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Apoidea (*Hymenoptera*) in habitats of former agriculture area in a renaturization stage of Kampinos National Park (Poland)

Abstract: Wild bee community in habitats of abandoned village in forest territory of Kampinos National Park was studied. From 1998 to 1999, 77 species of *Apoidea* were registered, including 21 not recorded so far from the Kampinos National Park and 11 for Mazovian Lowland. Bees in the studied habitats represented 8 zoogeographical elements, of which the widely distributed species: palearctic, european, eurosiberian and holarctic accounting for about 95%. As regarding the number of species, the most attractive habitats were the area of the Field Centre (anthropogenic plant communities) and the xerothermic grassland with an admixture of synanthropic plants, 44 and 31 respectively. The lowest number of species was registered in the moist meadow. The values of Marczewski-Steinhaus' index (0,05< *MS* <0,33) indicated on considerable qualitative differences in bee species composition between all studied habitats.

Key words: *Apoidea*, *Hymenoptera*, former agriculture area, abandoned village

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INTRODUCTION

Till now, on the territory of the Kampinos National Park and its buffer zone, 187 species of *Apoidea* were noted (DOMAGAŁA-LIPIŃSKA 1961, BANASZAK & PLEWKA 1981). The most data comes from the paper of the latter authors, where description of the bee fauna and the list of 180 species is given.

The present paper describe the community of *Apoidea* (*Hymenoptera*) in habitats of an abandoned village in a renaturization stage, in the western part of the Kampinos National Park.

STUDY AREA, MATERIAL AND METHODS

Kampinos National Park is placed in the Mazovian Lowland, central Poland (ANDRZEJEWSKA *at al.* 2000). Studies were carried out between June and October of 1998 and 1999 on the area of Bromierzyk village (western part of Kampinos National Park) abandoned in the 1970s. The study area was described in details in the earlier paper of SZCZEPKO, KOWALCZYK (2001). The material was collected in the following study habitat sites:

1. the area of the Łódź University Field Centre: a brick house, grass, flowering plants, pine and birch trees and a small sand dune, surrounded with pine forest (*Peucedano-Pinetum*)
2. a wooden stable, outside the area of the Field Centre
3. old willows alongside a road
4. an old wooden barn with the thatched roof, on an abandoned farm
5. xerothermic grassland surrounded with pine youngstand
6. a sand dune, on a lower part overgrown with grass
7. xerothermic grassland with an admixture of synanthropic plants
8. a moist meadow

All samples were collected using Moericke's traps. The traps were emptied every eight days. Cups were hung on trees or sticks (sites: 3, 8), on the walls of buildings (sites: 1, 2, 4) and they were placed on the ground (sites: 1, 5, 6, 7).

The parameters of the samples were calculated for each habitat (site) for both seasons together. The following indices were used to describe *Apoidea* community in habitats:

1. number of species (*S*)
2. Marczewski-Steinhaus' index (*MS*) for qualitative comparisons of the habitats, $MS = w/(a + b - w)$, where a – number of species in the first habitat, b – number of species in the second habitat, w – number of species common for the two compared habitats
3. an individual dominance (*D*), $D = n/N$ [%], were counted for all community on a study area.

RESULTS AND DISCUSSION

A total of 468 specimens representing 77 species of *Apoidea* were collected in the studied habitats (Table I). There were 21 new species for Kampinos National Park, what lengthened the list of *Apoidea* known from the area of Kampinos National Park to 208 species (44.3% of Polish fauna). There were also 11 species, which had not been found in the Mazovian Lowland as yet (BANASZAK 1982, BANASZAK 2000, BANASZAK

et al. 1978, BANASZAK & PLEWKA 1981, BANASZAK & ROMASENKO 2001) (Table I). In the group of those species, some deserve on special attention:

Hylaeus gredleri FÖRST.– the species was found only on few stands in the Kraków-Częstochowa Upland, Silesian Upland and Bieszczady Mts. (CELARY & WIŚNIOWSKI 2001).

Colletes inexpectatus NOSK. – till now reported from south-eastern part of Poland (BANASZAK 2000).

Coelioxys alata FÖRST. – reported only from Pieniny Mts. (BANASZAK 2000).

Epeoloides coecutiens (FABR.) – observed in different part of Poland, however, even where it is found, it is very rare (CELARY & WIŚNIOWSKI 2001).

Psithyrus norvegicus SP.-SCH. – very rare (BANASZAK 1993b), known only from few sites in Poland (CELARY 1989, WIŚNIOWSKI 2000).

Table I. The list of *Apoidea* collected in various habitats in the western part of Kampinos National Park (N – sum of individuals, D – species domination, [a]) – first record for the territory of Kampinos National Park, [b]) – first record for the Mazovian Lowland.

No.	Species	Number of individuals in habitats									D [%]
		1	2	3	4	5	6	7	8	1–8	
1.	*Hylaeus brevicornis* NYL.	1	5	1	–	–	–	–	–	7	1.5
2.	*H. styriacus* FÖRST.	–	–	–	1	–	–	–	–	1	0.2
3.	*H. hyalinatus* SM.	6	2	–	–	–	–	–	–	8	1.7
4.	*H. sinuatus* (SCHCK.) [ab]	1	5	1	1	–	–	–	–	8	1.7
5.	*H. gredleri* FÖRST. [ab]	2	1	–	–	–	–	–	–	3	0.6
6.	*H. communis* NYL.	3	18	–	6	–	1	–	–	28	6.0
7.	*H. difformis* (EVERSM.)	–	5	1	–	–	–	–	–	6	1.3
8.	*H. confusus* NYL.	2	2	2	–	–	–	–	–	6	1.3
9.	*Colletes inexpectatus* (NOSK.)	–	–	–	1	–	–	–	–	1	0.2
10.	*C. succinctus* (L.) [ab]	–	–	–	1	–	–	–	–	1	0.2
11.	*Andrena combinata* (CHRIST) [ab]	–	–	–	–	–	–	1	–	1	0.2
12.	*A. alfkenella* PERK.	–	–	–	–	–	–	2	–	2	0.4
13.	*A. subopaca* NYL.	2	–	–	–	2	2	–	–	6	1.3
14.	*A. fulvida* SCHCK. [a]	1	–	1	–	–	–	–	–	2	0.4
15.	*A. barbilabris* (K.)	–	–	–	–	–	2	–	–	2	0.4
16.	*A. fucata* (MÜLL.)	–	1	–	–	–	–	–	–	1	0.2
17.	*A. argentata* SM.	–	–	–	–	–	1	–	–	1	0.2
18.	*A. denticulata* (K.) [a]	1	–	–	–	–	–	–	–	1	0.2
19.	*A. haemorrhoa* (F.)	3	–	–	–	–	–	1	–	4	0.9
20.	*Panurgus calcaratus* (SCOP.)	–	–	–	1	2	–	1	–	4	0.9
21.	*Halictus maculatus* SM.	1	1	–	–	–	–	–	1	3	0.6
22.	*H. confusus perkinsi* BLÜ.	7	1	–	1	7	2	4	–	22	4.7
23.	*H. tumulorum* (L.)	1	–	–	–	2	–	2	–	5	1.1
24.	*H. rubicundus* (CHRIST)	2	–	–	–	–	–	–	–	2	0.4
25.	*Lasioglossum albipes* (F.)	37	15	4	3	1	13	3	–	76	16.3
26.	*L. sextrigatum* (SCHCK.)	8	11	4	21	1	1	5	–	51	10.9
27.	*L. quadrinotatulum* (SCHCK.)	1	–	–	–	1	–	–	–	2	0.4
28.	*L. morio* (F.)	2	1	–	1	–	–	1	–	5	1.1
29.	*L. aeratum* (K.) [a]	1	–	–	–	–	–	–	–	1	0.2
30.	*L. punctatissimum* (SCHCK.) [ab]	–	1	–	2	–	–	1	–	4	0.8
31.	*L. rufitarse* (ZETT.) [a]	–	–	1	–	–	–	–	–	1	0.2
32.	*L. tarsatum* (SCHCK.) [ab]	4	–	–	–	1	1	7	–	13	2.8
33.	*L. minutissimum* (K.) [a]	4	–	–	1	1	–	–	–	6	1.3
34.	*L. calceatum* (SCOP.)	27	4	2	3	1	–	2	1	40	8.6

No.	Species	Number of individuals in habitats									D [%]
		1	2	3	4	5	6	7	8	1–8	
35.	*L. lativentre* (SCHCK.)	1	–	–	–	–	–	–	–	1	0.2
36.	*L. semilucens* (ALFK.) [a]	1	–	–	–	–	–	3	–	4	0.8
37.	*L. leucozonium* (SCHRK.)	1	–	–	–	–	–	1	–	2	0.4
38.	*Sphecodes gibbus* (L.)	–	–	–	–	2	–	–	–	2	0.4
39.	*S. monilicornis* (K.)	2	–	–	–	–	–	–	–	2	0.4
40.	*S. geofrellus* (K.)	–	–	–	–	–	–	2	–	2	0.4
41.	*S. puncticeps* THOMS.	–	1	–	–	–	–	–	–	1	0.2
42.	*S. pellucidus* SM.	–	–	–	–	–	–	1	–	1	0.2
43.	*S. ferruginatus* HAG. [ab]	1	–	–	–	1	–	–	–	2	0.4
44.	*Macropis fulvipes* (F.)	–	–	–	–	1	–	–	–	1	0.2
45.	*M. europaea* WARN.	1	–	–	–	1	4	–	–	6	1.3
46.	*Dasypoda altercator* (HARR.)	–	–	–	2	–	–	2	–	4	0.9
47.	*Heriades truncorum* (L.)	1	4	1	1	–	–	–	–	7	1.5
48.	*Chelostoma maxillosum* (L.)	–	–	2	–	–	–	–	–	2	0.4
49.	*Hoplitis leucomelana* (K.)	–	–	–	–	–	–	3	–	3	0.6
50.	*Osmia confusa* MOR. [a]	–	–	–	1	–	–	–	–	1	0.2
51.	*Megachile centuncularis* (L.)	–	1	–	–	–	–	1	1	3	0.6
52.	*M. rotundata* (F.)	–	–	–	–	–	–	1	–	1	0.2
53.	*M. maritima* K.	–	–	–	–	–	–	1	–	1	0.2
54.	*M. willughbiella* (K.) [a]	–	1	–	–	–	–	–	–	1	0.2
55.	*M. ligniseca* (K.) [a]	1	4	4	1	–	–	–	–	10	2.1
56.	*M. alpicola* ALFK.	–	–	–	–	1	–	1	–	2	0.4
57.	*M. versicolor* SM.	–	–	–	–	–	–	1	–	1	0.2
58.	*Coelioxys elongata* LEP.	–	–	–	–	–	–	1	–	1	0.2
59.	*C. alata* FÖRST. [ab]	1	–	–	–	–	–	–	–	1	0.2
60.	*Nomada moeschleri* ALFK. [a]	1	–	–	–	–	–	–	–	1	0.2
61.	*N. ochrostoma* ZETT.	1	–	–	–	–	–	–	–	1	0.2
62.	*N. fuscicornis* (K.)	–	–	–	–	–	1	–	–	1	0.2
63.	*Epeoloides coecutiens* (F.)	–	1	–	–	–	–	–	–	1	0.2
64.	*Bombus pascuorum* (SCOP.)	9	–	–	–	5	1	3	1	19	4.1
65.	*B. lucorum* (L.)	8	–	1	–	1	1	11	–	22	4.7
66.	*B. hypnorum* (L.)	–	1	–	–	–	–	–	–	1	0.2
67.	*B. terrestris* (L.)	1	–	–	–	–	3	–	–	4	0.9
68.	*B. sylvarum* (L.)	–	–	–	–	–	–	2	–	2	0.4
69.	*B. hortorum* (L.)	1	–	–	–	–	–	–	–	1	0.2
70.	*B. pratorum* (L.)	–	–	–	–	–	–	1	–	1	0.2
71.	*B. ruderarius* (MÜLL.) [a]	1	–	–	–	–	–	1	–	2	0.4
72.	*B. lapidarius* (L.)	2	–	–	–	1	–	–	–	3	0.6
73.	*Psithyrus norvegicus* SP.–SCH. [ab]	2	–	–	–	–	1	–	–	3	0.6
74.	*P. bohemicus* (SEIDL) [ab]	1	1	–	–	–	–	–	–	2	0.4
75.	*P. rupestris* (F.)	2	–	–	–	1	–	–	–	3	0.6
76.	*P. campestris* (PZ.)	4	–	–	–	–	2	1	–	7	1.5
77.	*Apis mellifera* L.	3	–	–	–	–	–	3	2	8	1.7
	Total (N)	163	87	25	48	33	36	70	6	468	

The species of *Apoidea* in the studied habitats belonged to 8 zoogeographical elements (BANASZAK & ROMASENKO 2001, CELARY 1995, GOGALA 1999), of which the widely distributed: palearctic, european, eurosiberian and holarctic species accounted for 95%. The remaining – pontian, mediterranean, boreomontane and cosmopolitan elements – were represented only by single specimens (Fig. 1): *Hylaeus styriacus* FÖRST., *Hylaeus hyalinatus* SM., *Megachile alpicola* ALFK. and *Apis mellifera* L., respectively.

The highest number of individuals (Table I), more than 30% of all collected specimens, was found in the area of the Field Centre, the lowest (about 5%) in the moist meadow.

The proportion of dominance (*D*) varied from 0.2% to 16.3% (Table I). Those values were significantly higher than that (0.08–3.4%) found by BANASZAK & PLEWKA (1981).

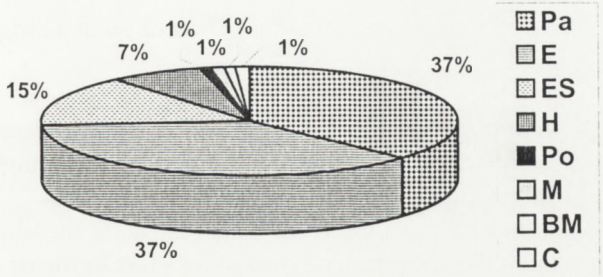

Fig. 1. Proportion of zoogeographical elements in fauna of *Apoidea* of studied habitats (Pa – Palearctic, E- European, ES- Euro-Siberian, H – Holarctic, Po – Pontian, M – Mediterranean, BM – Boreomontane, C – cosmopolitan)

The collected material was divided into three classes of dominance (BANASZAK & PLEWKA 1981): class I (less than 1%), class II (1–3%) and class III (more than 3%). Most of the species were rare in the studied habitats of abandoned village, and belonged to I class, 15 species were frequent and 7 were very frequent (Fig. 2: a). The studied *Apoidea* community was largely predominated by: *Lasioglossum albipes* (F.), *L. sextrigatum* (SCHCK.) and *L. calceatum* (SCOP.). *Hylaeus communis* NYL., *Halictus confusus perkinsi* BLÜ., *Bombus lucorum* (L.) and *B. pascuorum* (SCOP.) were also numerous. Altogether they covered more than 55% of all collected material (Fig. 2: b).

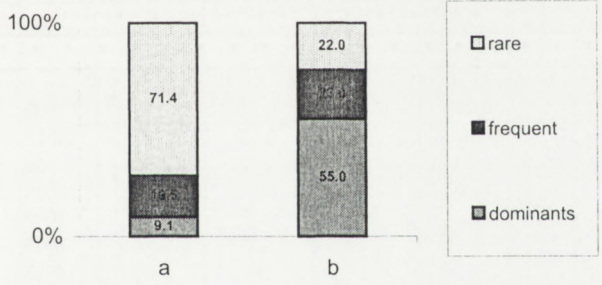

Fig. 2. The proportion of number of species (a) and abundance (b) of *Apoidea* in the studied habitats.

The dominant structure of studied *Apoidea* community differed from those of such community in the eastern part of Kampinos National Park (BANASZAK & PLEWKA 1981). In the diversified habitats studied by these authors, dominants were two species of genus *Lasioglossum* CURT. and *Hylaeus* F., but species belonged to *Bombus* LATR. were not numerous. The composition of most abundant species resembled rather those of Warsaw (BANASZAK 1982) were, besides the genus *Lasioglossum*, *Bombus* species were recorded in high numbers.

Taking into consideration a social status of dominant species group, all but *Hylaeus communis* represented social life, from high degree (like *Bombus*) to the lower level, like genus *Lasioglossum* (BANASZAK & PLEWKA 1981, GOGALA 1999).

Habitat preferences of the dominant species were differentiated and reflected habitat heterogeneity of the studied territory of the abandoned village. The species that represented *Halictidae* (*Lasioglossum albipes, L. sextrigatum, L. calceatum, Halictus confusus perkinsi*) prefer open and dry habitats, from grasslands or roadsides to sandy

dunes (PESENKO *et al.* 2000), then *Hylaeus communis*, *Bombus lucorum* and *B. pascuorum* are connected with forest's margins, clearings, glades and shrubs (BANASZAK 1993b).

With respect to the foodplant preferences *Apidae* are divided into tree categories (BANASZAK 1980, 1982, BANASZAK & PLEWKA 1981, GOGALA 1999):

1. polylectic/polyphages species, which collect pollen of many different plant species
2. oligolectic/oligophages, need the pollen of a single plant genus or even a single species
3. cleptoparasitic species.

All of the most abundant species were polylectic. Polyphages group also predominated in all collected material of studied habitats and accounted for 57%. Oligophages comprised 22%. Cleptoparasitic bees were represented by 16 species (21%).

The number of species at individual habitats ranged from 5 on the moist meadow to 44 on the area of the Field Centre (Table II). The similar types of habitats in the eastern part of Kampinos National Park were also characterised by BANASZAK & PLEWKA (1981) as visited by bees very rarely and very often, respectively. The rich habitats, on the studied area of abandoned village, as regarding the number of species, were also the xerothermic grassland with an admixture of synanthropic plants and the wooden stable near the Field Centre (31 and 23 species, respectively).

Table II. Qualitative comparisons of *Apoidea* in various habitats in the western part of Kampinos National Park (S – number of species; *MS* – Marczewski-Steinhaus's index, + – low similarity)

Parameter	Habitats							
	1	2	3	4	5	6	7	8
S	44	23	13	17	19	15	31	5
MS								
1	1.00	0.29	0.21	0.15	0.26	0.23	0.25	0.09
2	+	1.00	0.33	0.33	0.11	0.12	0.13	0.12
3	+	+	1.00	0.25	0.14	0.17	0.10	0.06
4	+	+	+	1.00	0.16	0.10	0.20	0.05
5	+	+	+	+	1.00	0.31	0.19	0.09
6	+	+	+	+	+	1.00	0.18	0.05
7	+	+	+	+	+	+	1.00	0.13
8	+	+	+	+	+	+	+	1.00

The calculated values of Marczewski-Steinhaus' index were low (0,05< MS <0,33) (Table II), what indicated that all studied habitats were considerably different in species composition and specifically attractive for bees. The highest values of MS index were found for Apoidea communities of habitat of the wooden stable compared with habitats of the old willows and the old wooden barn (sites 2 and 3, 2 and 4, MS = 0.33). The similarity in species composition was the lowest for the habitats: 8 and 4, 8 and 6 (MS = 0.05) and 8 and 3 (MS = 0.06).

The studied habitats of the abandoned village in the forest territory characterised the high number of bee species. On the small area, about 0.7 ha, 77 species of Apoidea were noted. It constituted 41% of local fauna (DOMAGAŁA-LIPIŃSKA 1961, BANASZAK &

PLEWKA 1981). The similarly high number of species was found by CIERZNIAK (1998) in suburbs near Wielkopolski National Park, on the comparable area (0.65 ha).

The number of species and diversity of bees is connected with habitat heterogeneity of studied former agriculture area. The positive correlation between the mosaic of anthropogenically modified and natural habitats, and number of species and specimens for communities of Apoidea was found also by BANASZAK (1993a), BANASZAK & PLEWKA (1981), CIERZNIAK (1998) and PAWLIKOWSKI (1989, 1991, 2000).

The present results will give the possibility of studying changes in attractiveness for bee fauna of the former agriculture area, during their development into the climax stage, that on the territory of Kampinos National Park is represented by *Pino-Qercetum* mixed forest (MICHALSKA-HEJDUK 1999). The renaturization process and, as an effect, afforestation of the described area will probably decrease, both the number and diversity of Apoidea (BANASZAK 1993a).

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STRESZCZENIE

[Tytuł: *Apoidea* (*Hymenoptera*) terenów porolnych w stanie renaturalizacji w Kampinoskim Parku Narodowym (Polska)]

Praca przedstawia dane na temat składu gatunkowego i struktury zespołu *Apoidea* opuszczonej wsi, w zachodniej części Kampinoskiego Parku Narodowego. Materiał zbierano wykorzystując metodę Moerickego, w latach 1998–1999. Odnotowano występowanie 77 gatunków *Apoidea*, w tym 21 nie podawanych dotychczas z terenu KPN i 11 z Niziny Mazowieckiej. W wyniku analizy rozsiedlenia poszczególnych gatunków wyróżniono 8 elementów zoogeograficznych, z których szeroko rozpowszechnione, palearktyczne, europejskie, eurosyberyjskie i holarktyczne, stanowiły około 95%. Najwyższą liczbę gatunków zanotowano na terenie Stacji Terenowej (zabudowania i towarzysząca im roślinność synantropijna) i na murawie kserotermicznej zarastanej roślinnością synantropijną, odpowiednio 44 i 31 gatunków, najniższą na podmokłej łące. Udział poszczególnych gatunków (*D*) w zebranym materiale wahał się w granicach 0.2% – 16.3%. Zdecydowana większość gatunków należała do I klasy dominacji (rzadkie), 15 do II klasy (częste) i 7 to gatunki liczne (III klasa dominacji). Wśród odnotowanych gatunków pszczół przeważały polifagi, stanowiące 57%. Oligofagi stanowiły 22%, kleptopasożyty 21% (16 gatunków). Niskie i średnie wartości współczynnika Marczewskiego-Steinhausa (0,05< *MS* <0,33) świadczą o dużym zróżnicowaniu gatunkowym i zindywidualizowanym charakterze jakościowym zgrupowań poszczególnych środowisk.