century information about various groups of invertebrates inhabiting Puszcza Sandomierska was publishing by Leopold Wajgiel and Józef Bąkowski. During first decades of XX century Marian Nowiński examined flora and plant cover of the area.

Generally speaking, not many biologists have been interested in Puszcza Sandomierska. One of the factors causing such a dislike was probably an opinion first about inaccessibility of this area, then — about very strong anthropopression associated with industry development project so called COP (the Central Industrial Division) which started in the period between World War I and II.

Our knowledge about fauna of Puszcza Sandomierska is very insufficient even in a sense of basic inventory. We only have a relatively good inventory of vertebrates, mainly thanks to investigations carried out during last two decades. According to our present knowledge a number of species of vertebrates in the Puszcza Sandomierska ranges from 45% for mammals to 75% for amphibians of whole fauna of Poland. Thus in the Puszcza Sandomierska we know 42 species of the mammals and 12 species of the amphibians. Such high percentage of known species has never been recorded among invertebrates. At the time when our investigations started it was recorded e. g. only 5% Polish *Orthoptera*, 16% of *Carabidae*, 17% of *Cerambycidae*, 12% of *Curculionidae*, 4% of *Symphyta*, and 0,7% of *Cynipidae*.

Localities and Environments

The investigations, started in 1996 by the Museum and Institute of Zoology PAS, due to financial problems had to be planned on a much smaller scale than the earlier regional ones. Only a few specialists could participate in them directly. That is why it was decided than many different trapping methods should be applied during the investigations. With such an approach it is, of course, impossible to collect all species (or even majority of them) but on the other hand the traps can work during the whole growing season, so there is no need of engaging a large number of staff.

The researches were extensive, i. e. were carried out in a large area and, at the same time, in different types of the environments. From 1996 to 1998 the explorations were conducted mainly in three Forest Inspectorates: Rozwadów, Buda Stalowska and Rudnik, and also in few localities in the Forest Inspectorate Leżajsk and Kolbuszowa. The total of 25 sites of trapping investigations were studied in area allowed by localities: Kotowa Wola, Rozwadów, Nisko, Rudnik, Kamień, and Huta Komorowska. In 1997 and 1998 various traps were working there throughout the

whole growing seasons. During the first year of the investigations (1996) the traps were placed in 11 localities and worked from August to the beginning of November. In 1999 traps were set in several localities in Płaskowyż Kolbuszowski In similar area but in other 8 localities (four sites each year) in 1997 and in 1998 light traps catching mainly moths worked continuously. At the same time, the area was explored with the help of direct-catch techniques.

The following types of environment and plant associations were permanently investigated (Table I): oak-hornbeam forest *Tilio-Carpinetum*, fresh coniferous forest *Leucobryo-Pinetum*, mixed coniferous forest *Querco roboris-Pinetum*, marshy coniferous forest *Vaccinio uliginosi-Pinetum*, highmoor *Ledo-Sphagnetum*, alder carr *Ribo nigri-Alnetum*, riverside carr *Circaeo-Alnetum* (and transitional associations of two last ones), elm-ash riverside carr *Ficario-Alnetum*, lowmoor with community of *Carici-Agrostietum*, sandy grasslands *Spergulo-Corynophoretum*. In 1999 some other environment such as beech forest *Dentario glandulosae-Fagetum* and larch-stands were took into consideration.

Apart from that many other kinds of environments were explored with the help of direct-catch techniques but, because of their unusual fitosociological characteristics it is difficult or even impossible to define them precisely. Such environments included e. g. forest margins, roadsides, clearings, croplands, etc.

Methods and Material

In most of the permanently investigated sites, Moericke traps were used. They consisted of yellow dishes with mixture of glycol, water and detergent. These traps were installed in many different vegetation layers: they were put on the understorey or hung on stakes up to 1 m above ground; or they were hung on bushes and trees of the ground cover up to 2,5 m above ground surface, and in canopies at a height of 5–15 m (Figs. 6–8).

In 1996 and 1997 in most of the localities Barber traps were also installed. These are glass jars or cylinders buried in soil and partly filled with glycol. In 1998 this type of traps was set only in Kotowa Wola.

A Malaise trap represented the third type of traps used by us during the investigations in Puszcza Sandomierska. Several kinds of this trap were used, i. e. traditional, screen, and combined (Figs. 5 & 9). The second and the third trap was designed by T. Huflejt. The last kind consisted of a tent similar to that in the traditional one, but it was ca. 4 m long. The tent had three point of support. The capturing containers were placed at both tops of the tent. Oblong containers filled with a preservative liquid were installed along the long axis of the trap. Additionally, yellow dishes were hung under the hood of the tent (Fig. 6). Information about localities and period in which mentioned trap-catches were made is given in Table I.

Light traps were set to catch moths. At the bottom of the traps there were containers with a soporific agent (Fig. 10). Apart from that, the moth were also caught with the help of a screen in other localities, changed every time (K. Pałka of University of Maria Curie-Skłodowska in Lublin conducted this part of program).

Invertebrates living in soil or litter were also caught by sieving with the help of entomological sieves. Specimens were collected from the sieved material in camping site laboratory.

Apart from that the researchers collected material using various direct-techniques, e. g. with an entomological net, collecting from plants, looking under bark, stones, etc. Such techniques were used at least at 150 different localities throughout the whole area but in some cases number of localities could be smaller or greater. *Symphyta* were captured in this way in about 200 sites. Apart from that, in some localities the zoologists collected samples of sieved a litter, touchwood and moss. They also collected material for breeding in laboratory, such as pieces of tree trunks, mined leaves, galls, pupae, laid eggs etc. It is impossible to name here all the localities in which the specialists used these catching techniques.

Till the present ca. 2/3 of the material from traps was revised and sorted in the Museum and Institute of Zoology (except for light trap catches). Information about this material is given in Table II.

In the case of vertebrates, information were collected about distribution of different species (amphibians, reptiles, some birds and mammals), taking notes in the field. A small number of vertebrates (amphibians, small rodents) was collected during traps catches of invertebrates. They were found mainly in Barber's traps. Bats and doormice, however, were the subject of distinct detailed studies.

Fig. 2. An old alder forest in the range Bania (Forest District Berówka); a transitional association between *Ribo nigri-Alnetum* and *Circaeo-Alnetum*

Fig. 3. A marshy forest *Vaccinio uliginosi-Pinetum* and a highmoore in the range Zimna Smuga (Forest District Krawce)

Fig. 4. A management of traps by a team of zoologists in the range Jesiony (Forest District Groble)

Fig. 5. A screen-Malaise trap instaled in an alder swamp in the range Ameryka (Forest District Berówka)

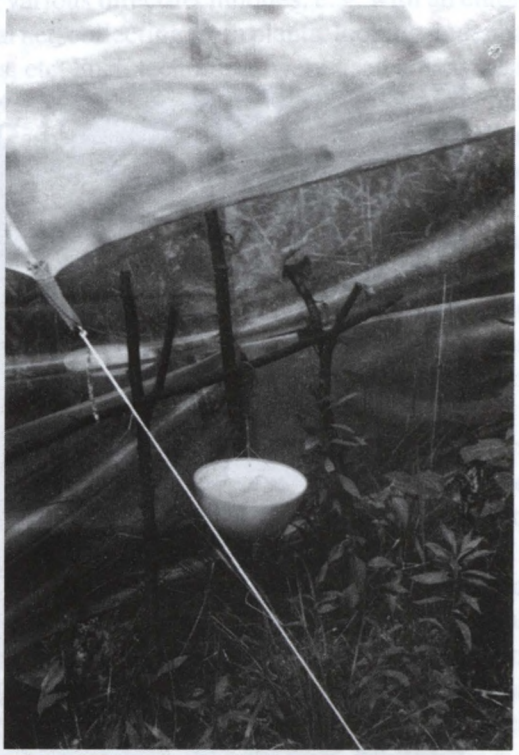

Fig. 6. A Moericke trap hung under overlap of combined Malaise trap in the range Ameryka

Fig. 7. A Moericke trap instaled in a riverside carr in the range Jesiony (Forest District Groble)

Fig. 8. A Moericke trap hung in a marshy forest in the range Zimna Smuga (Forest District Krawce)

Fig. 9. A classic Malaise trap in a highmoore in the range Cietrzewiec (Forest District Poręby)

Fig. 10. A light-trap for sampling lepidopterans in the Forest District Szkółkarskie (Kotowa Wola)

Table I. Localities of studies by means of traps in the Puszcza Sandomierska

No.	Locality	Sort of trap	Period
	fresh pine coniferous forest *Leucobryo-Pinetum*		
1.	Forest District Ciemny Kąt, comp. 166	Barber, Moericke	1996
2.	Forest District Krawce, comp. 58	Barber, Moericke	1996-1998
3.	Krawce, a burn	Moericke	1998
	humid pine coniferous forest		
4.	Kotowa Wola, forest nursery	Malaise, Barber	1998
	marshy pine coniferous forest *Vaccinio uliginosi-Pinetum*		
5.	Forest District Krawce, comp. 53, range "Zimna Smuga"	Barber, Moericke	1997, 1998
	highmoor		
6.	Forest Districts Poręby and Lipie, range "Cietrzewiec"	Barber, Malaise	1996, 1997
	mixed coniferous forest		
7.	Forest District Berówka, comp. 138	Moericke	1998
	open oak wood		
8.	Forest District Żupawa, comp. 31	Malaise	1999
	Tilio-Carpinetum typicum		
9.	Forest District Stale, comp. 204	Barber	1996
10.	Forest District Stale, comp. 205	Barber	1997
11.	Forest District Berówka, comp. 84	Barber, Moericke	1996-1998
12.	Forest District Lipie, comp. 74	Moericke	1998
13.	Forest nursery Bukie	Malaise	1997-1998
	Tilio-Carpinetum corydaletosum		
14.	Forest District Czarny Las, comp. 116, forest nursery	Malaise, Moericke — canopy, ground cover	1997, 1998
15.	Forest District Czarny Las, comp. 117	Barber, Moericke	1996, 1997
	riverside carr *Ficario-Ulmetum*		
16.	Forest District Groble, comp. 120, range "Jesiony"	Barber, Malaise, Moericke canopy, ground cover	1996-1999
	poplar-willow riverside carr		
17.	Stalowa Wola-Sochy	Moericke	1999
	transitional environment: riverside carr/dry ground forest		
18.	Forest District Buda Tuszowska, comp. 144, range "Łęg nad Korzeniem"	Barber, Moericke	1996-1998
	alder carr (alder forest)		
19.	Forest District Zaosie, comp. 136	Barber, Moericke in shrubs	1996
20.	Kotowa Wola, on the Osa stream	Moericke	1998
21.	Forest District Berówka, comp. 152	Barber, Moericke	1996-1998
22.	Forest District Berówka, comp. 112, range "Ameryka"	Malaise (combine, screen), Moericke	1998
	beech wood *Dentario-Fagetum*		
23.	Forest District Marynin, comp. 207 (interior and clearing)	Moericke (in ground cover, in canopy)	1999
24.	Forest District Wydrze, comp. 45, larch-stand	Moericke in ground cover	1999
25.	Forest District Kamień, comp. 225, range "Studzieniec"	Moericke	1999
26.	Forest District Kamień, comp. 191, Grabinka, forest margin	Malaise, Moericke	1999
	mixed forest		
27.	Forest District Berówka, Buda Stalowska, forest nursery	Malaise	1997
28.	Forest District Czarny Las, comp. 129, larch-greenwood	Moericke	
29.	Forest District Kamień, comp. 193, (former forest reserve Morgi)	Moericke	1999
	ecotonic environments		
30.	Forest District Stale, brushwood, range "Głogowiec"	Moericke	1998
31.	Forest District Stale, patch of dry ground forest in the middle of meadows (Bukie)	Malaise (screen), Moericke	1999

Table I continued

32.	Forest District Lipie, comp. 109/110, willow brushwood on drainage channel in forest	Moericke	1998
33.	Forest District Berówka, willow brushwood on fishpond	Moericke	1998
34.	Rudnik, wasteland, shrubs of rose	Moericke	1999
35.	Forest District Czarny Las, comp. 116, transitional environment: riverside carr/dry ground forest	Malaise, Moericke	1999
36.	Forest District Czarny Las, Popielarnia, willow brushwood	Moericke	1998
37.	Forest District Czarny Las, comp. 116, shrubs of blackthorn	Moericke	1999
	lowmoor		
38.	Forest District Zatyki, range "Bardo"	Moericke	1997, 1998
	varia		
39.	Forest District Zerwanka, Brzóza Królewska, capercaillie farming	Malaise	1999
40.	Forest District Szkółkarskie, forest nursery	Malaise	1999

Systematic Groups Examined

At the beginning of our project many specialists from several Polish institutes (MiIZPAN Warszawa, UMCS Lublin. UAM Poznań, AR in Lublin and Poznań) wanted to take part in the investigations. Systematic groups being examined in detail, are given below: orthopterans and allied groups (*Orthoptera*, *Blattodea*, *Dermaptera* and *Mantodea*); thripses (*Thysanoptera*); scale insects (*Coccinea*, *Homoptera*); — beetles (*Coleoptera*, *Cerambycidae*); butterflies (*Lepidoptera*, *Rhopalocera*) and snout moths (*Lepidoptera*, *Pyralidae*); *Hymenoptera*: sawflies (*Symphyta*), bees (*Apoidea*); gall-wasps (*Cynipidae*); bats and doormice (*Mammalia*, *Chiroptera et Gliriidae*). There is also a likelihood of examining trapped animals from the following groups: spiders (*Aranei*), dragonflies (*Odonata*), ground beetles, leaf beetles and click beetles (*Coleoptera*: *Carabidae*, *Chrysomelidae*, *Elateridae*), noctuids (*Lepidoptera*, *Noctuidae*), ants (*Hymenoptera*, *Formicidae*).

Material collected by means of direct-catch techniques, and especially trapped material which has not been examined yet, is kept in the Collection Division of the Museum and Institute of Zoology PAS. We can make the material available to those who would like to examine it. This part of collection consists mainly of the following groups of invertebrates: *Acari*, *Apterygota* (mainly from Barber's trap), *Coleoptera*, *Staphylinoidea* and different small families; *Diptera*: *Muscidae*, *Phoridae*, *Sciaridae*; *Hymenoptera* (some *Ichneumonoidea* and some *Aculeata* except for *Apoidea*).

Acknowledgments

The investigations were given a three-year financial support from Voivodeship Office in Tarnobrzeg which does not exist any more because of the administrative reform. We got this support thanks to efforts of the former Provincial Nature Conservator Msc. F.E. Andrzej Sycz.

Table II. Material of several taxons collected by means of traps and segregated (about 3/4 material from 1996-1998)

No.	Taxon	Number of specimens
1.	*Gastropoda terrestria*	1 646
2.	*Isopoda*	1 304
3.	*Diplopoda*	885
4.	*Chilopoda*	469
5.	*Aranei*	5 562
6.	*Opiliones*	440
7.	*Acari*	78
8.	*Apterygota*	21 289
9.	*Heteroptera*	1 614
10.	*Homoptera*	6 598
11.	*Lepidoptera*	3 680
12.	*Mecoptera*	4 936
13.	*Neuroptera*	166
14.	*Orthoptera*	25
15.	*Blattodea*	89
16.	*Dermaptera*	60
17.	*Trichoptera*	111
18.	*Plecoptera*	72
19.	*Diptera*	107 873
20.	*Hymenoptera*	20 595
21.	*Coleoptera*	15 301
	Invertebrata total	192 762
22.	*Vertebrata*	114

During field research the collective of zoologists was given assistance of several Forest Districts, especially in the Forest Inspectorates Buda Stalowska and Rudnik, which enabled us to create temporary camping sites, made forest maps available, gave much useful information, and from time to time provided us even with their owns means of transport.

The chief of the Collection Division of MIZ PAS Msc. F.E. Tomasz Huflejt, has made much effort in organizing of studies and selecting research methods. Without his participation, implementing of the program would not be possible.

The author would like to express her gratitude to all the above mentioned persons and institutions.

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