

## BIOGEOGRAPHIC, ECOFAUNISTIC AND FLIGHT-DYNAMIC COMPOSITION OF THE APOIDEA FAUNA AT THE TISZA-VALLEY

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### Abstract

During the ten-years studies almost half of the *Apoidea* fauna of the Carpathian basin, a total of 293 species were registered at the Hungarian section of the river Tisza. In scientific respect the *Melitta moczari* TANÁCS, 1985 is a new species. The *Halictus aegyptiacus* FRIESE, 1916; *Lasioglossum opacum* PEREZ, 1895; *Sphecodes ruficornis* SICHEL, 1836; *Sphecodes rufiventris* (PANZER, 1798) are new species in the Hungarian fauna. According to zoogeographical estimation the Palaearctic as well as the European species were the most significant. The ratio of the Northern Mediterranean, Holomediterranean, Ponto-Mediterranean and Central European species is considerable.

As to the distribution of the species according to climatic tolerance, the euryoecic eremophilous species have the highest ratio. Based on flight-dynamic estimation the most significant communities were formed by the species with medium flying period.

### Introduction

The agricultural development, the concomitant agrotechnique, the use of weedicides were inevitably accompanied by decreasing the food sources, the decrease in the density and species number of the wildbee populations (BENEDEK, 1968b; BANASZAK, 1978). In the course of the past three decades there has been an increase in the significance of studies at areas approaching the natural conditions as well as in the importance of their preservation from chemicals (BANASZAK, 1980). The areas suitable for studies were the dam-system and the flood-plain of the river Tisza, as well as the back area in the vicinity of the safe side, exempt from agriculture. These areas are not treated with pesticides, except for the periodical protection against mosquitos at the holiday resorts along the river Tisza. The majority of the areas are free from continuous human interventions, thus their primary production is almost undisturbed aside from the periodical reaping at the dam sides and flood-plain meadows.

The apidological studies published so far do not comprise an overall, objective analysing method for the judgement of the spread of wildbees. In many cases divergent interpretations exist in respect to the circumscription of the different zoogeographical units. Regarding the diurnal butterflies VARGA (1977) specified an

objective area analytical method. Unfortunately, in case of wildbees, the application of the method is made difficult by the varying degrees of investigation at the different areas, as well as by the contradictions found in the literature. Therefore, the collected wildbees were analysed by the author with the descriptive method, based on the given literary data.

In the Hungarian literature on hymenoptera the zoogeographical spread of the *Hylaeus* species occurring in the Carpathian basin was referred to in detail by M. MÓCZÁR (1960). In case of the species belonging to the *Andrenidae* family, data on such concern are provided by STÖCKERT (1930, 1935, 1942); OSYCHNIUK — PANFILOV — PONOMARJEVA (1978). The latter study also refers to the spread of the *Melittidae* family. As to the *Halictus* and *Lasioglossum* genera, important informative data are given on the zoogeographical spread of the species in the revisory works of EBMER (1969 — 1971).

M. MÓCZÁR (1958) reported on the zoogeographical spread of the species of the *Megachilidae* family. The *Megachilidae* revisory publications from the past two decades — with reference to the zoogeographical spread of the species — are firstly attached to the names of PASTEELS (1965), TKALCU (1967, 1970, 1974a, 1974b, 1974c, 1975), REBMANN (1968) and WARNCKE (1980).

Data on the spread of the *Bombus*, *Megabombus*, *Pyrobombus* and *Psithyrus* species have been reported by MÓCZÁR (1953, 1957), REINIG (1976), DELMAS (1976), RASMONT (1983), ÖSBEK (1983). According to the recent taxonomical literary data we are to distinguish the *Anthrophorodae* family. The zoogeographical spread of the species was reported by M. MÓCZÁR (1954, 1957), in case of the species of the *Tetralonia* genus this entry was referred to by TKALCU (1979), and by WARNCKE (1981, 1982) concerning the parasitic wildbees belonging to the *Anthophoridae* family.

The work of PITTIONI and SCHMIDT (1942) deals with the spread and distribution of the *Hymenoptera* with the consideration of environmental, relief relations. In their hymenopterological works, MÓCZÁR (1948) and POSNER (1952) frequently classified the species according to ecological viewpoints. Among the environmental conditions of the wildbee species — apart from the possibilities of feeding and nesting — the climatic factors are of the greatest significance. In case of the wildbees, the author has adapted the conclusions made on several species from the work of PITTIONI and SCHMIDT (1942), but many species were reconsidered, or the unclassified ones arranged into groups. In classifying the species according to climatic tolerance, besides the classic publications, the author made use of his own experiences gained throughout almost one and a half decades (TANÁCS, 1981, 1982; TANÁCS and JÓZAN, 1985), based on his recordings related to the habitat character and climatic tolerance of the species.

In the Hungarian hymenopterological literature the classification of the wildbees according to flight-dynamic principles — concerning the economically appreciable pollinating populations — was published by BENEDEK (1968a, 1968b). In the course of the classification, apart from the author's own observations, other literary data referring to information on phenology and bionomy were also made

use of. According to the reports of KOCOUREK (1966), L. MÓCZÁR and WARNCKE (1972), one part of the *Andrena* species is of medium flying period. In case of the *Halictus* and *Lasioglossum* species the works of M. MÓCZÁR (1967) and EBMER (1969—1971) contain important data on flying period. The publication of L. MÓCZÁR and SCHWARZ (1968) comprises data on the flight-dynamics of the species belonging to the *Nomada*, *Ammobates* and *Paramobatodes* genera of the Carpathian basin. It is apparent from the literature that the different groups also represent a biologically uniform group the flying period of which becomes shorter in general towards Northern direction.

We aimed to determine the composition of the wildbee communities occurring at the studied area, according to zoogeographical spread, climatic tolerance and flight-dynamic distribution.

### Material and method

The sampling sites were the grass-communities of the flood-plain and dam-sides between Tiszaziget (165 rkm) and Tarpa (712 rkm) at the Hungarian section of the river Tisza. According to the volumes published under the editorship of J. KAKAS (1960, 1967), author divided the dam-system of the river Tisza into three sections on the basis of the differences in climatic factors. Accordingly, the three reaches were the Lower-Tisza (between Tiszaziget — Tizzaszölös), the Middle-Tisza (between Kisköre — Tiszafüred) and the Upper-Tisza (between Tokaj — Tarpa).

The plant communities of the studied areas were defined by BODROGKÖZY (1965, 1966). During the sampling wildbees were collected from the following plant-associations:

- a) *Agrostio-Alopecuretum pratensis* SOÓ (1933) 1947 *poetosum angustifoliae* BODRG. 1962.
- b) *Cynodonto-Poetum-angustifoliae* (RAPAICS, 1926) SOÓ 1957 *alopecuretosum* BODRG. 1966
- c) *Cynodonto-Poetum-angustifoliae* (RAPAICS, 1926) SOÓ 1957 *lepidetosum drabae* BODRG. 1966.
- d) *Cynodonto-Poetum-angustifoliae* (RAPAICS, 1926) SOÓ 1957 *medicaginetosum rigidulae* BODRG. 1966.
- e) *Sclerochloo-Polygonetum avicularis* (GAMS, 1927) SOÓ 1940.
- f) *Glycerietum maximae* HUECK, 1931.
- g) *Poligono-Bolboschoenetum oeanthetosum* BODRG. 1965.
- h) *Salicetum albae-fragilis* ISSLER, 1926. (flower level and grass level)
- i) *Alopecuretum pratensis* (NOWINSKI, 1918)
- j) *Caricetum gracilis* (GRABNER et HUECK, 1931) Tx. 1937.

The wildbees were collected in single from the sampling sites, using butterfly net. The collections lasted for one hour per study site.

The number of collecting days at the three dam-sections was 203 during a period of 10 years, the number of collected and appreciated wildbees was 10016 individuals.

### Results and discussion

The data of the species regarding zoogeographical spread, climatic tolerance, flight-dynamics are given in the author's Dissertation for Candidate Degree (TANÁCS, 1986).

*Table 1.* Distribution of the species at the dam-system and flood-plains of the river Tisza, according to zoogeographical spread

Types according to zoogeographical spread	reaches							
	Along the Lower-Tisza		Along the Middle-Tisza		Along the Upper-Tisza		Along the Tisza river	
	species	%	species	%	species	%	species	%
Holarctic	3	1.31	2	0.94	3	2.34	3	1.02
Palaearctic	48	20.96	47	22.17	37	28.92	57	19.45
Euro-Asian	1	0.44	—	—	1	0.78	2	0.68
Euro-Siberian	9	3.93	6	2.83	3	2.34	12	4.10
Euro-Turanian	1	0.44	1	0.47	2	1.56	2	0.68
Western Palaearctic	9	3.93	10	4.72	6	4.69	13	4.44
European	28	12.23	24	11.32	17	13.29	33	11.26
Holomediterranean	29	12.66	25	11.79	13	10.16	39	13.36
Northern Mediterranean	37	16.16	35	16.51	16	12.50	49	16.72
Ponto-Mediterranean	15	6.55	16	7.55	10	7.81	21	7.17
Ponto-Caspian-mediterranean	5	2.18	6	2.83	2	1.56	6	2.05
Ponto-Caspian	2	0.87	1	0.47	1	0.78	2	0.68
Pontic	6	2.62	6	2.83	3	2.34	8	2.73
Sarmatian	—	—	1	0.47	—	—	1	0.34
Atlantic	5	2.18	1	0.47	1	0.78	5	1.71
Central European	13	5.68	12	5.66	6	4.69	14	4.78
Northern and Central European	6	2.62	6	2.83	3	2.34	7	2.39
Endemic	3	1.31	2	0.94	1	0.78	3	1.02
Unappreciated	9	3.93	11	5.19	3	2.34	16	5.46
Total	229	100.00	212	100.00	128	100.00	293	100.00

Table 2. Distribution of the species at the dam-system and flood-plains of the river Tisza, according to climatic tolerance

Types according to climatic tolerance	reaches							
	Along the Lower-Tisza		Along the Middle-Tisza		Along the Upper-Tisza		Along the Tisza river	
	species	%	species	%	species	%	species	%
stenoecic eremophilous	32	13.97	30	14.15	13	10.16	39	13.31
euryoecic eremophilous	94	41.05	86	40.57	52	40.63	122	41.64
hypereuryoecic intermediary	55	24.02	50	23.58	42	32.81	69	23.55
euryoecic hylophilous	37	16.16	35	16.51	19	14.84	46	15.70
stenoecic hylophilous	9n 2	0.87	1	0.47	—	—	3	1.02
unappreciated	9	3.93	10	4.72	2	1.56	14	4.78
Total	229	100.00	212	100.00	128	100.00	293	100.00

## 1. APPRECIATION OF THE WILDBEE COMMUNITY ACCORDING TO ZOOGEOGRAPHICAL DISTRIBUTION

A total of 293 bee species were found at the dams and flood-plains of the river Tisza. The Palaearctic and the European species were the most significant fauna elements. Among the Mediterranean distribution types the Northern Mediterranean, Ponto-Mediterranean and Holomediterranean; from the European types the central European species had significant ratios (Table 1).

## 2. APPRECIATION OF THE WILDBEE COMMUNITY ACCORDING TO CLIMATIC TOLERANCE

At the sampling sites the majority of the community was formed by the euryoecic eremophilous species being fond of heat and showing wider ecological valency. The ratio of the hypereuryoecic intermediary species was considerable (Table 2). Owing to the character of the biotopes, the data unambiguously evidenced the eremophilous species that are fond of heat form the majority of the community at all three reaches. The distribution of the euryoecic hylophilous species within the wildbee community was found to be relatively negligible according to reaches.

Table 3. Distribution of the species at the dam-system and flood-plains of the river Tisza, according to flight dynamics

Types according to flight dynamics	reaches							
	Along the Lower-Tisza		Along the Middle-Tisza		Along the Upper-Tisza		Along the Tisza river	
	species	%	species	%	species	%	species	%
species with short flying period	48	20.96	41	19.34	23	17.97	56	19.11
species with medium flying period	81	35.37	72	33.96	42	32.81	109	37.20
species with continuous and long flying period	24	10.48	24	11.32	20	15.63	28	9.56
bivoltine species with long flying period	64	27.95	63	29.72	39	30.46	84	28.67
unappreciated	12	5.24	12	5.66	4	3.13	16	5.46
Total	229	100.00	212	100.00	128	100.00	128	100.00

### 3. FLIGHT-DYNAMIC APPRECIATION OF THE WILDBEE COMMUNITY

The majority of the community at the sampling sites along the river Tisza was formed by the species with medium flying period. The ratio of the bivoltine species with long flying period was also considerable. The species with short flying period formed about only 1/5 of the community. The wildbee species with continuous and long flying period were found to be the fewest in number within the community (Table 3).

At the studied area, in North-Eastern direction, the number of Mediterranean species showed a decrease, while an increase was detectable in the ratio of the Palaearctic and Ponto-Mediterranean species (Table 1). Summarizing the results, a phenomenon similar to that of experienced by BÁBA (1982) for snails is observable. The continentality of the species is greater towards North-eastern direction. Upon comparing the results with those obtained from studies performed at the Kiskunság National Park (KNP) (TANÁCS and JÓZAN, 1985), one finds the geographical distribution of the species according to types to be of similar ratios.

There are no fossil material available to be able to prove the distribution of the species (GRÜN WALDT, 1977; EBMER, 1969). The processing of the *Andrena* recens material, forming a significant group of the *Apoideas*, refers to the fact that a large part of the species occurs at the moderately dry, warm, wooded, steppe areas, under optimal living conditions, mainly at the Carpathian basin, in Southern-, South-eastern Europe (GRÜN WALDT, 1977; OSYCHNIUK, 1977). The majority of the species migrated to the area after the glacials, partly from western, but mostly from

the eastern neighbouring refuge areas. Besides the *Andrena* species, those of other genera — like the Eucerinae and Tetraloniae — are also the fauna elements originating from the near South-east (M. MÓCZÁR, 1957). Based on the afore-mentioned references it can be assumed that the species of the Carpathian basin of Continental and Southern origin firstly migrated to the area through the East- and South-Carpathian river valleys during the course of the historical times. It seems the primary condition at the time of the Apoidea migration was the favourable climate as well as the continuity of the foster plants.

In respect to the distribution according to climatic tolerance, the different types show a ratio similar to that of observed by the author at the KNP (TANÁCS and JÓZAN, 1985). An essential difference between the types is that the ratio of the stenoecic eremophilous species is 4,75% lower at the Tisza-valley than at the KNP, which can be explained by the lower ratio of mainly the Mediterranean, Ponto-Caspian-Mediterranean and Pontic fauna elements.

The euryoecic eremophilous species that are fond of heat and with wider ecological valency have a ratio similar to that of determined by the author at the area of the KNP.

Appreciating the value within community of the species that are fond of heat at the KNP at the Great Hungarian Plain, at the Tisza-valley and the Hortobágy National Park (HNP), it could be concluded that the highest (60,32%) was found at the KNP (TANÁCS and JÓZAN, 1985) and the lowest (39,2%) at the area of the HNP (TANÁCS, 1981).

Regarding the type of casual spread, this value is 45,6% at the area of the HNP, 23,55% at the Tisza-valley, and only 21,61% at the KNP. The results of the systematic studies carried out at the Lowlands prove that even besides the heterogeneous nature of the sampling sites, the most important community-forming elements are the Southern, South-eastern ones being fond of heat, and mainly the Continental ones having wider ecological valency.

During the flying period the monthly average temperature is 2—3 °C lower at the environs of the Upper-Tisza than along the Lower-Tisza reach. At the Tisza-valley, the ratio within community of the species with short as well as medium flying periods shows a continuous decrease towards North-east, according to sampling sections, while an increase is manifest in regard to the bivoltine species and those with continuous and long flying period. This can be explained by the fact that the species with short as well as those with medium flying period are mostly fond of heat, while the bivoltine species and those with continuous and long flying period firstly belong to the type of casual spread.

As to the appreciation of the flight-dynamic types, similar ratios were gained for the Tisza-valley and the KNP (TANÁCS and JÓZAN, 1985). At the HNP the species with short and medium flying periods manifest a lower ratio within community (TANÁCS, 1981). This can partly be explained by the smaller number of species originating from the South. Such are mainly the species with short as well as medium flying periods.

Upon the appreciation of the fauna, summarizing the results it could be concluded that tight relationship may exist between the zoogeographical spread, climatic tolerance as well as flying period; the mathematic estimation of which is an important task of the future.

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