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ECOFAUNISTICAL INVESTIGATION OF SPHECOID FAUNA ON A SANDY GRASSLAND

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Abstract

9O digger wasp species are reported from Bugacpuszta (Kiskunság National Park). *Miscophus helveticus* KOHL and females of *Crossocerus acanthophorus* (KOHL) proved to be new to the fauna of Hungary.

Tachysphex psammobius (KOHL) and *Tachysphex pompiliformis* (PANZER) were dominant species in the area investigated. More than three-quarters of the species were rare (<1% of individuals caught). Species were grouped according to their zoogeographical distribution, ecofaunistical character and prey species. The results may indicate the true roles of these categories if grouping is performed by taking the ratios of the numbers of individuals into consideration.

Palaearctic and European species play an important role in the composition of digger wasp fauna. Evaluating ecofaunistical characters, eremophilous species were dominant.

More than half of the species prey upon *Diptera, Orthoptera, Araneidea* and *Sternorrhyncha*. The predation pressure employed by digger wasps is the largest for *Orthoptera, Araneidea* and *Cicadinea*. The composition of sphecid assemblage is probably regulated by the availability of suitable nest sites and parasitation, although prey availability can also be important.
Key words: Sphecoidea, check list, zoogeographical distribution, ecofaunistical caracter, predation

Introduction

The purpose of my study was to establish a detailed faunistical list of digger wasps of a semi-natural part of a sandy grassland. The grouping of the species according to the quantitative characters (zoogeographical distribution, ecofaunistical characters and prey groups) is a rather superficial, but generally applied method. However, it can provide a suitable basis for further community ecology studies. Since more up-to-date (e.g. dynamic) zoogeographical data are not known for sphecid wasps, traditional categories have been used.

Very few faunistical reports on digger wasps are known that are based on large number of individuals and deal with the relative frequencies of the species found (HAESELER, 1972). The present aim was to determine the ratio of the applied qualitative characters (weighted on the basis of the frequency of species), and to establish relative frequencies. Data gained in this way may point to the role of the given category in the given habitat.

Numerous papers are known on the nesting and preying behaviour of digger wasps. These usually report the prey spectrum of one particular species (CALLAN, 1976; MILLER and KURCZEWSKI, 1976); occasionally they indicate quantitative data on prey species (DANKS, 1971; KROMBEIN, 1970). A number of authors considered the prey composition by orders and analysed them at this level (EVANS, 1970; WESTRICH, 1979). Most of the sphecid species prey on one order and, in the case of the few exceptions, most of the prey species belong to one order (EVANS, 1970; MILLER and KURCZEWSKI, 1975). However, if considerable differences in size or life-strategy (e.g. *Cicadinea* and *Sternorrhyncha*) or that of developmental stage (e.g. *Lepidoptera* and *Hymenoptera*) can be found within orders, it may be necessary to do further subdivisions.

Materials and methods

The investigated area is situated in the eastern part of the Bócsa-Bugac region of the Kiskunság National Park in Hungary. It consists of sand dunes with a maximum height of 1—3 metres. Because of the long-term intensive pasturage, the main plant association on the grazing land is *Potentillo-Festucetum pseudovinae* with scattered patches of ruderal associations (e.g. *Brometum tectorum*) (names after SOÓ (1964)). In 1976 a 2.4 ha plot of the pasture was fenced in to eliminate the destructive effect of the grazing. In the course of the secondary successional process, a *Festucetum vaginatae danubiale* plant association developed on the top of the dunes, and a *Molinio-Salicetum rosmarinifoliae* can be found in the hollows. Extremely hot and dry weather is characteristic of this area in the annual activity period of digger wasps (KÖRMÖCZI et al., 1981).

Sixty pan traps were used to collect insects within the enclosed area from 1983 to 1985. Traps were plastic bowls (15 cm diameter, rim 6 cm) lowered 2 cm deep in the soil. They contained ethylene-glycol as killing agent and preservative. Traps were emptied fortnightly from May to November. In 1986, 48 pan traps (size:50x25x4 cm) were placed onto the enclosed area and its environs. These traps contained water and detergent (Tip 67). In the main activity period of the digger wasps, from June to August (JÓZAN, 1985), these traps were set up for three days every two weeks. Additional collecting was made by hand picking. Possible prey species were collected by 70 pitfall traps from April to November.

For identification, I used the keys by BALTHASAR (1972), PULAWSKI (1971), LOMHOLD (1975), BAJÁRI (1957), MÓCZÁR (1959) and BOHART and MENKE (1976). Publications by JÓZAN (1985) and BENEDEK (1970), were used for geographical distribution; JÓZAN (1985) and WESTRICH (1979) for ecofaunistical categorization; OLBERG (1959), BALTHASAR (1972) and BAJÁRI (1957) for prey species.

Results and Discussion

Total of 90 species were caught on the studied area between 1983 and 1986, many more than previously known from the Bócsa—Bugac region of the Kiskunság National Park (JÓZAN, 1986). Five species were caught by hand picking only (Table 1, species denoted by an exclamation mark); 85 species (2765 individuals) were found exclusively in pan traps (only these were included for quantitative analysis).

Miscophus helveticus KOHL proved to be new to the fauna of Hungary. Females of *Crossocerus acanthophorus* (KOHL) were caught in Hungary for the first time; JÓZAN (pers. comm.) collected males in Tihany. The most typical genera in this area were *Tachysphex*, *Oxybelus*, *Miscophus* and *Diodontus* respecting the number of species and individuals. It is worth noting the presence of the subendemic *Oxybelus dissectus elegans* MOCSÁRY.

Table 1. Number (N) and relative frequency (RF%) of sphecid species caught (+ = RF%<0.1; ! = caught by hands).

Species	N 1983—1985 pan trap A	RF% 1983—1985 pan trap A	N 1986 pan trap B	RF% 1986 pan trap B	N total	RF% total
Dolichurus						
— *corniculus* (SPINOLA) 1808	0	0	4	0.49	4	0.14
Podalonia						
— *luffi* (SAUNDERS) 1903	103	5.30	5	0.61	108	3.90
— *affinis* (KIRBY) 1798	8	0.41	0	0	8	0.29
Ammophila						
— *terminata mocsáryi* FRIDVALDSKY 1876	5	0.26	0	0	5	0.18
— *campestris* LATREILLE 1809	3	0.15	0	0	3	0.11
— *sabulosa* (LINNAEUS) 1758	9	0.46	0	0	9	0.32
Sceliphron						
— *destillatorium* (ILLIGER) 1807	0	0	2	+	2	+
Sphex						
— *rufocinctus* BRULLE 1833	34	1.75	4	0.49	38	1.37
Prionyx						
— *kirbyi* (VANDER LINDEN) 1827	5	0.26	1	0.12	6	0.22
Diodontus						
— *minutus* (FABRICIUS) 1793	37	1.90	128	15.57	165	5.97
— *insidiosus* SPOONER 1938	26	1.34	32	3.89	58	2.10
— *major* KOHL 1901	0	0	1	+	1	+
Psenulus						
— *pallipes* (PANZER) 1798	0	0	2	+	2	+
Passaloecus						
— *gracilis* (CURTIS) 1834 !						
Mimesa						
— *caucasica* MAIDL 1914	1	+	0	0	1	+
Pemphredon						
— *inornatus* SAY 1824 !						
— *rugifer* DAHLBOM 1844	0	0	1	+	1	+
— *lugubris* (FABRICIUS) 1793 !	0	0	1	+	1	+
Astata						
— *rufipes* MOCSARY 1883	1	+	1	+	2	+
— *kashmirensis* NURSE 1909	1	0.05	7	0.58	8	0.30
— *minor* KOHL 1885	2	+	0	0	2	+
— *boops* (SCHRANK) 1781	1	+	0	0	1	+
— *costae* A.COSTA 1867	0	0	1	+	1	+
Dryudella						
— *tricolor* (VANDER LINDEN) 1829	64	3.29	21	2.55	85	3.07
Dinetus						
— *pictus* (FABRICIUS) 1793	6	0.31	0	0	6	0.22
Tachytes						
— *europaeus* KOHL 1884	92	4.74	10	1.22	102	3.70
— *etruscus* (ROSSI) 1790	2	+	0	0	2	+
— *obsoletus* (ROSSI) 1792	3	0.15	3	0.37	6	0.22
Tachysphex						
— *fulvitarsis* (COSTA) 1867	31	1.60	10	1.22	41	1.48

— *grandii* BEAUMONT 1965	21	1.08	2	0.24	23	0.83
— *helveticus* KOHL 1885	33	1.70	19	2.31	52	1.88
— *nitidus* (SPINOLA) 1805	14	0.72	1	0.12	15	0.54
— *pompiliformis* (PANZER) 1804	293	15.08	73	8.88	366	13.24
— *psammobius* (KOHL) 1880	391	20.12	1	0.12	392	14.18
— *panzeri* (VANDER LINDEN) 1829	2	0.10	1	0.12	3	0.11
— *obscuripennis* (SCHENCK) 1857	123	6.33	26	3.16	149	5.39
Palarus						
— *variegatus* (FABRICIUS) 1781	3	0.15	0	0	3	0.11
Larra						
— *anathema* (ROSSI) 1790	1	+	0	0	1	+
Nitela						
— *fallax* KOHL 1884	0	0	1	+	1	+
Solierella						
— *compedita* (PICCOLI) 1869	8	0.41	3	0.37	11	0.40
Miscophus						
— *bicolor* JURINE 1807	18	0.93	7	0.85	25	0.90
— *concolor* DAHLBOM 1844	12	0.62	6	0.73	18	0.65
— *spurius* (DAHLBOM) 1832	106	5.46	37	4.50	143	5.17
— *helveticus* KOHL 1883	0	0	3	0.36	3	0.11
Trypoxylon						
— *scutatum* CHEVRIER 1867	8	8.41	164	19.95	172	6.22
— *attenuatum* F.SMITH 1851	1	0.05	3	0.37	4	0.14
— *clavicerum* LEP. & SERV. 1828 !						
— *fronticorne* GUSSAKASKIJ 1936	1	0.05	2	0.24	3	0.11
Oxybelus						
— *latro* OLIVIER 1811	5	0.26	1	0.12	6	0.22
— *bipunctatus* OLIVIER 1811	3	0.15	2	0.24	5	0.18
— *dissectus elegans* MOCSÁRY 1879	2	+	0	0	2	+
— *quattuordecimnotatus* JURINE 1807	50	2.57	36	4.38	86	3.11
— *victor* LEPELETIER 1845	65	3.35	10	1.22	75	2.71
— *variegatus* WESMAEL 1852	6	0.31	0	0	6	0.22
— *latidens* GERSTAECKER 1867	1	+	0	+	1	+
— *aurantiacus* MOCSÁRY 1883	1	0.05	2	0.24	3	0.11
— *argentatus gerstaeckeri* P.VERH. 1948	1	+	0	+	1	+
Entomognatus						
— *brevis* (VANDER LINDEN) 1829	1	+	0	0	1	+
Crossocerus						
— *quadrimaculatus* (FABRICIUS) 1793 !						
— *acanthophorus* (KOHL) 1892	0	0	1	+	1	+
Lestica						
— *alata* (PANZER) 1797	5	0.26	0	0	5	0.18
Lindenius						
— *panzeri* (VANDER LINDEN) 1829	1	+	1	+	2	+
— *albilabris* (FABRICIUS) 1793	1	+	0	0	1	+
Crabro						
— *peltarius* (SCHREBER) 1784	2	+	0	0	2	+
Ectemnius						
— *confinis* (WALKER) 1871	1	+	0	0	1	+
— *cavifrons* (THOMSON) 1870	2	+	0	0	2	+
— *lituratus* (PANZER) 1804	1	+	0	0	1	+
— *continuus* (FABRICIUS) 1804	0	0	1	+	1	+

Mellinus						
— *arvensis* (LINNAEUS) 1758	10	0.52	0	0	10	0.36
Alysson						
— *spinosus* (PANZER) 1801	5	0.26	23	2.80	28	1.01
Brachystegus						
— *scalaris* (ILLIGER) 1807	1	+	0	0	1	+
Nysson						
— *dimidiatus* JURINE 1807	55	2.83	1	0.12	56	2.03
— *maculosus* (GMELIN) 1790	25	1.29	1	0.12	26	0.94
— *roubali* ZAVADIL 1937	7	0.36	0	0	7	0.25
— *tridens* GERSTAECKER 1867	3	0.15	0	0	3	0.11
— *niger* CHEVRIER 1868	1	+	0	0	1	+
Dineoplus						
— *laevis* (LATREILLE) 1792	3	0.15	1	0.12	4	0.14
— *elegans* (LEPELETIER) 1832	12	0.62	2	0.24	14	0.51
— *moravicus* (SNOFLAK) 1946	44	2.26	21	2.55	65	2.35
Gorytes						
— *albidulus* (LEPELETIER) 1832	1	+	0	0	1	+
— *sulcifrons* (A. COSTA) 1869	3	0.15	0	0	3	0.11
Bembecinus						
— *tridens* (FABRICIUS) 1781	128	6.59	130	15.8	258	9.33
Bembix						
— *megerlei* DAHLBOM 1845	3	0.15	0	0	3	0.11
— *rostrata* (LINNAEUS) 1758	1	+	0	0	1	+
Philanthus						
— *triangulum* (FABRICIUS) 1775	7	0.36	0	0	7	0.25
Cerceris						
— *arenaria* (LINNAEUS) 1758	4	0.21	1	0.12	5	0.18
— *albofasciata* (ROSSI) 1790	10	0.51	6	0.73	16	0.58
— *rybyensis* (LINNAEUS) 1771	1	+	0	0	1	+
— *sabulosa* (PANZER) 1799	1	+	0	0	1	+
— *flavilabris* (FABRICIUS) 1793	1	+	0	0	1	+

Tachysphex psammobius (KOHL) and *Tachysphex pompiliformis* (PANZER) were the dominant species (Table 1). Relative frequencies (RF%) of both species were above 10% (pooled data). *Tachysphex obscuripennis* (SCHENK), *Diodontus minutus* (FABRICIUS), *Trypoxylon scutatum* CHEVRIER, *Miscophus spurius* (DAHLBOM) and *Bembecinus tridens* (FABRICIUS) were also common species. More than the three-quarters of the species (66 from 85) were rare (RF⟨1 %); supposedly, they have little ecological importance.

Differences in the result were caused not only by the differences in methods but probably by the large fluctuation of sphecid populations, too. A possible cause of this phenomenon may be parasitization (EVANS, 1970).

One-quarter of the species (25.5%) was Palaearctic (Fig. 1/a). The frequencies of the European, Ponto- and Holomediterranean species were lower, but noteworthy.The weighting of zoogeographical categories on the basis of specimen number altered the ratios of Palaearctic and various Mediterranean categories to small extents, but the value for the European group increased by more than 150%

(Fig. 1/b). The values for the Holarctic and Central European groups decreased nearly to zero. This indicated that the importance of these categories with low numbers of species and individuals was negligible.

The significance of Mediterranean species is usually emphasized when evaluating the composition of sphecid fauna of the Kiskunság National Park, and particularly at Bugac (JÓZAN, 1986). Though their pooled frequency was considerable (36.5%, the weighted value is 35.7%), the Palaearctic and European species were more important when the number of individuals caught were considered.

The distribution of the species according to the ecofaunistical characters may reflects the quality and the environmental conditions of the habitat; this gives a method for habitat comparisons (WESTRICH, 1979; JÓZAN, 1986). Nearly the three-quarters (72,1%) of the total number of species were eremophilous, and the ratio of stenoecious-eremophilous species was high (Fig. 2/a). Only a few hylophilous, and no stenoecious hylophilous species were found. Weighting (based on the number of individuals caught) reduced the participation of hylophilous species almost to zero and increased the proportion of eurioecious eremophils (Fig. 2/b). It indicated that the area studied was suitable habitat for thermophilous species. Supposedly hylo-

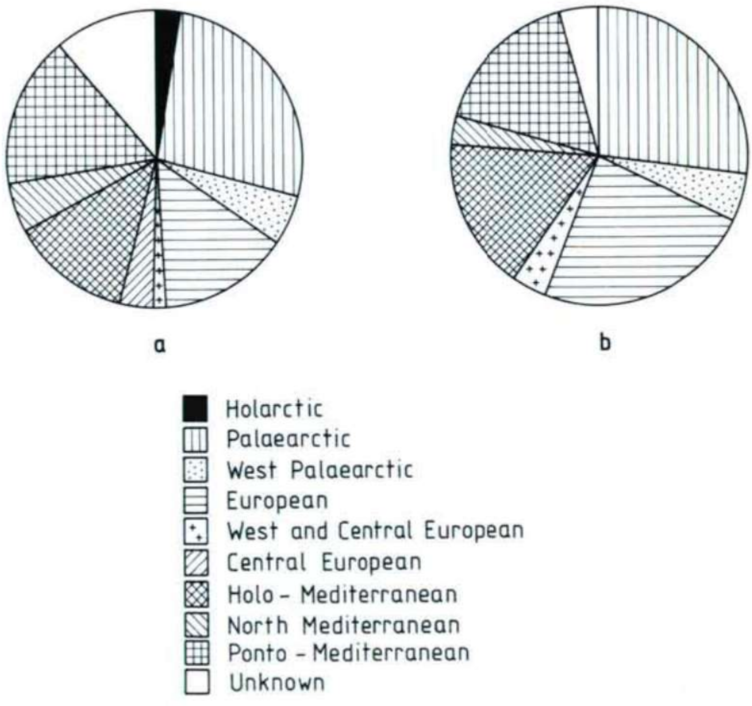

Fig. 1: Distribution of Sphecid assamblage according to zoogeographical distribution:
a: all species,
b: weighted on basis of relative frequency of sphecid species found in traps

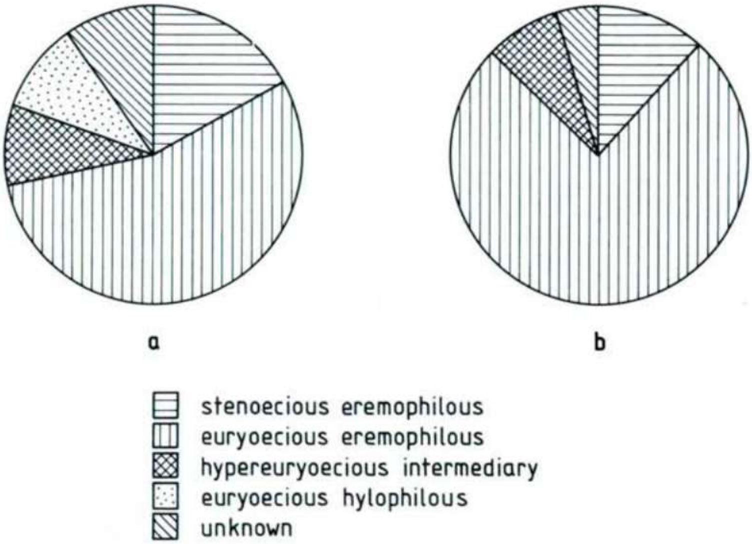

Fig. 1: Distribution of Sphecid assamblage according to ecofaunistical character:
a: all species,
b: weighted on basis of relative frequency of sphecid species found in traps

philous species may try to colonize, but the numbers and sizes of vegetation patches with a favourable microclimate (e.g. a *Molinio-Salicetum rosmarinifoliae* plant association) are too small. Accordingly, stable assemblages which are characteristic of this type of habitat, can not develop (KARSAI, 1988).

More than the half of the species prey upon four groups (*Diptera, Orthoptera, Araneidea* and *Sternorrhyncha*) and these seem to be the most important prey-groups. Participation of prey groups counted on the basis of the number of individuals of every single wasp species reflect the predation pressure of digger wasps on certain prey groups. In the course of this evaluating process, the predation pressure values for Hymenoptera larvae and adults, and for *Coleoptera* and *Lepidoptera* adults was negligible (Fig. 3/b). The predation pressure on *Orthoptera* was very high; that on *Cicadinea* and *Araneidea* was also considerable. The relevance of this effect is reasonable if we consider the high fecundity and high efficiency of preying (about 100 prey/wasp) (EVANS, 1970; DANKS, 1971). The values of predation pressure in case of *Diptera* and *Sternorrhyncha* decreased strongly. This relates to the fact, that in spite of great number of sphecid species preying upon these group, the pooled number of wasp individuals is low. (Fig. 3/a).

Sternorrhyncha comprises the majority of the all insects caught with pitfall traps (possible prey species) (Fig. 3/c). They probably represent large oversupply for wasps (EVANS, 1970) and as the wasps which prey on this group are not very common, they are not limited by the quantity of their prey. *Hymenoptera* also constituted a considerable part of prey species, but most of them were small-sized

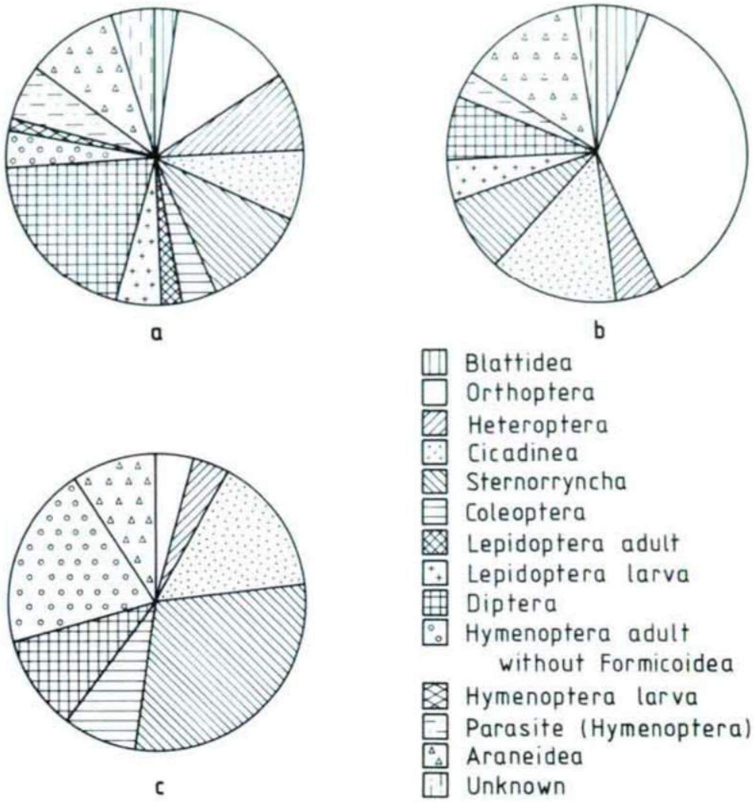

Fig. 1: Distribution of Sphecid assamblage according to prey species:
a: all species,
b: weighted on basis of relative frequency of sphecid species found in traps
c: distribution of possible prey species (caught in pitfall traps)

chalcid wasps, which were not preyed by digger wasps. The proportion of *Diptera* and *Cicadinea* from the potential prey species caught are nearly consistent with the level of predation pressure. In case of *Araneidae* this value is lower than that of predation pressure, but pitfall traps underestimate the abundance of web spider (MERETT and SNAZELL, 1983) and *Orthoptera* (SZŐNYI and KINCSEK, 1986). This, and the fact that Orthopteras are abundant only on the pasture was responsible for the same type of deviation is case of *Orthoptera*.

The composition of digger wasp assemblage is probably regulated by the availability of suitable nest sites (DANKS, 1971; KROMBEIN, 1967) and parasitization (EVANS et al., 1980; JACOB—REMACLE, 1986; PECKHAM, 1977; WCISLO et al., 1985), although prey availability can also be important.

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