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Changes in lucerne pollinating wild bee assemblages in Hungary from the pre-pesticide era to 2007

With 4 tables

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Summary

As a result of five national surveys in Hungary from the pre-pesticide era up to recent years (1954-1956, 1967-1968, 1971-1972, 1998-2002, 2003-2007), rich wild bee assemblages were recorded at flowering lucerne fields. 196 bee species were detected, including the honey bee. Comparing the structure of wild bee assemblages visiting flowering lucerne fields in Hungary, it can be concluded that their species composition changed considerably in this period of rather more than fifty years. First, a dramatic decline of *Eucera* and *Tetralonia* species of medium flight periods was detected from the pre-pesticide era (1954-1956) up to the pesticide era in Hungary (1967-1968). This situation remained unchanged up to the present time. The main reason for this is the more widespread use of herbicides on arable land, as well as mechanical weed control becoming a regular practice along roadsides, ditches and in fields of cultivated crops. The decline of non-cultivated ruderal plots in cultivated crop fields and nearly-natural areas at the expense of more intense agricultural land use are also responsible for the considerable changes in the composition of wild bee assemblages. At the same time, the ratio of some mid summer wild bee species of short flight period increased considerably (*Melitta leporina* (Pz.), *Rhophitoides canus* Ev.) from the fifties up to the late sixties, because the acreage of lucerne production increased in this period and the size of individual lucerne fields was greatly enlarged, providing greater pollen resources and nesting possibilities for these specialist bees. This tendency, however, reversed in the past decade because lucerne production greatly decreased as a result of a greatly reduced demand for fodder legumes in Hungary. In recent years a new trend seems to have arisen, with a rapid increase in the dominance of bumble bees (*Bombus* species) and accompanying reduction in abundance of other groups of wild bee.

Zusammenfassung

Als Ergebnis von fünf landesweiten Erhebungen seit der Zeit vor der Pestizid-Ära bis in die Gegenwart (1954-1956, 1967-1968, 1971-1972, 1998-2002, 2003-2007) wurden artenreiche Wildbienenzönosen an blühenden Luzernefeldern ermittelt. 196 Bienenarten, einschließlich der Honigbiene, wurden nachgewiesen. Aus dem Vergleich der Artenspektren der Blütenbesucher kann geschlossen werden, dass sich die Wildbienenzönosen in diesem Zeitabschnitt von etwas mehr als fünfzig Jahren deutlich verändert haben. Zunächst wurde ein dramatischer Rückgang von *Eucera*- und *Tetralonia*-Arten mit mittellanger Flugperiode zwischen der Zeit vor der Pestizid-Ära (1954-1956) bis in die Pestizid-Ära in Ungarn (1967-1968) festgestellt. Dieser Zustand blieb bis zur heutigen Zeit unverändert. Die Hauptursachen für diese Entwicklung sind der verstärkte Einsatz von Pestiziden auf Kulturböden sowie das Aufkommen einer regelmäßigen mechanischen Unkrautbekämpfung entlang von Straßen, Gräben und auf Kulturflächen. Ferner ist der Rückgang unkultivierter Flächen in Feldern und naturnahen Gebieten zugunsten einer intensiveren Agrarlandnutzung eine weitere Ursache für die bedeutende Veränderung in den Wildbienenzönosen. Gleichzeitig ist der Anteil von Hochsommer-Wildbienenarten mit kurzer Flugperiode (*Melitta leporina* (Pz.), *Rhophitoides canus* Ev.) während der 50er bis späten 60er Jahren beträchtlich größer geworden, weil sowohl die Anbaufläche für Luzerne als auch die Schlaggröße der Luzerne-Felder erheblich vergrößert worden waren. Dadurch wurden

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die Pollen-Ressourcen und Nistmöglichkeiten für diese spezialisierten Bienen vermehrt. Jedoch kehrt sich diese Tendenz im letzten Jahrzehnt um, weil die Nachfrage nach Futter-Leguminosen stark nachließ. In den letzten Jahren scheint sich ein neuer Trend entwickelt zu haben: die Dominanz von Hummeln (*Bombus*-Arten) hat stark zugenommen, die Abundanz von anderen Wildbienengruppen hat dagegen abgenommen.

Key words

wild bees, changing dominance, effect of changing agriculture

Introduction

To preserve diversity of igenous wild bee fauna is a vital element in sustainable agriculture (Williams 1996, Eardley 2001, Raw 2001). Seed production of lucerne (alfalfa) is also dependent on the pollinating activity of bees (Bohart 1957, 1960; Free 1970, 1993; Williams 1996).

It was in the pre-pesticide era in the mid 1950s when a detailed survey on the specific structure of lucerne pollinating Apoidea began in Hungary (Móczár & Böjtös 1957, Móczár 1959a, 1959b, 1961a, 1961b). In the late 1960s, after the pesticide usage had become a general practice, a second national survey was made in Hungary (Benedek 1967, 1968a, 1968b, 1969a, 1969b, 1970). In the 1970s a third survey was made at Great Hungarian Plain (Tanács 1972, 1974, 1977). For detecting the possible changes in wild bee assemblages there were two more national surveys organized in the period of 1998-2002 and 2003-2007 by the authors of this paper (Tanács & Benedek 2004, and Tanács, Benedek & Bodnár 2008).

The wild bee fauna of the Carpathian Basin consists of approximately 700 species of which 170 species have been registered at lucerne fields in flower (Móczár 1959a, 1959b, 1961a, 1961b, Benedek 1967, 1968a, 1968b, 1969a, 1969b, 1972, Tanács 1972, 1974, 1977, Tanács & Benedek 2004, Tanács, Benedek & Bodnár 2008).

Methods

In the past 54 years two methods were applied to collect lucerne visiting wild bees. Móczár and Böjtös in 1954-1956, and Tanács in 1971-1972 used Móczár's "track method" during their collections (Móczár & Böjtös 1957). They marked out 10 m^2 plots with string and 4 poles at flowering lucerne fields and they dived each plot to ten 1 m long subplots. They observed each 1 m^2 subplots for 30 seconds collecting all wild bee individuals flying in and visiting lucerne flowers at the subplots with an entomologist's net. Ten 10 m^2 plots were taken diagonally at each lucerne field examined and so 100 m^2 area was inspected at each lucerne field surveyed. This method was applied at a number of lucerne fields in bloom between 9 am and 4 pm daily, on days favouring for bee activity.

Benedek used a "simple track method" (Benedek 1967). He was walking slowly along a 100 m long and 50 cm wide track within flowering lucerne fields for 50 minutes (120 m per hour) looking steadily in a 45 degree angle. Each wild bee on wing at lucerne flowers got to be collected with an entomologist's net in the track observed. The method was applied between 9 am and 4 pm daily on several days with favourable or acceptable weather for bee activity.

Most lucerne fields were of 1 to 20 or sometimes some 50 ha large but occasionally there were some fields with an area of 100-150. Very large fields were divided into two or three parts and we made two or three collections daily.

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The collected bees were prepared that day and were identified later. The dominance conditions of the wild bee assemblages can be seen from the percentage of the wild bee species collected. The structure of the assemblages collected in the five survey periods was estimated one by one. In addition to the dominance of wild bee species collected in the pre-pesticide and pesticide era also their geographical distribution and the climatic demands were analysed. Also the distribution of wild bees according to their seasonal flight periods was evaluated (types of seasonal flight periods were treated according to Benedek (1968a).

Material

Móczár and his co-workers in 1954-1956 collected 8 168 wild bees of 89 species during their research made at 27 lucerne fields in 274 collecting at 4 regions of Hungary (counties Baranya, Fejér, Szolnok, Békés).

Benedek and his co-workers collected 13 672 wild bees of 66 species in the fields of 117 settlements (same number of collecting) in Hungary during their surveys in 1967-1968 at 4 regions (counties Békés, Hajdú-Bihar, Jász-Nagykun-Szolnok and Győr-Moson-Sopron).

Tanács collected 1 145 wild bees of 68 species in sandy and heavy soil lucerne fields on the southern part of the Great Hungarian Plain (counties Csongrád County) in 38 days during the same number of collecting in 1971-1972.

Tanács and Benedek collected 3 184 wild bees of 88 species in 59 days during 86 collecting in the period of 1998-2002 at 5 regions in Hungary (counties Békés, Csongrád, Győr-Moson-Sopron, Jász-Nagykun-Szolnok and Hajdú-Bihar).

During the research of Tanács and Benedek in 2003-2007 there were 5 735 wild bees collected of 111 species near 77 settlements at the same 5 regions as during their previous survey, during 442 collecting.

So the total number of wild bees collected was 31 904 specimens that was the result of 957 individual collecting.

Results

As a result of the five series of national surveys in the past 54 years in Hungary as much as 196 Apoidea species including honey bees were identified at flowering lucerne fields (Table 1).

Evaluating the dominance of the species detected (Table 2), in the pre-pesticide era in 1954-1956 *Eucera clypeata* Er. was found to be dominant during all over Hungary (20.46 %), while *Melitta leporina* (Pz.) (18.86 %) and *Andrena ovatula* (K.) (16.90 %) were subdominant.

In 1967-1968 *Melitta leporina* (Pz.) (20.15 %) was dominant all over Hungary, while *Bombus terrestris* (L.) (15.22 %), *Andrena ovatula* (K.) (14.13 %), *Lasioglossum malachurum* (K.) (13.04 %) and *Rhophitoides canus* Ev. (12.12 %) were subdominant species (Table 2).

In 1971-1972 the *Melitta leporina* (Pz.). (13.45 %) was dominant during the collections on the Southern region of the Great Hungarian Plain, while *Andrena ovatula* (K.) (12.14 %) and *Melitturga clavicornis* Latr. (8,12 %) were subdominant species (Table 2).

Between 1998-2002 *Melitta leporina* (Pz.) (15.73 %) and *Rhophitoides canus* Ev. (14.26 %) were found to be co-dominant, while *Bombus lapidarius* (L.) (9.45 %), *Halictus simplex* (Blüthgen)

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(8.23 %), *Andrena flavipes* Pz. (7.54 %), *Bombus terrestris* (L.) (6.88 %) and *Bombus humilis* Illiger (6.60 %) were subdominant.

In 2003-2007 *Bombus terrestris* (L.) (18.62 %) and *Bombus lapidarius* (L.) (16.98 %) were co-dominant species during the collections all over Hungary, while *Andrena flavipes* Pz. (10.80 %), *Melitta leporina* (Pz.) (6.94 %) and *Andrena labialis* (K.) (6.54 %) were subdominant species.

Evaluating the composition of wild bee assemblages at flowering lucerne fields in Hungary during past 54 years we found that definite changes were going on in the structure and the dominance ratios of the species. In the pre-pesticide era (1954-1956) *Eucera clypeata* Er. with medium flight period made up over one fifth of the wild bee assemblages at flowering lucerne fields. The ratio of this taxon as well as of all the other *Eucera* and *Tetralonia* species of medium flight period drastically declined later on. The dominance of *Melitta leporina* Pz., being oligolecties at Fabaceae and closely adapted to the genera Medicago, increased in number in the 1960s and 70s. The dominance of lucerne visiting *Bombus* species within the assemblages, on the other hand, grew considerably due to their great density in the past 10 years. The latest collecting during the past 10 years seem to prove that also *Andrena*, *Halictus*, *Lasioglossum* and *Megachile* species have remained abundant within the wild bee assemblages at lucerne fields.

In all the five survey periods, the ratio of Palaearctic bees were the greatest (Table 3). The percentage of European species was also significant within the wild bee assemblages (Table 3). The Mediterranean species in the overall estimation (Ponto-Mediterranean, North Mediterranean, Holomediterranean) showed the greatest number within the wild bee assemblages (33.34 - 39.71 %). When estimating the zoogeographical distribution of wild bee species recorded at flowering lucerne fields we cannot observe clear differences between the pre-pesticide and pesticide eras. One important fact is, however, that in Hungary the dominance and especially the density of *Eucera* and *Tetralonia* species with Southern-origin declined significantly at lucerne fields during the past 54 years in the pesticide era.

As far as the climatic demands of wild bees is concerned (Table 4) in the pre-pesticide era during the collecting in 1954-1956 the euryoecious eremophilous species were the most numerous within the assemblages (42.70 %) followed by the hypereuryoecious intermediary species (29,21 %). The percentage of the euryoecious hylophilous species was the lowest (10.11 %) within the assemblages. In the period of 1967-1968 the ratio of euryoecious eremophilous species was 48.48 % while that of the hypereuryoecious intermediary species was 24.24 % within the assemblages. The number of stenooecious eremophilous species (10.61 %), was the lowest (Table 4). Also the euryoecious eremophilous species had the most significant ratio in 1971-1972 (42.65 %), followed by hypereuryoecious intermediary species (30.88 %). Here the ratio of the euryoecious hylophilous (8.82 %) species was the lowest (Table 4). During the examinations in 1998-2002 the euryoecious eremophileus species (37.50 %) and the hypereuryoecious intermediary group (34.09 %) were dominant and the lowest ratio (12.50 %) was that of the euryoecious hylophilous species (Table 4). During 2003-2007 the dominant group consisted of the euryoecious eremophilous species 43.24 % followed by the hypereuryoecious intermediary group 28.83 % while the euryoecious hylophilous species (11.71 %) had the lowest percentage (Table 4).

Discussion and conclusions

Comparing the specific structure of wild bees visiting flowering lucerne field in Hungary in past 54 years it can be concluded that the composition of the wild bee assemblages changed considerably. First a dramatic decline of *Eucera* and *Tetralonia* species of medium flight periods was

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detected from the pre-pesticide era (Móczár 1957, 1959a, 1959b) up to the pesticide era in Hungary (Benedek 1967, 1968a, 1968b, 1969a, 1969b). This situation remained constant later on, in the period between 1971 and 1972 (Tanács 1974, 1977) and later on up to present time (Tanács & Benedek 2004; Tanács, Benedek & Bodnár 2008). The main reason for this is the decreasing amount and partial disappearance of Lamiaceae and Fabaceae pollen resources of these kinds of oligolectic wild bees for broadening use of herbicides at arable land as well as for mechanical weed control becoming a regular practice along road sides and ditches and among cultivated crop fields (Benedek 1968a, 1968b, 1997, 1998a, 1998b). Also the decline for more intense agricultural land usage of non cultivated ruderal plots among cultivated crop fields and close-to-nature areas are responsible for the considerable changes in the structures of wild bee species (Benedek 1997, 1998a).

Evaluating the structure of lucerne visiting wild bee assemblages from the point of view of climatic demands of species we can conclude that in the five collecting periods the ratio of euryoecious eremophilous species was the highest (between 37.50 % and 48.48 %), which can be explained with the Mediterranean origin of most of these species. The second largest group was made up of hypereuryoecious intermediary species with a ratio between 24.24 % and 34.09 %. This can be explained by the fact that a significant part of these species are Palaearctic or European suggesting their wide ecologic valences. While it meant only the transformation of the species structure until the 1970s without the change in the total density of wild bees (Benedek 1997, 1998a, 1998b), by today it resulted in a considerable decline even in the density of wild bees, in addition to structural changes.

The main explanation for changing specific structure and changing densities of wild bees visiting lucerne fields in the past 54 years from the pre-pesticide era until now can be explained as follows. Due to the transforming land usage in Hungary from the pre pesticide era to the mid and late 60s the mosaic pattern of the agricultural land ceased to exist any more. Agricultural technology also changed with the use of high power cultivating machinery, small plots of few hectare area each were united in 2 to 50 or as large as 100 hectares large fields and as a result of monoculture Medicago sativa was grown on such large fields too, and so lucerne was abundant in flower ready for lucerne oligoleges to increase their density and dominance within wild bee assemblages. These species, on the other hand, make their nests in the area of lucerne fields so large lucerne crops provided much larger nesting areas to them. Therefore, the density of the *Melitta leporina* (Pz.) and *Rhophitoides canus* Ev., adapted to Medicago species as their pollen source, increased significantly from the 50s to the late 60s. The very same changes had adverse effects on other Apoidea species because their nesting areas were destroyed when creating big fields. For the concentrated amount of food at large flowering lucerne fields and the acceptable habitat there the density of some other wild bees, like *Andrena flavipes* Pz., and *Andrena labialis* (K.), remained approximately the same in the 60s and 70s as it was in the pre pesticide ere in the 50s.

In recent years a new tendency seems to arise because the dominance of bumble bees (*Bombus* species) has increased rapidly and other groups of wild bee seem to be less numerous than before. This phenomenon, however, needs further studies for a proper explanation.

References

Benedek, P. 1967: Új ismeretek a lucernát megporzó vadméhekről. (in Hungarian). – MÉM Információs Központ, Budapest: 1-83.

Benedek, P. 1968a: The flight period of wild bee (Hymenoptera, Apoidea) pollinating lucerne, and its plant protection aspects. – Acta Phytopathologica et Entomologica Hungarica **3**: 59-71.

DOI: 10.21248/contrib.entomol.59.2.335-353

Benedek, P. 1968b: Vizsgálatok lucernát megporzó méhalkatú rovarokon (Hymenoptera, Apoidea) Északnyugat-Magyarországon (Examinations on Lucerne pollinating wild bees in Noth-West Hungary). – Növénytermelés **17**: 277-284.

Benedek, P. 1969a: Flower-visiting habits of lucerne pollinating wild bees and the increasing of wild bees population by providing unbrocken feeding, possibilities. – Zeitschrift für angewandte Entomologie **63**: 186-199.

Benedek, P. 1969b: Examinations on lucerne pollinating wild bees (Hymenoptera, Apoidea) in the Hungarian Great Plain. – Folia Entomologica Hungarica Budapest **22**: 101-116.

Benedek, P. 1970: Effects of the plot size, stand desity and state of flowering on wild bees pollinating lucerne. – Acta Agronomica Academiae Scientiarum Hungaricae **19**: 283-292.

Benedek, P. 1972: The role of honey bees in the pollination of lucerne in relation to the activity of wild bees. – Zeitschrift für angewandte Entomologie **70**: 174-179.

Benedek P. 1997: Structure and density of lucerne pollinating wild bee populations as affected by changing agriculture. – Acta Horticulturae **437**: 353-357.

Benedek P. 1998a: Ecological impact of changing agriculture on wild bees pollinating lucerne in Hungary. – In: Agricultural Challenges and EU Enlargement, 1997 Ed. by Tenk, A.; Szabó, Z.; Goda, M. – Pannon University of Agricultural Sciences, Mosonmagyarovár: 151-163.

Benedek P. 1998b: A mezőgazdaság hatása az állatvilág diverzitására (in Hungarian). „AGRO-21" – Füzetek **21**: 56-65.

Bohart, G. E. 1957: Pollination of alfalfa and red clover. – Annual Review of Entomologie **2**: 355-380.

Bohart, G. E. 1960: Insect pollination of forage legumes. – Bee World **41**: 57-64, 85-97.

Eardley, C. 2001: Pollinator biodiversity a co-ordinated global approach. – Acta Horticulturae **561**: 331-332.

Free, J. B. 1970: Insect pollination of crops. – Academic Press, London: 1-544.

Free, J. B. 1993: Insect pollination of crops. 2nd edition. – Academic Press, London: 1-684.

Móczár L. & Böjtös Z. 1957: A lucernát megporzó méhfélék (in Hungarian). – Magyar Tudományos Akadémia Agrár Osztály Közleményei **13**: 147-178.

Móczár, L. 1959a: Méhalkatú rovarok (Hymenoptera, Apoidea) szerepe lucernásainkban. Thesis for doctor of Science. – Hungarian Academy of Sciences, Budapest: 257.

Móczár, L. 1959b: The activity of the wild bees (Hymenoptera, Apoidea) in Hungarian lucerne fields. – Acta Agronomica Academiae Scientiarum Hungaricae **9**: 237-289.

Móczár, L. 1961a: A lucernát megporzó magyarországi méhalkatú fajok (Hymenoptera, Apoidea). (Wild bees pollinating lucerne in Hungary). – Folia Entomologica Hungarica Budapest **14**: 217-236.

Móczár, L. 1961b: A hazai lucernások vadméheinek mennyisége (in Hungarian). – Állattani Közleményei **48**: 95-105.

Raw, A. 2001: The risk of pollinator decline and global pollinators initiative. – Acta Horticulturae, **561**: 327-330.

Tanács L. 1972: Méhalkatú rovarok (Hymenoptera: Apoidea) szerepe a Szeged környéki lucernásokban (in Hungarian). – Thesis, Szegedi Tudományegyetem, Szeged: 99 pp.

Tanács L. 1974: The flower-visiting activity of Apoidea on lucerne (Hymenoptera, Apoidea): Acta Biologica Szegediensis **20**: 179-182.

Tanács, L. 1977: Flower-visiting bees in lucerne fields near Szeged. – Acta Agronomica Academiae Scientiarum Hungaricae **26**: 419-425.

Tanács, L. & Benedek, P. 2004: Változások homoki és kötött talajú lucernások vadméh közösségeinek faji szerkezetében (Hymenoptera: Apoidea) a Nagy-alföld területén, az elmúlt évtizedekben. – Növénytermelés **3**: 599-615.

DOI: 10.21248/contrib.entomol.59.2.335-353

Tanács, L.; Benedek, P. & Bodnár, K. 2008: A hazai lucernásokat megporzó vadméh közösségek (Hymenoptera: Apoidea) diverzitásának és faji szerkezetének változásai az elmúlt évtizedekben. – Növénytermelés 57 (3): 341-357.

Williams, I. H. 1996: Aspects of bee diversity and crop pollination in the European Union. – In: The conservcovation of bees. – Ed. by Matheson, A.; Buhmann, S. I.; O'Toole, C.; Westrich, P. & Williams, I. H. – Linnean Society, London, Symposium Series **18**: 63-80.

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Tab. 1: Wild bee species recorded at flowering lucerne fields in Hungary during the past 54 ears (from 1954 to 2007).

Species recorded Altogether	Geographical distribution	Climatic demands	Species recorded at individual survey periods				
			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
1. *Hylaeus annularis* (Kirby, 1802)	European	hypereuryoecious intermediary	+				
2. *Hylaeus brevicornis* Nylander, 1852	Palaearctic	hypereuryoecious intermediary				+	
3. *Hylaeus communis* Nylander, 1852	Palaearctic	hypereuryoecious intermediary		+		+	+
4. *Hylaeus confusus* Nylander, 1852	Palaearctic	hypereuryoecious intermediary	+				
5. *Hylaeus cornutus* Curtis, 1831	Holomedi-terranean	euryoecious eremophilous	+				
6. *Hylaeus euryscapus* Förster, 1871	North Medi-terranean	euryoecious eremophilous				+	
7. *Hylaeus gibbus* Saunders, 1850	European	euryoecious eremophilous					+
8. *Hylaeus leptocephalus* (Morawitz, 1870)	European	euryoecious eremophilous		+		+	+
9. *Hylaeus pectoralis* Förster, 1871	Euroturanian	euryoecious eremophilous					+

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Species recorded Altogether	Geographical distribution	Climatic demands	Species recorded at individual survey periods				
			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
10. *Hylaeus variegatus* (Fabricius, 1798)	Holomediterranean	euryoecious eremophilous				+	+
11. *Colletes daviesanus* Smith, 1846	Palaearctic	hypereuryoecious intermediary			+	+	
12. *Colletes hylaeiformis* Eversmann, 1852	European	hypereuryoecious intermediary				+	
13. *Melitta leporina* (Panzer, 1799)	European	euryoecious eremophilous	+	+	+	+	+
14. *Macropis europaea* Warncke, 1973	Central European	euryoecious hylophilous					+
15. *Dasypoda hirtipes* (Fabricus, 1793)	Palaearctic	euryoecious eremophilous	+	+			
16. *Andrena aeneiventris* Morawitz, 1872	Pontomediterranean	euryoecious eremophilous	+				
17. *Andrena albopunctata* Rossi, 1792	Holomediterranean	euryoecious eremophilous	+				
18. *Adrena argentata* Smith, 1844	Atlantic	euryoecious eremophilous		+			
19. *Andrena combinata* (Christ, 1791)	Palaearctic	hypereuryoecious intermediary					+
20. *Andrena cordialis* Morawitz, 1877	Pontic	euryoecious eremophilous				+	+
21. *Andrena flavipes* Panzer, 1799	Palaearctic	euryoecious eremophilous	+	+	+	+	+
22. *Andrena hypopolia* Schmiedeknecht, 1883	Pontomediterranean	stenooecious eremophilous		+			
23. *Andrena labialis* (Kirby, 1802)	Palaearctic	hypereuryoecious intermediary	+	+	+	+	+
24. *Andrena morio* Brullé, 1832	Pontomediterranean	euryoecious eremophilous	+		+		
25. *Andrena nitidiuscula* Schenck, 1853	Pontomediterranean	euryoecious eremophilous	+				
26. *Andrena nobilis* Morawitz, 1874	Eurotu-ranian	euryoecious eremophilous	+				
27. *Andrena ovatula* (Kirby, 1802)	Atlantic	hypereuryoecious intermediary	+	+	+	+	+
28. *Andrena pilipes*, Fabricius, 1781	Palaearctic	hypereuryoecious intermediary				+	+
29. *Andrena pillichi* Noskiewicz, 1939	Pontomediterranean	euryoecious eremophilous		+			
30. *Andrena tibialis* (Kirby, 1802)	Eurosiberian	euryoecious hylophilous					+
31. *Andrena variabilis* Smith, 1853	Pontic	euryoecious eremophilous	+	+	+	+	+
32. *Panurgus calcaratus* (Scopoli, 1763)	Palaearctic	hypereuryoecious intermediary	+				
33. *Melitturga clavicornis* (Latreille, 1806)	North Mediterranean	stenooecious eremophilous	+	+	+	+	+

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Species recorded Altogether	Geographical distribution	Climatic demands	Species recorded at individual survey periods				
			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
34. *Halictus brunnescens* (Eversmann, 1852)	Holomedi-terranean	euryoecious eremophilous				+	
35. *Halictus carinthiacus* Blütghen, 1936	Central European	euryoecious hylophilous	+	+			
36. *Halictus confusus* Smith, 1853	European	hypereuryoecious intermediary				+	+
37. *Halictus eurygnathus* Blüthgen, 1931	North Medi-terranean	euryoecious eremophilous	+	+	+	+	+
38. *Halictus fulvipes* (Klug, 1817)	Palaearctic	hypereuryoecious intermediary				+	+
39. *Halictus kessleri* Bramson, 1879	Pontic	stenooecious eremophilous		+	+	+	+
40. *Halictus langobardicus* Blüthgen, 1944	Holomedi-terranean	stenooecious eremophilous					+
41. *Halictus leucaheneus* Ebmer, 1972	Palaearctic	hypereuryoecious intermediary	+				
42. *Halictus maculatus* Smith, 1848	Central European	euryoecious eremophilous	+	+	+	+	+
43. *Halictus patellatus* Morawitz,1873	Pontomedi-terranean	euryoecious eremophilous		+	+	+	+
44. *Halictus pollinosus* Sichel, 1860	Palaearctic	hypereuryoecious intermediary	+	+			
45. *Halictus quadricinctus* (Fabricius, 1776)	Palaearctic	hypereuryoecious intermediary	+	+	+	+	+
46. *Halictus rubicundus* (Christ, 1791)	Holarctic	hypereuryoecious intermediary	+		+		
47. *Halictus sajoi* Blüthgen, 1923	West Palaearctic	euryoecious eremophilous		+	+	+	+
48. *Halictus scabiosae* (Rossi, 1790)	Holomedi-terranean	stenooecious eremophilous					+
49. *Halictus seladonius* (Fabricius, 1794)	Pontomedi-terranean	euryoecious eremophilous	+				
50. *Halictus semitectus* Morawitz, 1874	Palaearctic	hypereuryoecious intermediary				+	
51. *Halictus sexcinctus* (Fabricius, 1775)	Palaearctic	euryoecious eremophilous				+	+
52. *Halictus simplex* Blüthgen, 1923	Holomedi-terranean	euryoecious eremophilous	+	+	+	+	+
53. *Halictus smaragdulus* Vachal, 1895	Holomedi-terranean	stenooecious eremophilous		+	+		+
54. *Halictus subauratus* (Rossi, 1792)	Holomedi-terranean	stenooecious eremophilous	+	+		+	+
55. *Halictus tetrazonius* (Klug, 1817)	Euro Siberian	hypereuryoecious intermediary		+	+		+
56. *Halictus tumulorum* (Linnaeus, 1758)	Palaearctic	hypereuryoecious intermediary		+		+	+
57. *Lasioglossum calcea-tum* (Scopoli, 1763)	Palaearctic	hypereuryoecious intermediary	+	+	+	+	+

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			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
58. *Lasioglossum clypeare* (Schenck, 1853)	Holomediterranean	euryoecious eremophilous					+
59. *Lasioglossum convexiusculum* (Schenck, 1853)	Holomediterranean	euryoecious eremophilous	+				
60. *Lasioglossum costulatum* Kriechbaumer, 1873	Palaearctic	hypereuryoecious intermediary	+			+	
61. *Lasioglossum crassepunctatum* (Blüthgen, 1923)	Palaearctic	hypereuryoecious intermediary				+	+
62. *Lasioglossum discum* (Smith, 1853)	North Mediterranean	euryoecious eremophilous		+	+	+	+
63. *Lasioglossum euboeense* (Strand, 1909)	Holomediterranean	euryoecious eremophilous	+				
64. *Lasioglossum glabriusculum* (Morawitz, 1872)	North Mediterranean	euryoecious eremophilous				+	
65. *Lasioglossum interruptum* (Panzer, 1798)	North Mediterranean	hypereuryoecious intermediary		+	+		
66. *Lasioglossum laticeps* (Schenck, 1870)	North Mediterranean	euryoecious eremophilous	+		+		+
67. *Lasioglossum lativentre* (Schenck, 1853)	European	hypereuryoecious intermediary	+				
68. *Lasioglossum leucozonium* (Schranck, 1781)	Holarctic	hypereuryoecious intermediary	+	+	+	+	+
69. *Lasioglossum lineare* (Schenck, 1869)	Holomediterranean	euryoecious eremophilous					+
70. *Lasioglossum majus* (Nylander, 1852)	Pontomediterranean	euryoecious eremophilous	+	+			
71. *Lasioglossum malachurum* (Kirby, 1802)	Holomediterranean	euryoecious eremophilous	+	+	+	+	+
72. *Lasioglossum marginatum* (Brullé, 1832)	Holomediterranean	euryoecious eremophilous	+		+	+	
73. *Lasioglossum mesosclerum* (Perez, 1903)	Ponto-Caspic–Mediterranean	euryoecious eremophilous		+			
74. *Lasioglossum minutulum* (Schenck, 1853)	Holomediterranean	euryoecious eremophilous				+	+
75. *Lasioglossum morio* (Fabricius, 1793)	North Mediterranean	euryoecious eremophilous					+
76. *Lasioglossum nigripes* (Lepeletier, 1841)	North Mediterranean	stenooecious eremophilous	+				
77. *Lasioglossum nitidiusculum* (Kirby, 1802)	Atlantic	euryoecious hylophilous	+				
78. *Lasioglossum nitidulum aenedorsum* (Alfken, 1924)	West Palaearctic	hypereuryoecious intermediary	+				
79. *Lasioglossum nitidulum* (Fabricius, 1804)	West Palaearctic	euryoecious hylophilous		+			
80. *Lasioglossum pallens* (Brullé, 1832)	Holomediterranean	euryoecious eremophilous		+			

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81. *Lasioglossum parvulum* (Schenck, 1853)	European	hypereuryoecious intermediary					+
82. *Lasioglossum pauxillum* (Schenck, 1853)	Ponto-Caspic–Mediterranean	euryoecious eremophilous				+	
83. *Lasioglossum politum* (Schenck, 1853)	Pontomediterranean	euryoecious eremophilous		+			
84. *Lasioglossum quadrinotatulum* (Schenck, 1861)	Holomediterranean	euryoecious eremophilous					+
85. *Lasioglossum quadrinotatum* (Kirby, 1802)	European	euryoecious eremophilous	+				
86. *Lasioglossum quadrisignatum* (Schenck, 1853)	Holomediterranean	euryoecious eremophilous			+		
87. *Lasioglossum setulellum* (Strand, 1909)	West Palaearctic	euryoecious hylophilous		+			
88. *Lasioglossum sexnotatum* (Kirby, 1802)	North & Central European	hypereuryoecious intermediary	+				
89. *Lasioglossum trichopygum* (Blüthgen, 1923)	North Mediterranean	euryoecious eremophilous		+			
90. *Lasioglossum xanthopus* (Kirby, 1802)	Central European	euryoecious eremophilous	+				
91. *Lasioglossum villosulum* (Kirby, 1802)	European	hypereuryoecious intermediary					+
92. *Sphecodes alternatus* Smith, 1853	North Mediterranean	euryoecious eremophilous					+
93. *Sphecodes ephippius* (Linnaeus, 1767)	Palaearctic	hypereuryoecious intermediary			+		+
94. *Sphecodes gibbus* (Linnaeus, 1758)	Palaearctic	hypereuryoecious intermediary					+
95. *Sphecodes monilicornis* (Kirby, 1802)	Palaearctic	hypereuryoecious intermediary					+
96. *Sphecodes rufiventris* (Panzer, 1798)	European	-					+
97. *Pseudapis diversipes* (Latreille, 1806)	North Mediterranean	stenooecious eremophilous	+				+
98. *Pseudapis femoralis* (Pallas, 1773)	North Mediterranean	stenooecious eremophilous					+
99. *Pseudapis unidentata* (Olivier, 1811)	Holomediterranean	stenooecious eremophilous	+			+	
100. *Rophites hartmanni* Friese, 1902	Central European	euryoecious eremophilous	+				
101. *Rophites quinquespinosus* Spinola, 1808	North & Central European	euryoecious hylophilous	+	+	+	+	
102. *Rhophitoides canus* (Eversmann, 1852)	European	euryoecious hylophilous	+	+	+	+	+

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			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
103. *Nomioides minutissimus* (Rossi, 1790)	Ponto-Caspic–Mediterranean	euryoecious eremophilous				+	
104. *Nomioides variegatus* (Olivier, 1789)	Holomediterranean	stenooecious eremophilous				+	+
105. *Systropha curvicornis* (Scopoli, 1770)	Central European	euryoecious eremophilous	+		+		+
106. *Systropha planidens* Giraud, 1861	Holomediterranean	stenooecious eremophilous	+		+		
107. *Megachile apicalis* Spinola, 1808	Holomediterranean	euryoecious eremophilous		+			+
108. *Megachile centuncularis* (Linnaeus, 1758)	European	hypereuryoecious intermediary	+	+	+	+	+
109. *Megachile ericetorum* Lepeletier, 1841	Palaearctic	euryoecious eremophilous	+	+	+	+	+
110. *Megachile flabellipes* Pérez, 1895	North Mediterranean	euryoecious eremophilous	+				
111. *Megachile genalis* Morawitz, 1880	Palaearctic	euryoecious eremophilous		+			
112. *Megachile lagopoda* (Linnaeus, 1761)	Palaearctic	euryoecious eremophilous				+	+
113. *Megachile leachella* Curtis, 1828	Palaearctic	euryoecious eremophilous	+	+	+	+	+
114. *Megachile leucomalla* Gerstaecker, 1869	North Mediterranean	euryoecious eremophilous					+
115. *Megachile ligniseca* (Kirby, 1802)	North & Central European	euryoecious hylophilous					+
116. *Megachile maritima* (Kirby, 1802)	Palaearctic	euryoecious eremophilous	+	+	+	+	+
117. *Megachile pilicrus* Morawitz, 1877	Holomediterranean	euryoecious eremophilous					+
118. *Megachile pilidens* Alfken, 1924	West Palaearctic	euryoecious eremophilous	+		+	+	+
119. *Megachile pyrenaea* Pérez, 1890	North & Central European	hypereuryoecious intermediary					+
120. *Megachile rotundata* (Fabricius, 1787)	Holomediterranean	hypereuryoecious intermediary	+	+	+	+	+
121. *Megachile versicolor* Smith, 1844	European	euryoecious eremophilous	+		+	+	+
122. *Megachile willoughbiella* (Kirby, 1802)	North & Central European	hypereuryoecious intermediary				+	+
123. *Lithurgus chrysurus* Fonscolombe, 1834	Holomediterranean	euryoecious eremophilous				+	
124. *Lithurgus cornutus* (Fabricius, 1787)	Holomediterranean	euryoecious eremophilous					+

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125. *Osmia aurulenta* (Panzer, 1799)	European	hypereuryoecious intermediary	+		+		+
126. *Osmia bidentata* Morawitz, 1876	North Medi-terranean	euryoecious eremophilous					+
127. *Osmia brevicornis* (Fabricius, 1798)	North Medi-terranean	euryoecious eremophilous			+		
128. *Osmia caerulescens* (Linnaeus, 1802)	Palaearctic	euryoecious eremophilous				+	+
129. *Osmia melanogaster* Spinola, 1808	Holomedi-terranean	euryoecious eremophilous					+
130. *Osmia rufohirta* Latreille, 1811	Holomedi-terranean	euryoecious eremophilous					+
131. *Osmia tridentata* Dufour. & Perris, 1840	Holomedi-terranean	euryoecious eremophilous			+	+	
132. *Heriades crenulatus* Nylander, 1856	Holomedi-terranean	euryoecious hylophilous				+	
133. *Anthidium florentinum* (Fabricius, 1775)	Palaearctic	euryoecious eremophilous	+	+		+	+
134. *Anthidium laterale* Latreille, 1809	West Palaearctic	stenooecious eremophilous					+
135. *Anthidium manicatum* (Linnaeus, 1758)	Palaearctic	hypereuryoecious intermediary	+		+	+	+
136. *Anthidium oblongatum* (Illiger, 1806)	Palaearctic	euryoecious eremophilous					+
137. *Anthidium strigatum* (Panzer, 1805)	West Palaearctic	stenooecious eremophilous				+	+
138. *Coelioxys afra* Lepeletier, 1841	Holomedi-terranean	euryoecious eremophilous	+		+	+	+
139. *Coelioxys aurolimbata* Förster, 1853	Holomedi-terranean	stenooecious eremophilous	+				+
140. *Coelioxys brevis* Eversmann, 1852	Holomedi-terranean	stenooecious eremophilous				+	
141. *Coelioxys conoidea* (Illiger, 1806)	European	euryoecious eremophilous				+	+
142. *Coelioxys echinata* Förster, 1853	North Medi-terranean	euryoecious hylophilous					+
143. *Coelioxys elongata* Lepeletier, 1841	West Palaearctic	euryoecious hylophilous				+	
144. *Coelioxys rufescens* Lepeletier & Serville, 1825	Central European	euryoecious hylophilous					+
145. *Stelis punctulatissima* (Kirby, 1802)	European	euryoecious eremophilous					+
146. *Tetralonia armeniaca* Morawitz, 1878	Ponto-caspian	stenooecious eremophilous	+		+		+
147. *Tetralonia hungarica* (Friese, 1895)	Holomedi-terranean	stenooecious eremophilous	+		+		

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148. *Tetralonia macroglossa* (Illiger, 1806)	Euroturanian	stenooecious eremophilous				+	
149. *Tetralonia pollinosa* (Lepeletier, 1841)	Pontocaspic-Mediterranean	stenooecious eremophilous		+	+		
150. *Tetralonia ruficornis* Fabricius, 1804	Pontocaspic-Mediterranean	stenooecious eremophilous	+				+
151. *Tetralonia salicariae* (Lepeletier, 1841)	Pontocaspic-Mediterranean	euryoecious eremophilous	+				+
152. *Tetralonia tricincta* Erichson, 1835	Pontocaspic-Mediterranean	stenooecious eremophilous	+				
153. *Eucera cineraria* Eversmann, 1852	Pontocaspic-Mediterranean	euryoecious eremophilous	+	+	+		
154. *Eucera clypeata* Erichson, 1835	Holomediterranean	stenooecious eremophilous	+	+	+	+	+
155. *Eucera curvitarsis* Mocsary, 1879	Holomediterranean	euryoecious eremophilous		+			
156. *Eucera interrupta* Baer, 1850	Pontocaspic-Mediterranean	euryoecious eremophilous	+	+	+		+
157. *Eucera longicornis* (Linnaeus, 1758)	European	euryoecious eremophilous	+	+	+		
158. *Eucera nigrifacies* Lepeletier, 1841	Holomediterranean	euryoecious eremophilous					+
159. *Eucera nitidiventris* Mocsáry, 1879	North Mediterranean	stenooecious eremophilous	+		+	+	+
160. *Eucera pollinosa* Smith, 1854	North Mediterranean	stenooecious eremophilous	+		+	+	+
161. *Eucera similis* Lepeletier, 1841	North Mediterranean	euryoecious eremophilous			+		
162. *Amegilla quadrifasciata* (Villers, 1789)	North Mediterranean	stenooecious eremophilous			+	+	
163. *Amegilla salviae* (Morawitz, 1876)	Pontocaspian	stenooecious eremophilous					+
164. *Anthophora crinipes* Smith, 1854	North Mediterranean	hypereuryoecious intermediary			+		
165. *Anthophora retusa* (Linnaeus, 1758)	European-med.	euryoecious eremophilous		+			
166. *Biastes emarginatus* (Schenck, 1853)	Central European	euryoecious hylophilous	+				
167. *Xylocopa iris* (Christ, 1791)	Holomedi-erranean	euryoecious hylophilous				+	
168. *Xylocopa valga* Gerstaecker, 1872	North Mediterranean	euryoecious hylophilous				+	+

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			Móczár: 1954-1956	Benedek: 1967-1968	Tanács: 1971-1972	Tanács & Benedek: 1998-2002	Tanács & Benedek: 2003-2007
169. *Xylocopa violacea* (Linneaus, 1758)	North Mediterranean	euryoecious hylophilous		+	+	+	+
170. *Ceratina chalybea* Chevrier, 1872	North Mediterranean	euryoecious hylophilous					+
171. *Ceratina cyanea* (Kirby, 1802)	European	hypereuryoecious intermediary	+			+	+
172. *Nomada basalis* Herrich-Schäffer, 1839	North Mediterranean	euryoecious hylophilous		+			
173. *Nomada bluethgeni* Stöckhert, 1943	Central European	euryoecious eremophilous					+
174. *Nomada calimorpha* Schmiedeknecht, 1882	North Mediterranean	euryoecious hylophilous		+			
175. *Nomada flavopicta* (Kirby, 1802)	European	stenooecious eremophilous				+	
176. *Nomada fucata* Panzer, 1798	West Palaearctic	hypereuryoecious intermediary	+		+	+	+
177. *Nomada rhenana* Morawitz, 1872	West Palaearctic	-					+
178. *Bombus barbutellus* (Kirby, 1802)	Palaearctic	euryoecious hylophilous	+		+	+	+
179. *Bombus fragrans* (Pallas, 1771)	Pontic	stenooecious eremophilous	+				
180. *Bombus hortorum* (Linnaeus, 1761)	Palaearctic	hypereuryoecious intermediary	+	+	+	+	+
181. *Bombus humilis* Illiger, 1806	European	hypereuryoecious intermediary	+	+	+	+	+
182. *Bombus hypnorum* (Linnaeus, 1758)	North & Central European	euryoecious hylophilous				+	
183. *Bombus laesus mocsary* Kriechbaumer, 1877	North Mediterranean	stenooecious eremophilous	+		+	+	
184. *Bombus lapidarius* (Linnaeus, 1758)	Palaearctic	hypereuryoecious intermediary	+	+	+	+	+
185. *Bombus lucorum* (Linnaeus, 1761)	Palaearctic	euryoecious hylophilous	+				+
186. *Bombus muscorum* (Linnaeus, 1758)	Palaearctic	euryoecious eremophilous	+	+	+		
187. *Bombus pascuorum* (Scopoli, 1763)	Eurasian	hypereuryoecious intermediary	+	+	+	+	+
188. *Bombus ruderarius* (Müller, 1776)	North & Central European	euryoecious hylophilous	+	+	+	+	+
189. *Bombus ruderatus* Fabricius, 1775	North Mediterranean	euryoecious eremophilous	+		+		
190. *Bombus rupestris* (Fabricius, 1793)	Palaearctic	hypereuryoecious intermediary				+	

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191. *Bombus soroeensis* (FABRICIUS, 1776)	North & Central European	euryoecious hylophilous				+	
192. *Bombus subterraneus* (LINNAEUS, 1758)	North & Central European	euryoecious hylophilous		+			
193. *Bombus sylvarum* (LINNAEUS, 1761)	Central European	hypereuryoecious intermediary	+	+	+	+	+
194. *Bombus sylvestris* (LEPELETIER, 1832)	North European - Borealic	hypereuryoecious intermediary				+	
195. *Bombus terrestris* (LINNAEUS, 1758)	Palaearctic	euryoecious hylophilous	+	+	+	+	+
196. *Apis mellifera* LINNAEUS, 1758	Cosmo-politan	hypereuryoecious intermediary	+	+	+	+	+

Tab. 2: Dominance ratios of wild bee species recorded at flowering lucerne fields in Hungary during the past 54 years (1954-2007).

Survey periods	Dominant species and their ratios in per cents	Co-dominant species and their ratios in per cents	Subdominant species and their ratios in per cents %	Accompanying species and their ratios in per cents	Number of other species and their ratios in per cents
MÓCZÁR: 1954-1956	*Eucera clypeata* ER.: 20.46 %		*Melitta leporina* (PZ.): 18.86 % *Andrena ovatula* (K.): 16.90 %	*Bombus lapidarius* (L.): 5.92 % *Halictus eurygnathus* BLÜTHG.: 4.06 % *Bombus terrestris* (L.): 3.85 % *Andrena flavipes* PZ.: 2.71 % *Melitturga clavicornis* LATR.: 2.66 % *Halictus rubicundus* (CHRIST): 2.48 % *Eucera pollinosa* SMITH: 2.47 % *Eucera cinerea* LEP.: 2.02 % *Eucera nitidiventris* MOCS.: 1.22 % *Halictus maculatus* SMITH: 1.16 % *Rhophitoides canus* EV.: 0.97 %	75 species: 14.26 %
BENEDEK: 1967-1968	*Melitta leporina* (PZ.): 20.15 %		*Bombus terrestris* (L.): 15.22 % *Andrena ovatula* (K.): 14.13 % *Lasioglossum malachurum* (K.): 13.04 % *Rhophitoides canus* EV.: 12.12 %	*Halictus simplex* (BLÜTHG.): 7.06 % *Bombus lapidarius* (L.): 4.85 % *Andrena flavipes* PZ.: 2.54 % *Eucera clypeata* ER.: 2.51 % *Bombus sylvarum* (L.):1.96 % *Bombus humilis* ILLIGER: 0.99 % *Melitturga clavicornis* LATR.: 0.83 %	54 species: 4.6 %

Survey periods	Dominant species and their ratios in per cents	Co-dominant species and their ratios in per cents	Subdominant species and their ratios in per cents %	Accompanying species and their ratios in per cents	Number of other species and their ratios in per cents
Tanács: 1971-1972	*Melitta leporina* (Pz.): 13.45 %		*Andrena ovatula* (K.): 12.14 % *Melitturga clavicornis* Latr.: 8.12 %	*Halictus eurygnathus* Blüthg.: 7.42 % *Bombus pascuorum* (Scop.) : 7.42 % *Lasioglossum malachurum* (K.): 7.07 % *Andrena flavipes* Pz.: 6.72 % *Bombus terrestris* (L.): 6.20 % *Halictus tetrazonius* Klug: 4.28 % *Andrena labialis* (K.): 3.81 % *Bombus lapidarius* (L.): 3.76 % *Eucera clypeata* Er.: 3.41 % *Bombus sylvarum* (L.): 2.71 % *Megachile leachella* Curtis: 2.01 %	54 species: 11.48 %
Tanács & Benedek: 1998-2002		*Melitta leporina* (Pz.): 15.73 % *Rhophitoides canus* (Ev.): 14.26 %	*Bombus lapidarius* (L.): 9.45 % *Halictus simplex* (Blüthg.): 8.23 % *Andrena flavipes* Pz.: 7.54 % *Bombus terrestris* (L.): 6.88 % *Bombus humilis* Illiger: 6.60 %	*Megachile leachella* Curtis: 3.80 % *Andrena ovatula* (K.): 3.64 % *Bombus pascuorum* (Scop.): 2.80 % *Andrena variabilis* Smith: 2.45 % *Bombus sylvarum* (L.): 2.39 % *Megachila willoughbiella* (K.): 2.01 % *Andrena labialis* (K.): 1.66 % *Halictus malachurum* (K.): 1.32 % *Bombus hortorum* (L.): 1.32 % *Eucera clypeata* Er.: 1.13 % *Megachile maritima* (K.): 1.13 %	70 species: 7.66 %
Tanács & Benedek: 2003-2007		*Bombus terrestris* (L.): 18.62 % *Bombus lapidarius* (L.): 16.98 %	*Andrena flavipes* Pz.: 10.80 % *Melitta leporina* (Pz.): 6.94 % *Andrena labialis* (K.): 6.54 %	*Halictus simplex* (Blüthg.): 4.90 % *Lasioglossum malachurum* (K.): 4.90 % *Rhophitoides canus* Ev.: 4.81 % *Bombus pascuorum* (Scop.): 4.18 % *Andrena ovatula* (K.): 2.56 % *Bombus sylvarum* (L.): 2.47 % *Bombus humilis* Illiger: 1.95 % *Megachile leachella* Curtis: 1.54 % *Megachile willoughbiella* (K.): 1.14 % *Anthidium florentinum* (F.): 1.04 %	96 species: 10.63 %

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Tab. 3: Geographical distribution of wild bee species recorded at lucerne fields in Hungary during the past 54 years (1954-2007).

Range of geographical distribution	Survey periods									
	MÓCZÁR: 1954-1956		BENEDEK: 1967-1968		TANÁCS: 1971-1972		TANÁCS & BENEDEK: 1998-2002		TANÁCS & BENEDEK: 2003-2007	
	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents
Holarctic	2	2.25 %	1	1.51 %	2	2.94 %	1	1.14 %	1	0.90 %
Eurasian	1	1.12 %	1	1.51 %	1	1.47 %	1	1.14 %	1	0.90 %
Euro Siberian	-	-	1	1.51 %	1	1.47 %			2	1.80 %
Palaearctic	21	23.60 %	17	25.76 %	15	22.07 %	26	29.54 %	27	24.33 %
West Palaearctic	3	3.37 %	3	4.55 %	3	4.41 %	5	5.68 %	6	5.41 %
European	11	12.36 %	6	9.09 %	7	10.29 %	11	12.50%	15	13.51 %
Central European	7	7.87 %	3	4.55 %	3	4.41 %	2	2.27 %	6	5.41 %
North and Central European	3	3.37 %	3	4.55 %	2	2.94 %	5	5.68 %	4	3.60 %
North European and Borealic							1	1.14 %		
Atlantic	2	2.25 %	2	3.03 %	1	1.47 %	1	1.14 %	1	0.90 %
European Mediterranean			1	1.51 %						
Ponto-Mediterranean	5	5.62 %	5	7.58 %	2	2.94 %	1	1.14 %	1	0.90 %
North Mediterranean	10	11.23 %	8	12.12 %	14	20.59 %	11	12.50%	16	14.41 %
Holomediterranean	15	16.85 %	9	13.64 %	11	16.18 %	17	19.31 %	22	19.83 %
Ponto-Caspian-Mediterranean	5	5.62 %	4	6.06 %	3	4.41 %			3	2.70 %
Euroturanic	1	1.12 %					1	1.14 %	1	0.90 %
Pontic	2	2.25 %	2	3.03 %	2	2.94 %	3	3.41 %	3	2.70 %
Pontocaspian	1	1.12 %			1	1.47 %	2	2.27 %	2	1.80 %
Total	89	100.00 %	66	100.00 %	68	100.00 %	88	100.00 %	111	100.00 %

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Tab. 4: Climatic demands of wild bee species recorded at floweing lucerne fields in Hungary duing the past 54 years (1954-2007).

Climatic demands	Survey periods									
	Móczár: 1954-1956		Benedek: 1967-1968		Tanács: 1971-1972		Tanács & Benedek: 1998-0202		Tanács & Benedek: 2003-2007	
	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents	number of species	ratio in per cents
Stenooecious eremophilous species	16	17.98 %	7	10.61 %	12	17.65 %	14	15.91 %	18	16.22 %
Euryoecious eremophilous species	38	42.70 %	32	48.48 %	29	42.65 %	33	37.50 %	48	43.24 %
Hypereuryoecious intermediary species	26	29.21 %	16	24.24 %	21	30.88 %	30	34.09 %	32	28.83 %
Euryoecious hylophilous species	9	10.11 %	11	16.67 %	6	8.82 %	11	12.50 %	13	11.71 %
Stenooeciosus hylophilous species	-	-	-	-	-	-	-	-	-	-
Total	89	100.00 %	66	100.00 %	68	100.00 %	88	100.00 %	111	100.00 %

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