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BEES (*APOIDEA*) OF MOIST MEADOWS ON THE MAZOVIAN LOWLAND

ABSTRACT

In the course of studies (1981–1983) on *Apoidea* on the Mazovian Lowland, 48 species were recorded. The distinctly prevailing species included: *Andrena haemorrhoa* (Fabr.) — 20.1%, *Lasioglossum calceatum* (Scop.) — 18.9% and *Apis melifera* L. — 12.2%. The curve of seasonal changes in the number of species was provided along with the curves of changes in abundance of the dominant. Effectiveness of the three applied methods of sampling was estimated, namely of Moericke traps, window traps and sweeping with an entomological sweep-net.

INTRODUCTION

Information on bees (*Apoidea*) of grassland communities is scattered in various faunistic works. For instance, Adolph (1934) reported more than 10 species from wet meadows in the environs of Vilnius. The area of Poland was examined by Torka (1913), Dylewska (1966), Żak (1969) and Banaszak (1973). A more detailed account of the community structure and abundance of *Apoidea* on a humid mown meadow of the class *Molinio-Arrhenatheretea* has been recently given by Banaszak (1983). Moreover, the quoted work also evaluated the significance of humid meadow ecosystem to bees in terms of feeding grounds and not living grounds.

Although there is a long-lasting tradition of faunistic studies in Poland, our knowledge of communities of animals in particular ecosystems, the meadows environments included, is, indeed, superficial. The research on the fauna of moist meadows, headed by the Institute of Zoology, Polish Academy of Sciences, granted the opportunity of improving our knowledge on the subject, also as regards the fauna of pollinating insects. The findings of the present research concern the species composition, relative abundance and certain issues of phenology of *Apoidea* of rye-grass meadows on the Mazovian Lowland.

RESEARCH SITES, MATERIAL AND METHODS

In 1981–1983 bee (*Apoidea*) communities were examined on three grasslands of the association of the rye-grass meadow — *Arrhenatheretum medioeuropaeum*. The sites differed in their area, soil moisture content, intensity of fertilization and exploitation.

1. Zbroszki near Pułtusk (60 km N Warsaw). A small farm meadow of about 0.5 ha in area, recently set in place of a cleared orchard, in the vicinity of farm settlements. Extensively exploited, not fertilized, subject to one spring mowing and pastured later on. The vegetation of this site included species characteristic of moist meadows, e.g. the grasses: *Dactylis glomerata*, *Poa pratensis*, *P. trivialis*, *Festuca rubra*, *Lolium perenne* and plants significant to bees: *Achillea millefolium* and *Trifolium repens*.

2. Klembów near Tłuszcz (40 km NE Warsaw). The meadow of 0.5 ha in area adjacent to a linden-oak-hornbeam forest complex, recently set on former crop fields. Very extensively exploited, mown once a year in spring and subsequently grazed till autumn. The sward noted for a homogeneous occurrence of, among others, *Poa pratensis*, *Dactylis glomerata* and *Festuca rubra* and, with respect to bee food plants, of *Taraxacum officinale*.

3. Chylice near Grodzisk Mazowiecki (40 km SW Warsaw). The meadow of the largest area, spreading on 7 ha and bordering on multihectare pasture. Exploited as grassland for the last 30 years. Subject to intensive mineral fertilization; yields two to three hay crops a year. The dominating were the high-yielding grass species — *Dactylis glomerata*, *Festuca pratensis*, *Poa pratensis* and the bee food plants — *Taraxacum officinale* and *Knautia arvensis*.

The material was sampled by means of three methods: coloured traps (yellow Moericke dishes with preserving fluid), window traps and sweeping. Three Moericke dishes were laid out directly in grass and three were attached to pegs 0.5 m above the ground. Three window traps (of 1 m^2 total surface) were hung upright on frames close above oblong vessels filled with preserving liquid. Moericke traps were emptied of insects every seven days. In the case of sweeping with an entomological sweep-net 10 series of samples were taken, each made up of 25 sweepings. Unfortunately, all the three methods could have been applied only on the meadow at Chylice, the remaining sites having been subject to sweep-net sampling only.

THE EVALUATION OF EFFECTIVENESS OF THE APPLIED SAMPLING METHODS

The actual employment of all three sampling methods on the meadow at Chylice allowed estimation of their effectiveness. The results of evaluation are presented in Table 1. It was found out that the most effective in *Apoidea* sampling was the method of Moericke traps hung up above the vegetation layer. Over 60%

Table 1. Effectiveness of *Apoidea* sampling methods employed on the meadow at Chylice (near Warsaw) in 1981–1983

Taxons	Method effectiveness in % of specimen number			
	Coloured traps		Window traps	Entomological sweep-net
	on pegs	in grass		
Apoidea	63.3	25.3	7.2	4.2
Wild *Apoidea*	66.8	26.4	3.9	2.9
Bombus Latr.	59.6	32.5	7.0	0.9
Apis mellifera	36.0	16.0	33.3	14.7
Andrema haemorrhoa	73.0	27.0	0.0	0.0
Lasioglossum calceatum	88.3	7.0	3.9	0.8

of the sampled wild bees were trapped this way, the amount ranging even between 70–80% in the case of certain species. Approximately a quarter of the material was sampled by means of Moericke traps laid out directly in grass. Relatively little effective method of wild bee sampling were window traps and sweeping. Only for *Apis mellifera* the amount of window trapped material was fairly satisfactory (33%). Sweeping is of little use for estimation of bee abundance, both as regards honeybees as well as wild bees, due to a clumped spatial distribution of these insects. Although this difficulty may be overcome by appropriately increasing the number of samples, yet still the setback in sampling by this method consists in scampering away the bees while changing the direction of sweeping.

SPECIES COMPOSITION

48 *Apoidea* species were reported in total from the three examined meadows (Tab. 2). However, it should be emphasized that the bulk of the material (46 species) came from the meadow at Chylice, owing to various sampling methods applied there and the larger area of the research site. The material sampled on the meadow at Klembów (4 species) and Zbroszki (5 species) did not allow for any kind of analysis.

The total number of *Apoidea* recorded on meadows was fairly large as compared to 18 *Apoidea* species which had formerly been reported from a meadow of the class *Molinio-Arrhenatheretea* on the Wielkopolsko-Kujawska Lowland. Moreover, a majority of species came from the meadow at Chylice, which was subject to very intensive agricultural use.

All the species belong to seven *Apoidea* families, the most numerous being *Andreanidae*, *Halictidae* and *Apidae*. Strikingly little was the number of species from the families *Colletidae*, *Megachilidae* and *Anthophoridae*. However, it should

Table 2. Species composition of *Apoidea* of moist meadows (*Arrhenatheretum medioeuropaeum*) on the Mazovian Lowland
(% — contribution of specimens of a given species to the sampled material in per cent)

No.	Species	%	Sites		
			Chylice	Klembów	Zbroszki
1	2	3	4	5	6
	Colletidae				
1	*Prosopis hyalinata* (Smith)	0.1	+	—	—
	Andrenidae				
2	*Andrena nigrospina* Thomson	0.3	+	—	—
3	*Andrena subopaca* Nylander	0.1	—	+	—
4	*Andrena minutuloides* Perkins	0.3	+	—	—
5	*Andrena nanula* Nylander	0.1	—	—	+
6	*Andrena haemorrhoa* (Fabricius)	20.1	+	+	+
7	*Andrena flavipes* Panzer	0.1	+	—	—
8	*Andrena albofasciata* Thomson	0.1	+	—	—
9	*Andrena cineraria* (Linnaeus)	2.3	+	—	—
10	*Andrena nigroaenea* (Kirby)	0.1	+	—	—
11	*Andrena bicolor* Fabricius	0.4	+	—	—
12	*Andrena ruficrus* Nylander	0.3	+	—	—
13	*Andrena dorsata propinqua* Schenck	0.1	+	—	—
14	*Andrena sabulosa* (Scopoli)	0.1	+	—	—
15	*Andrena varians* (Kirby)	0.4	+	—	—
16	*Andrena praecox* (Scopoli)	1.6	+	—	—
	Halictidae				
17	*Halictus maculatus* Smith	1.0	+	—	—
18	*Halictus tumulorum* (Linnaeus)	2.0	+	—	—
19	*Lasioglossum sexnotatum* (Kirby)	0.1	+	—	—
20	*Lasioglossum quadrinotatum* (Kirby)	0.4	+	—	+
21	*Lasioglossum quadrinotatulum* (Schenck)	0.7	+	—	—
22	*Lasioglossum zonulum* (Smith)	1.9	+	—	—
23	*Lasioglossum leucozonium* (Schrank)	3.8	+	—	—
24	*Lasioglossum villosulum* (Kirby)	4.8	+	—	+
25	*Lasioglossum sexstrigatum* (Schenck)	1.3	+	—	—
26	*Lasioglossum lucidulum* (Schenck)	0.6	+	—	—
27	*Lasioglossum minutissimum* (Kirby)	0.3	+	—	—
28	*Lasioglossum pauxillum* (Schenck)	0.6	+	+	—
29	*Lasioglossum calceatum* (Scopoli)	18.9	+	—	+
30	*Lasioglossum malachurum* (Kirby)	2.6	+	—	—
31	*Lasioglossum morio* (Fabricius)	0.6	+	—	+
32	*Sphecodes miniatus* Hagen	0.1	+	—	—
	Melittidae				
33	*Melitta leporina* (Panzer)	0.1	+	—	—
34	*Dasypoda hirtipes* (Fabricius)	0.3	+	—	—
	Megachilidae				
35	*Heriades truncorum* (Linnaeus)	0.1	+	—	—
36	*Chelostoma maxillosum* (Linnaeus)	0.4	+	—	—

1	2	3	4	5	6
37	*Osmia rufa* (Linnaeus)	3.1	+	—	—
	Anthophoridae				
38	*Nomada bifida* Thomson	0.1	+	—	—
	Apidae				
39	*Bombus terrestris* (Linnaeus)	4.8	+	—	—
40	*Bombus lucorum* (Linnaeus)	2.8	+	—	—
41	*Bombus lapidarius* (Linnaeus)	1.5	+	—	—
42	*Bombus hortorum* (Linnaeus)	0.1	+	—	—
43	*Bombus muscorum* (Linnaeus)	2.9	+	—	—
44	*Bombus pascuorum* (Scopoli)	0.1	+	—	—
45	*Bombus ruderarius* (Müller)	2.5	+	—	—
46	*Bombus sylvarum* (Linnaeus)	0.7	+	—	—
47	*Bombus veteranus* (Fabricius)	1.7	+	—	—
48	*Apis mellifera* Linnaeus	12.2	+	+	+

be called to mind that the environment of mown moist meadows is not the living grounds of the insects in question. Most bees fly up there in search of food only. As it has already been stated (Banaszak 1983), notwithstanding apparent similarity to sward associations, the environments of the moist meadows type resemble rather yellow lupin crops or rape crops with regard to their fauna.

A majority of reported species ranked among the common or frequent ones in Poland. One of them *Lasioglossum malachurum* had not been reported from the Mazovian Lowland, so far.

DOMINANCE STRUCTURE

The proportion of particular species in the material sampled on the studied meadows ranged between 0.1–20.1%.

A majority of species (29, i.e. 60%) was represented by a small number of specimens, accounting merely for less than 1% of the entire material (Tab. 2).

Sixteen species might be said to be common. Their proportion in the sampled material amounted to 1–5%. These species included (in the dominance sequence): *Lasioglossum villosulum*, *Bombus terrestris*, *Lasioglossum leucozonium*, *Osmia rufa*, *Bombus muscorum*, *B. lucorum*, *B. ruderarius*, *Lasioglossum malachurum*, *Andrena cineraria*, *Helictus tumulorum*, *Lasioglossum zonulum*, *Andrena praecox*, *Bombus lapidarius*, *Lasioglossum sextrigatum*, *Bombus veteranus* and *Halictus maculatus*.

Three species dominated pronouncedly (Fig. 1), i.e. *Andrena haemorrhoa* (20.1%), *Lasioglossum calceatum* (18.9%) and *Apis mellifera* (12.2%).

Andrena haemorrhoa is one of the most common spring species in Poland. Widely distributed in Europe. In April and May it occurs in large numbers on willow flowers as well as on *Tussilago farfara*, *Taraxacum officinale*, *Crataegus*

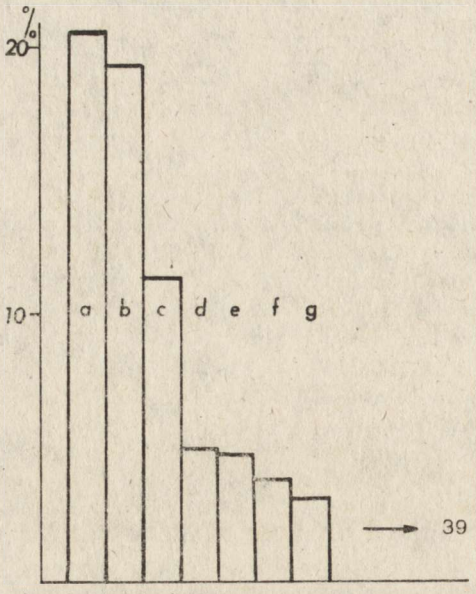

Fig. 1. Dominance structure of *Apoidea* communities on the meadow at Chylice; a — *Andrena haemorrhoa*, b — *Lasioglossum calceatum*, c — *Apis mellifera*, d — *L. villosulum*, e — *Bombus terrestris*, f — *L. leaucozonium*, g — *Osmia rufa*

oxyacantha and others. It is also the most frequent wild bee species on winter rape flowers (Banaszak 1982a), complementing the pollination activity of honeybees. It nests solitarily in escarpments and hill slopes.

Lasioglossum calceatum is an equally common bee in Poland, yet it occurs throughout the entire vegetative season. Large numbers of males may be very frequently found on flowers of *Senecio* sp. as late as in the end of autumn. Social species. Shows marked preference for open field areas (Banaszak 1983). In agricultural landscapes this polytrophic species nests on cart roads and their verges, finding its nutritive plants on roadsides.

PHENOLOGY

Moericke traps, attracting insects all the vegetative season long, enabled the acquisition of data on the occurrence of particular pollinators even in periods of vegetation regrowth following the former mowing. This, in turn, allowed for acquiring information on fauna and its qualitative changes from spring till autumn.

Changes in the number of *Apoidea* species over the vegetative season were presented in Figure 2. The course of dynamics curve was decided by a notable proportion of bees of the family *Andrenidae*, *Halictidae* and *Apidae*. In spring

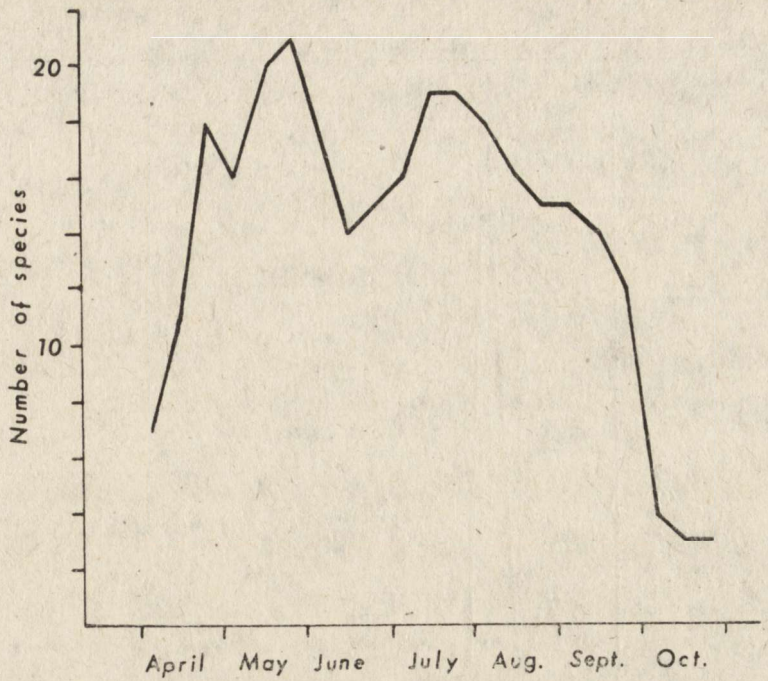

Fig. 2. Changes in the number of species over vegetation season on the meadow at Chylice

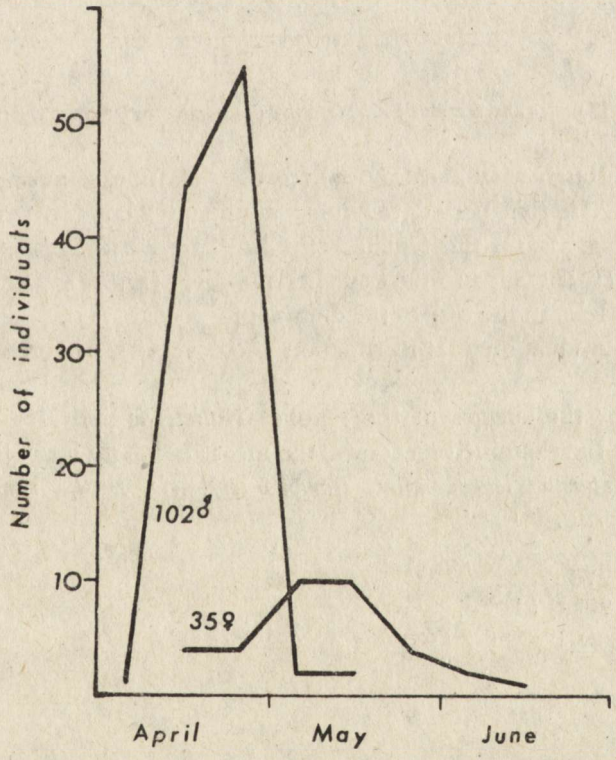

Fig. 3. Changes in males and females *Andrena haemorrhoa* abundance on the meadow at Chylice

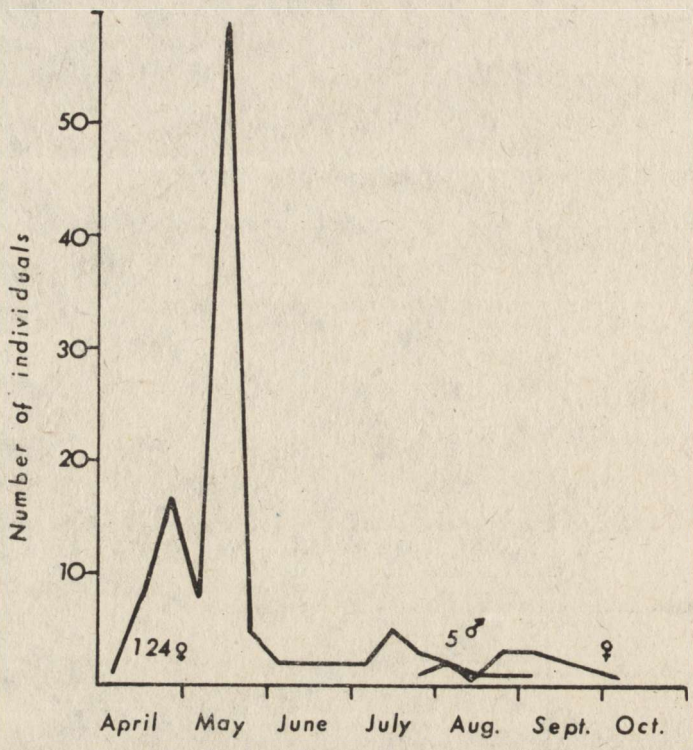

Fig. 4. Changes in males and females *Lasioglossum calceatum* abundance on the meadow at Chylice

time (April through May and the first ten days of June) *Andrenidae* and *Halictidae* prevailed. In this period the most abundant were the males of *Andrena haemorrhoa* (Fig. 3) and the females of *Lasioglossum calceatum*, which occurred still in summer, though in much smaller numbers (Fig. 4). The analysis of sex abundance, at least in the case of the dominating species, is of essential importance as it enables evaluation of the function these species perform in plant pollination.

In summer the species of the families *Halictidae* and *Apidae* substantially dominated on the examined meadows, the most abundant, apart from honeybees, being: *Lassioglossum leucozonium*, *Bombus terrestris*, *B. lucorum*, *B. muscorum* and *B. ruderarius*.

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PSZCZOŁY (*APOIDEA*) ŁĄK ŚWIEŻYCH NIZINY MAZOWIECKIEJ

STRESZCZENIE

W wyniku trzyletnich (1981–1983) badań nad *Apoidea* łąk rajgrasowych (*Arrhenatheretum medioeuropaeum*) na Nizinie Mazowieckiej stwierdzono występowanie 48 gatunków (tabl. 2), z których osiem nie było dotąd wymienianych z obszaru Mazowsza.

Materiał pozyskiwano stosując trzy metody: pułapek barwnych (żółte miski), tafli szklanych i czerpakowania. Najbardziej wydajną okazała się metoda pułapek barwnych podwieszonych na palikach na wysokości 0,5 m nad ziemią (tabl. 1).

Udział poszczególnych gatunków w zebranym materiale wahał się w granicach 0,1–20,1%. Zdecydowanie dominowały trzy gatunki: *Andrena haemorrhoa* (20,1%), *Lasioglossum calceatum* 18,9%) i *Apis mellifera* (12,2).

Krzywa obrazująca zmiany liczby gatunków na przestrzeni całego sezonu wegetacyjnego (rys. 2) ma przebieg dwuwierzchołkowy z dominacją wiosenną (21 gatunków, głównie *Andrenidae*, *Halictidae* i *Apidae*) i letnią (19 gatunków, głównie *Halictidae* i *Apidae*).

ПЧЕЛЫ (*APOIDEA*) СВЕЖИХ ЛУГОВ МАЗОВЕЦКОЙ НИЗМЕННОСТИ

РЕЗЮМЕ

Исследования (1981—1983) по *Apoidea* свежих лугов Мазовецкой низменности дали возможность констатировать 48 видов. Обнаружено, что следующие виды значительно превышают остальные по своей численности. Это: *Andrena haemorrhoa* (Fabr.) — 20,1%, *Lasiglossum calceatum* (Scop.) — 18,9% и *Apis mellifera* L. — 12,2%. Приведена кривая изменения числа видов на протяжении вегетативного периода, а также кривые изменения численности доминантов. Произведена оценка производительности трех примененных методов сбора пчел: цветных ловушек, стекляной пластинки и сбора при помощи энтомологического сачка.