

Herbarium Database of Hungarian Orchids I. Methodology, dataset, historical aspects and taxa

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Abstract: The paper introduces the Herbarium Database of Hungarian Orchids which contains all records of orchid (Orchidaceae) specimens stored in the Hungarian herbaria. All data from the herbarium sheets were entered into the database, and secondary data were also added it; including a taxonomic revision in line with current theory. Only unique data was considered, yielding 7,658 records of 55 species from 452 collectors. It covers the whole territory of Hungary, and spans two centuries ranging from 1804 to the present. The temporal frequency of collections shows a peak in the middle of the 20th century. The most effective collectors came from this era, and the name of Rezső Soó and his followers can be mentioned as most prominent. As in other countries, a decline in collection is seen in the last decades of the 20th century. A geographically uneven coverage of collections was observed, and the such heavily underrepresented regions could be identified with the help of the database. However, the value of collection for scientific purposes is emphasised, as can be readily seen in this database. Taxonomically, seven recently described species could be identified, which were collected before their description under other names more than one century ago. On the other hand, the earlier presence of species now considered to be extinct could be unequivocally proven, as in the case of *Malaxis monophyllos*. The multiple application of herbaria is illustrated by some examples, reinforcing unambiguously the usefulness of collecting for scientific purposes. Furthermore, new, as yet unforeseen, application of herbarium collections can be expected.

Key words: *Epipactis*; biological collections; herbaria; floristics; Orchidaceae; Rezső Soó; Hungary

Introduction

The herbarium has been indispensable and unsurpassable in the range of tools of botanical research for centuries (Linnaeus 1751: 7.). The development of the Herbarium at the University of Debrecen was among the main aims of Professor Soó along with his research into northern temperate orchids (Keller & Soó 1930–1940), and the synthesis of taxonomic and floristic information on the Hungarian vascular flora (Soó 1964–1980). With the intention of continuing Soó's intellectual heritage, we generated the Herbarium Database of Hungarian Orchids based on data of orchids preserved from all available Hungarian herbaria. This work not only provides valuable data about the regional distribution patterns of certain taxa, but also opens an avenue for different ecological analyses.

Material and methods

An archive of digital photos of orchids from 18 Hungarian public collections (Table 1) was built up. The pictures were taken with a ruler in order to make future morphometric measurements possible. All available data on the sheets

were entered into MS Excel spreadsheets. Some inconsistencies necessitated carefully considered processing of the information. Sheets without adequate data on when and where the specimens were collected had to be excluded from the database; additionally, when more species were placed on the same sheet, or the same sheet contained specimens from different collection places or times, these were considered as separate records with unique data (e.g. entering two records if the sheet had contained two species from the same place).

Primary data collected from the sheets were: (a) name of the species on the label; (b) name of collector; (c) name of taxonomic reviewer; (d) locality on the label; (e) altitude of the locality above sea level; (f) year of collection; (g) month of collection; (h) day of collection; (i) name of Herbarium; (j) filename of the digital photo; (k) number of the collected individuals (or shoots) and (l) phenological status with the following categories: i.) vegetative, ii.) in bud, iii.) blooming, iv.) in fruit, and v.) indeterminable (damaged).

The following data were added to the database: (m) current specific name; (n) subspecific name (if applicable); (o) county; (p) valid administrative affiliation; (q) name of exact locality; (r) vegetation belt, according to Ellenberg's (1996) classification; (s) the grid reference code of the Central European flora mapping, (t) the Julian day of the date of collection (where 1. January = 1., 31. December = 365.). In case of intact specimens in fruit, the fruit set was recorded

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Table 1. The main data of herbaria included in the present study. Brackets indicate a provisional herbarium acronym for collections not listed by *Index Herbariorum* (Holmgren & Holmgren 1998).

Institute	Acronym	No. of records	Time period	No. of collectors	No. of species	No. of counties
Hungarian National History Museum, Budapest	BP	4354	1804–2009	258	53	20
University of Debrecen, Debrecen	DE	666	1878–2009	68	45	18
Eötvös Loránd University, Budapest	BPU	337	1873–2005	35	46	15
Szent István University, Gödöllő	(SZIE)	294	1868–1978	49	38	15
Móra Ferenc Museum, Szeged	SZE	279	1837–1994	23	36	14
Savaria Museum, Szombathely	SAMU	263	1845–2003	19	35	11
University of Pécs, Pécs	JPU	242	1810–1981	60	41	14
Bakony Natural History Museum, Zirc	(ZIRC)	241	1949–2001	20	32	5
Mátra Museum, Gyöngyös	(MM)	239	1954–1999	14	38	12
Corvinus University, Budapest	(CORV)	194	1885–1952	8	37	14
Janus Pannonius Museum, Pécs	PECS	112	1914–2009	8	27	5
Eszterházy Károly College, Eger	EGR	106	1868–1979	6	36	13
University of West-Hungary, Sopron	(NyME)	80	1870–1971	20	31	9
Reformed College of Debrecen, Debrecen	(DRK)	67	1922–1962	12	20	7
Rippl-Rónay Museum, Kaposvár	(SMMI)	57	1970–2005	9	20	7
Kazinczy Ferenc Museum, Sátoraljaújhely	(KFM)	54	1926–1967	4	31	9
Munkácsy Mihály Museum, Békéscsaba	(BCS)	39	1910–2004	8	15	10
Déri Museum, Debrecen	(DMD)	34	1952–1978	1	14	6

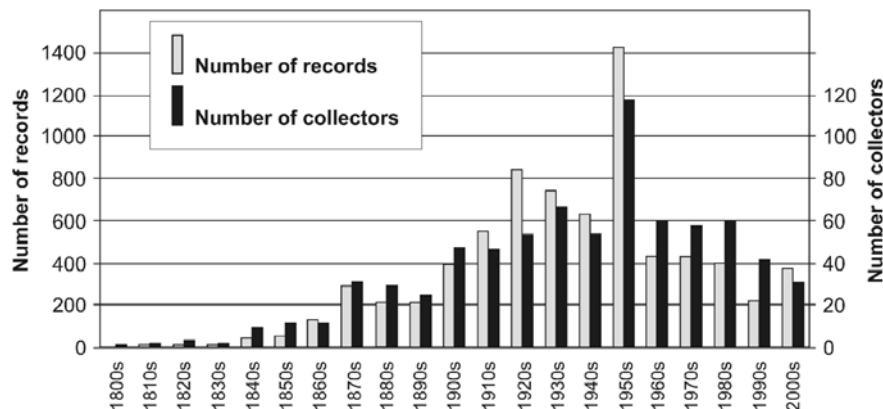


Fig. 1. The numbers of records and collectors broken down to decades.

(u), in terms of counting the number of fruits and the number of all the flowers (fertilised and non-fertilised) in the inflorescence. In some cases other information such as original remarks of the collector on the number of individuals, threatening factors, the habitat or colour variants and other infraspecific taxa were also recorded in a comment column (v).

The Central European flora mapping system (Niklfeld 1971) grid reference and the administrative affiliations of the localities were determined by Gergely Király and József Sulyok based on GIS reference information. Taxonomical revision of the whole dataset was performed by Attila Molnár V. The nomenclature used in this paper follows the results of the recent phylogenetic researches (Bateman et al. 1997). The data of the processed collections were handed over in digital format to the institutions where the herbaria originated. The database itself is the property of the Department of Botany at University of Debrecen (Debrecen, Hungary); data for scientific purpose can be retrieved from the corresponding author.

Results and discussion

The final database contains 7,658 records of 55 species

originating from 452 collectors covering the whole territory of Hungary. Some remarks on the significance of the Hungarian orchid collections can be drawn directly from the raw figures. It is plainly evident that the orchid collection is highly concentrated in Hungary (Table 1); the largest collection at BP has yielded more records than all the other collections together. This indicates the significance and value of the collection stored at Department of Botany of the Hungarian Natural History Museum, but at the same time raises issues of vulnerability; this concentration of irreplaceable material in one place could be lost in an unforeseen event. On the other hand, all collections contain unique sheets that have no duplicates in other collections.

Temporal coverage

In nearly 90% of the specimens we know the exact date of collection (Fig. 2). However, 232 records (3%) from the 19th century and 20 (0.3%) from the 20th century could not be dated accurately, and 23 (0.3%) collections could not be dated at all.

The oldest sheet included in the database dates back to June 1804, while the latest one to July 2009.

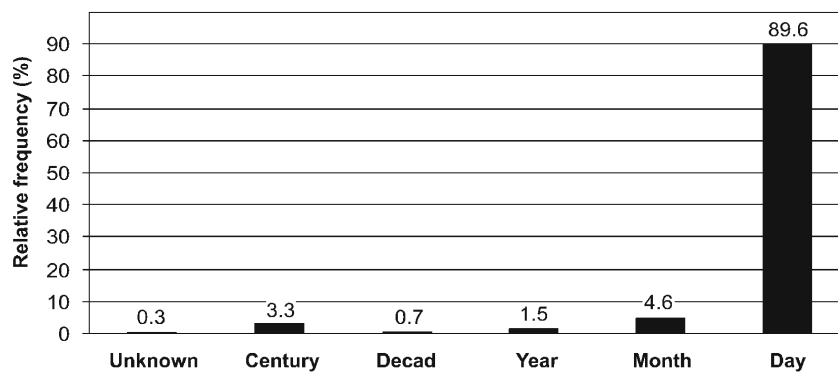


Fig 2. The accuracy of the dating of collections.

From the first half century, 19 years (1804, 1810, 1816, 1825–1827, 1836, 1841–1847, 1849–1854) have collections that can be dated accurately at least to the year; from 1849 onwards, however, every year has at least one collection.

During this period of more than two centuries, the intensity of collection shows considerable fluctuations (Fig. 1), strongly corresponding to the political and economic position of the country, which had a major influence on the floristic and taxonomic researches in Hungary. There was a peak in the level of collecting around the time of the Austro-Hungarian Compromise (1867) attributable to the work of Nándor Filarszky, Lajos Simonkai, Márton Vrabélyi, Győző Szépligeti, and Gyula Ágoston Tauscher, and from this time on, we can also find sheets from Lajos Jurányi, Sándor Feichtinger and Vince Borbás as well. From the 1880's to the 1920's, the number of collected orchids per decade grew continuously in Hungary. During the 1930's and 40's there was a reduction due to the economic difficulties and the World Wars. Both the number of collected plants and the number of the researchers involved in collecting peaked in the 1950's. In fact, the most intensive collecting can be dated to the period 1947–1955, since during this period an average of 106 sheets of orchids were collected yearly for scientific purposes. Interestingly, in 1956 the intensity of collection dropped abruptly by half, perhaps another sharp reflection of the country's political conditions. The abovementioned "Heroic Era" of orchid-collecting in Hungary can be characterised by the work of Rezső Soó's followers and colleagues (Imre Máthé, Lajos Felföldy, Olga Borsos, Pál Jakucs, Tibor Simon, Tamás Pócs, László Pólya, Endre Jeney, Gábor Vida, Szaniszló Prisztner, Zoltán Kárpáti), forester-botanists (Antal Majer, István Csapody, István Szodfridt, Pál Tallós, Ferenc Szy, Rudolf Vancsura), staff of the Department of Botany at the Hungarian Natural-History Museum (Sándor Jávorka, Bálint Zólyomi, Leona Baksay, József Ujhelyi, József Stieber, Júlia Szujkó-Lacza), and amateur botanists (Árpád Károlyi, Lehel Bánó, Rezső Moldvai, Miklós Szalai, László Vajda). Notwithstanding, other significant botanists of the era like Ádám Boros, József Papp, Antal Péntes and Zoltán Siroki also played significant roles, and although they worked as "applied botanists" (mostly in the field

of agronomy), they have intensively contributed to the collections.

The decrease in the number of collected orchids during the 1960's and 1970's is coincident with the shift of attention of Hungarian botanists from floristics and taxonomy to other fields of botany such as vegetation science, ecology, and production biology. Later on, despite the clear significant increase in floristics from the 1990's onward (Fekete 1998), no significant increase in collection can be observed. There are several reasons that might explain this phenomenon, but interestingly, the growing importance of legal species protection does not seem to have played a significant role, since there has also been a reduction in collecting other, non-protected taxa. We have to admit that collection has become somewhat "old-fashioned" in recent years. Although the ease of access to photography for documentary purposes has clearly contributed to the decrease in collecting from the 1980's onward, the interval between the "Heroic Era" and the botanists of the 1990's was probably so long that many young botanists have come to underrate the value of collecting. Possibly, this is mirrored in the figures for the latest years: the number of collected specimens has increased in the last decade, but the number of collectors has decreased gradually since the 1980's, although this seems to be a more general phenomenon that extends far beyond Hungary (Prather et al. 2004).

Geographic coverage

Orchids were collected from all 19 counties of Hungary as well as from the independent administrative unit of the capital, Budapest, but the spatial distribution of collection is extremely uneven (Table 2). Approximately 34% of the collected sheets are from the capital and Pest county, while less than 2% come from Jász-Nagykun-Szolnok, Békés, Tolna and Nógrád Counties altogether. While only a few sheets prove the presence of orchids from Cserhát Hills (Nógrád County) and from whole of Tolna County, a multitude of records are from the "shrine-areas" of certain botanists. Another aspect of this unevenness is the overrepresentation of "botanical sanctuaries" in the collections: e.g. almost half (48.2%) of the collections from County Szabolcs-Szatmár-Bereg comes from the outskirts of a single set-

Table 2. Orchid records of Hungarian counties and the capital.

County	No. of records	No. of species	No. of collectors	Time span	Years
Pest	1283	36	138	1810–2007	197
Budapest	1316	43	134	1826–2009	183
Veszprém	709	42	100	1844–2009	165
Borsod-Abaúj-Zemplén	627	37	85	1871–2009	138
Győr-Moson-Sopron	413	36	64	1825–2007	182
Heves	491	36	88	1818–2003	185
Baranya	387	34	86	1804–2009	205
Bács-Kiskun	380	24	59	1872–1995	123
Zala	365	31	42	1846–2009	163
Vas	324	29	51	1882–2003	121
Fejér	275	33	52	1869–2009	140
Komárom-Esztergom	240	36	33	1837–2007	170
Szabolcs-Szatmár-Bereg	195	21	30	1861–2004	143
Somogy	195	21	46	1912–2006	94
Csongrád	139	9	20	1901–1993	92
Hajdú-Bihar	131	11	27	1903–2007	104
Nógrád	73	21	31	1870–2005	135
Tolna	36	16	16	1871–2002	131
Békés	31	9	4	1921–2002	81
Jász-Nagykun-Szolnok	6	3	5	1988–2004	16

Table 3. The research intensity of the orchid-flora of the Hungarian counties and the capital as expressed by the sum of three relative measures based on data from the investigated herbaria.

County	No. of records / No. of species (A)	No. of collectors / No. of species (B)	No. of species / No. of years (C)	Research intensity (A + B + C)
Pest	35.64	3.83	0.18	39.7
Budapest	30.6	3.12	0.23	34
Veszprém	16.88	2.38	0.25	19.5
Borsod-Abaúj-Zemplén	16.95	2.3	0.27	19.5
Heves	16.64	2.44	0.19	19.27
Bács-Kiskun	15.83	2.46	0.2	18.5
Csongrád	15.44	2.22	0.1	17.8
Hajdú-Bihar	11.91	2.45	0.11	14.5
Baranya	11.38	2.53	0.17	14.1
Győr-Moson-Sopron	11.47	1.78	0.2	13.5
Zala	11.77	1.35	0.19	13.3
Vas	11.17	1.76	0.24	13.2
Somogy	9.29	2.19	0.22	11.7
Szabolcs-Szatmár-Bereg	9.29	1.43	0.15	10.9
Fejér	8.33	1.58	0.24	10.2
Komárom-Esztergom	6.67	0.92	0.21	7.8
Nógrád	3.48	1.48	0.16	5.1
Békés	3.44	0.44	0.11	4
Jász-Nagykun-Szolnok	2	1.67	0.19	3.9
Tolna	2.25	1	0.12	3.4

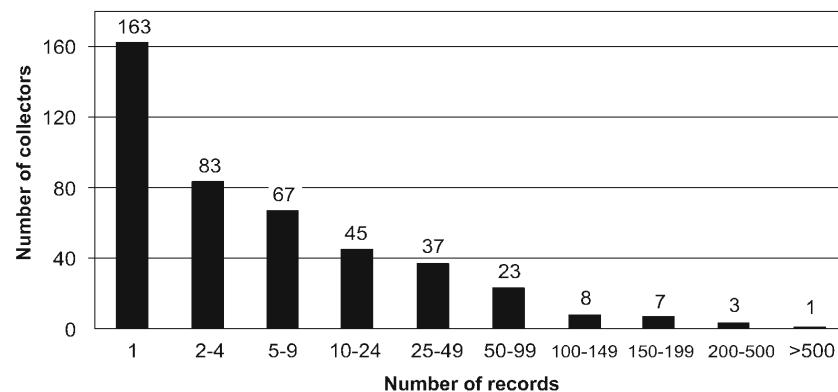


Fig. 3. The number of collectors in the view of collected sheets.

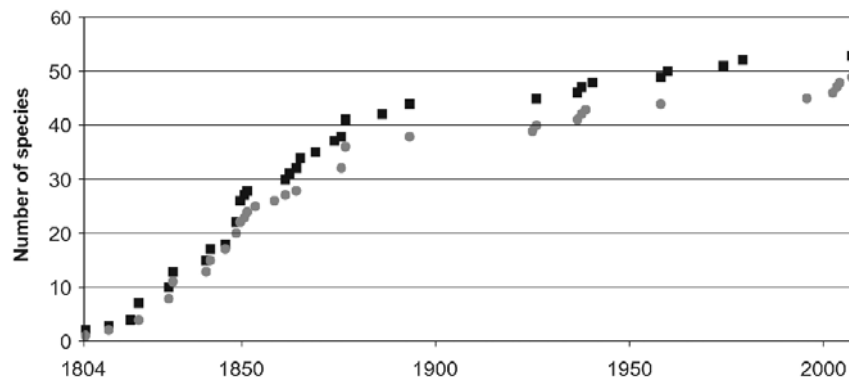


Fig. 4. Number of hitherto collected species (black squares) and collections specifically identified (grey dots) plotted against time from 1804 to 2008 as represented in the investigated Hungarian herbaria.

Table 4. The top 30 most effective collectors of the orchid-flora in Hungary.

Collector	No. of specimens	No. of counties	No. of species	Time Period
Ádám Boros (1900–1973)	666	18	40	1913–1968
Rezső Soó (1903–1980)	245	16	33	1922–1965
Sándor Jávorka (1883–1961)	238	15	39	1903–1954
Árpád Károlyi (1907–1972)	222	10	33	1944–1966
Norbert Bauer (1973–)	194	9	33	1999–2009
Endre Jeney (1934–2004)	187	16	31	1953–2001
Zoltán Siroki (1906–1987)	163	11	32	1939–1984
József Papp (1900–1985)	162	15	32	1935–1964
Zoltán Kárpáti (1909–1972)	157	12	32	1929–1952
Dénes Gotthárd (1905–2002)	153	9	32	1965–1992
Győző Csongor (1915–1997)	153	8	23	1947–1991
Zoltán Zsák (1880–1966)	148	11	31	1908–1940
Nándor Filarszky (1858–1941)	148	20	27	1871–1929
Sándor Polgár (1876–1944)	139	6	32	1898–1941
Árpád Degen (1866–1934)	130	9	32	1898–1932
István Galambos (1949–)	120	5	28	1973–2000
Géza Lengyel (1884–1965)	112	11	29	1901–1955
Tibor Simon (1926–)	103	8	28	1947–1962
Lajos Felföldy (1920–)	102	11	20	1937–2004
Lajos Simonkai (1850–1910)	91	8	31	1870–1906
Lehel Bánó (1905–1964)	91	11	33	1934–1959
László Vajda (1890–1986)	83	12	34	1911–1954
Gábor Vida (1935–)	81	11	29	1951–1957
Ferenc Kováts (1873–1956)	77	8	21	1925–1934
András Horánszky (1928–)	75	8	26	1946–1961
Gyula Ágoston Tauscher (1833–1882)	74	4	30	1850–1879
János Tuzson (1870–1943)	73	8	26	1906–1936
Tamás Pócs (1933–)	73	12	30	1944–1960
Márton Vrabélyi (1807–1877)	71	1	23	1865–1873
József Budai (1851–1939)	69	2	26	1897–1915

tlement, Bátorliget, where the “Bátorliget mire” is situated nearby.

If we look into the causes of this geographic unevenness, we must conclude that the size of a given county and the number of orchids in it are not the only reasons for the unevenness; the accessibility of certain areas may play a significant role. In our opinion the number of collected species alone does not faithfully mirror research intensity in a certain area. This could be better characterised by the following three factors: i) number of collected specimens; ii) number of collectors; and iii) time span of collection. If we compare these three factors with the number of species in certain counties (Table 3), we find there are virtually unex-

plored areas among those counties with moderate, not the lowest, numbers of species present. These are e.g. Nógrád County (21 species), Tolna County (16 species) or Komárom-Esztergom County (36 species), which are seemingly less explored than e.g. Hajdú-Bihar County (11 species) or Csongrád County (9 species). This may indicate areas to which contemporary botanists might profitably direct their attentions in future (in terms of discovering additional orchid species).

The collectors

The database contains 243 sheets without an indicated or identifiable collector, while the remaining sheets belong to 452 collectors. The numbers of sheets attributed

Table 5. The taxa included in the database.

Species	No. of records	No. of specimens	No. of counties	No. of collectors	No. of collections	Time Period
<i>Anacamptis palustris</i> (Jacq.) Bateman, Pridgeon & Chase	491	1099	19	138	18	1847–2006
<i>Anacamptis morio</i> (L.) Bateman, Pridgeon & Chase	464	1329	20	167	18	1827–2009
<i>Platanthera bifolia</i> (L.) Rich.	356	528	18	120	17	1818–2009
<i>Cephalanthera rubra</i> (L.) Rich.	333	622	15	119	17	1836–2007
<i>Cephalanthera damasonium</i> (Mill.) Druce	319	620	18	109	17	1841–2009
<i>Dactylorhiza incarnata</i> (L.) Soó	307	536	18	81	18	1845–2006
<i>Cephalanthera longifolia</i> (L.) Fritsch	300	452	18	105	17	1845–2009
<i>Neottia nidus-avis</i> (L.) Rich.	298	609	17	114	18	1826–2007
<i>Anacamptis pyramidalis</i> (L.) Rich.	269	569	14	91	16	1837–2009
<i>Gymnadenia conopsea</i> (L.) R. Br.	264	526	14	103	14	1804–2009
<i>Orchis militaris</i> L.	262	448	16	90	16	1827–2005
<i>Orchis purpurea</i> Huds.	261	350	14	104	15	1827–2009
<i>Anacamptis coriophora</i> (L.) Bateman, Pridgeon & Chase	248	826	17	96	15	1846–2009
<i>Neottia ovata</i> Bluff. & Fingerh.	243	363	18	95	18	1845–2009
<i>Ophrys sphegodes</i> Mill.	241	736	13	94	15	1845–2009
<i>Neotinea tridentata</i> (Scop.) Bateman, Pridgeon & Chase	240	623	14	85	15	1804–2009
<i>Dactylorhiza sambucina</i> (L.) Soó	195	514	10	89	14	1818–2009
<i>Limodorum abortivum</i> (L.) Sw.	191	288	12	81	16	1826–2009
<i>Epipactis helleborine</i> (L.) Cr.	186	233	16	74	14	1860–2008
<i>Epipactis atrorubens</i> (Hoffm.) Bess.	183	419	14	82	14	1810–2006
<i>Neotinea ustulata</i> (L.) Bateman, Pridgeon & Chase	180	494	12	82	13	1837–2008
<i>Epipactis palustris</i> (L.) Cr.	175	352	13	69	14	1857–2009
<i>Orchis mascula</i> subsp. <i>signifera</i> (Vest) Soó	131	218	9	52	13	1844–2007
<i>Epipactis microphylla</i> (Ehrh.) Sw.	131	266	15	56	11	1826–2008
<i>Platanthera chlorantha</i> (Cust.) Rchb.	123	166	15	54	11	1849–2006
<i>Dactylorhiza majalis</i> (Rchb.) Hunt et Summerh.	109	255	9	46	13	1844–2001
<i>Orchis pallens</i> L.	98	153	10	52	13	1844–2008
<i>Dactylorhiza viridis</i> (L.) Bateman, Pridgeon & Chase	79	210	8	40	12	1865–1999
<i>Dactylorhiza fuchsii</i> (Druce) Soó	68	134	11	38	12	1818–2005
<i>Epipactis purpurata</i> Sm.	67	98	11	26	10	1858–2004
<i>Traunsteinera globosa</i> (L.) Rchb.	66	151	7	35	11	1861–1989
<i>Himantoglossum caprinum</i> (Bieb.) Spreng.	61	77	7	37	5	1816–2007
<i>Orchis simia</i> Lam.	61	96	3	45	14	1873–2002
<i>Ophrys oestrifera</i> Bieb.	45	79	4	22	8	1873–1994
<i>Gymnaenia odoratissima</i> (L.) Rich.	42	86	7	18	5	1836–2000
<i>Spiranthes spiralis</i> (L.) Chevall.	46	144	9	24	9	1872–2008
<i>Ophrys insectifera</i> L. em. Grufb.	44	113	6	22	11	1861–2007
<i>Epipactis voethii</i> Robatsch	39	61	10	28	12	1844–2004
<i>Goodyera repens</i> (L.) R. Br.	37	113	5	17	8	1890–1958
<i>Himantoglossum adriaticum</i> Baumann	26	41	4	13	6	1870–2007
<i>Corallorhiza trifida</i> Chatel.	17	66	4	11	5	1890–1966
<i>Spiranthes aestivalis</i> (L.) Rich.	16	69	2	4	6	1935–1956
<i>Epipactis tallosii</i> Molnár & Robatsch	14	40	8	9	4	1883–2005
<i>Liparis loeselii</i> (L.) Rich.	9	14	2	4	5	1936–1974
<i>Ophrys apifera</i> Huds.	8	13	4	7	2	1873–2007
<i>Ophrys fuciflora</i> (F. W. Schmidt) Moench agg.	8	12	1	2	3	1957–1960
<i>Epipogium aphyllum</i> (Schm.) Sw.	7	14	3	5	4	1924–1975
<i>Epipactis leptochila</i> (Godf.) Godf.	7	12	4	7	3	1870–1996
<i>Epipactis pontica</i> Taubenheim	4	9	2	2	2	1939–1952
<i>Epipactis bugacensis</i> Robatsch	1	2	1	1	1	1974
<i>Epipactis albensis</i> Novakova & Rydlo	1	1	1	1	1	1979
<i>Epipactis futakii</i> Meredá & Potůček	1	1	1	1	1	2008
<i>Dactylorhiza maculata</i> (L.) Soó subsp. <i>transsylvanica</i> (Schur) Soó	1	1	1	1	1	1959
<i>Epipactis placentina</i> Bongiorno & Grünanger	1	2	1	1	1	1865
<i>Malaxis monophyllos</i> (L.) Sw.	1	2	1	1	1	19th century

to each collector show great variation: 36% of the collectors have only one sheet, whereas two-thirds of the collection comes from 10% of the collectors (Fig. 3). Almost half of the collected Hungarian orchid specimens are collected by 30 botanists (Table 4) mainly from the “Heroic Era”, who also collected other vascular plants without preference to orchids. Moreover, many of them collected bryophytes and lichens as well. Although primarily a bryologist, Ádám Boros is distinguished here not only because of his high efficiency in terms of the

number of collected species and specimens and the geographic coverage of the whole country, but also the long time-scale of his collecting activity. He collected his first orchid specimens at the age of 13, while the last one at the age of 68.

Taxa

Plants from the herbarium sheets in the database were successfully identified to the species level in 7,469 cases. The majority of the unidentifiable 189 records (183)

Table 6. The hidden presence of recently described species in Hungarian herbaria.

Species	Description	First year of collection, location	Collector
<i>Epipactis pontica</i>	Taubenheim (1975)	1939, near Bozsok	J. Jeanplong
<i>Himantoglossum adriaticum</i>	Baumann (1978)	1870, near Eger	M. Vrabélyi
<i>Epipactis bugacensis</i>	Robatsch (1990)	1974, near Zsombó	Gy. Csongor
<i>Epipactis nordeniorum</i>	Robatsch (1991)	1957, near Hidegkút	L. Felföldy
<i>Epipactis voethii</i>	Robatsch (1993)	1862, near Budapest	Gy. Tauscher
<i>Epipactis placentina</i>	Bongiorni & Grünanger (1993)	1865, near Parád	M. Vrabélyi
<i>Epipactis tallosii</i>	Molnár & Robatsch (1997)	1884, near Budapest	G. Hermann

belong to the taxonomically critical genus *Epipactis*, and the other 5 cases are vegetative or fruit-bearing tuberous plants without flowers. The data of 15,656 specimens (shoots) belonging to 55 species are included in the database (Table 5). The overall number of species present in different herbaria rises steeply until the 1880s (Fig. 4), and it continues to rise after that, though less steeply. *Anacamptis palustris* s. l. is the species represented most abundantly in the database (491 records), and it is followed by other common species such as *Anacamptis morio* (464 records), *Platanthera bifolia* (356 records), *Cephalanthera rubra* (333 records) and *C. damasonium* (319 records). Interestingly, the rather rare and local *Ophrys sphegodes* is the 11th on the list, while the 9th rank of *Anacamptis coriophora*, which is rather rare in other countries, also reflects to its relative abundance in Hungary. Altogether five species with known occurrence in Hungary (*Dactylorhiza lapponica* (Laestadius ex Hartman) Soó, *Epipactis exilis* P. Delforge, *Epipactis mecsekensis* Molnár & Robatsch, *Epipactis moravica* Batoušek, *Hammarbya paludosa* (L.) Kuntze) have no voucher specimen in the processed herbaria. On the other hand, the unambiguous presence of one of the three extinct Hungarian orchid species (Király 2007) can be validated by herbarium sheets. The first one is *Malaxis monophyllos*, for which we have one single sheet with two blooming specimens (BP). According to the label on the sheet, which has the handwriting of Gyula Tauscher, the specimen was collected by Bernardus Müller near Szentendre, on a forest meadow (clearing?) ("*E. pratensis sylvestribus ad Szent Endre cottus Pesthinensis*"). Although no date is mentioned on the label, the sheet can be dated before the death of Tauscher in 1883. As testified by this specimen, there is no reason for doubting the former presence of the species in the territory of present day Hungary, but we do not know its exact location or the cause of its disappearance.

The second case is of *Herminium monorchis*, of which we have two sheets, but neither of them can be unambiguously located. One undated specimen (JPU) collected by Tamás Nendtvich (1782–1858) from the 19th century specifies the collecting location as "Hungaria", which can easily refer to the territory of Kingdom of Hungary (for more details of confusions emerging from the territorial changes of the country consult Molnár 2007). The other specimen (BP) also dates back to the 19th century, and is from the herbarium of József Sadler. The plant is named as "*Malaxis*" on the la-

bel, and originating from Lake Fertő ("*Am Neusiedler See*"). However, this lake is now situated on the boundary between Austria and Hungary set after World War 1, therefore we can not exclude the possibility that it originated from what is now the Austrian side of the lake. Moreover, if we take the different habitats available on either side of the state boundary into consideration, it seems more likely that the plant originated from the other side of the lake. Therefore, the presence of the species in the territory of present day Hungary can not be validated in the absence of any unambiguous voucher specimens.

The taxonomic value of herbaria can be well exemplified by the presence of specimens of undescribed species: e.g. the presence of the *Epipactis leptochila* and *E. muelleri* in the former Czechoslovakia and in Hungary was unravelled by herbarial revision (Holub 1970, 1972). Out of the recently described 13 orchid species hitherto unknown from Hungary, eight had unidentified specimens in the collections, moreover, 7 were collected decades before description (Table 6); e.g. *Himantoglossum adriaticum*, described in 1978 (Baumann 1978), was collected in 1870 near Eger by Márton Vrabélyi; *Epipactis voethii*, described in 1993 (Robatsch 1993), was collected near Budapest as early as in 1862 by Gyula Ágoston Tauscher.

Herbaria evidently provide valuable data for taxonomic purposes, but there are other less direct uses as well. One emerging application is the collection of historical data on the phenological characteristics of taxa, which is an invaluable source in climate change studies (Robbirt et al. 2011). Herbarium sheets can provide important and statistically meaningful information on the seed and fruit-set of endangered taxa, even in an historical context (Farrell 1985: 1050.). They have an important role in documenting the historical distribution of taxa, which allows us to draw conclusions on conservation issues, i.e. the decline and vulnerability of species by comparing historical and recent data (Jacquemyn et al. 2005; Kull & Hutchings 2006). This account of the valuable applications of herbaria is far from complete, and certainly other, unforeseen uses may emerge.

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