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BEES FOR POLLINATION

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THE FAUNISTIC DRIFT OF APOIDEA IN BELGIUM

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ABSTRACT

The authors studied the faunistic drift in Apoidea of Belgium by comparing the relative number of species before and 1950 onwards. The change in the abundance was estimated by the Stroot & Depiereux (1989) method. On 360 species, 91 are decreasing (25,2%), 145 are stable (40,2%), 39 are expanding (10,8%), and 85 have an indeterminable status (rare species: 23,5%). This regression cannot be attributed to a lack of observations as they are more numerous in the second period. The authors compare different hypotheses that could explain this global regression. As the most important one affects species with a long tongue, it is likely due to the fall in availability of plants with long corollae (e.g. Lamiaceae, Fabaceae, Scrophulariaceae). The strong relative regression of cleptoparasites could be seen as the result of an absolute numerical decrease of all Apoidea. The relative regression of species nesting in ground could be the evidence of the lacking availability or suitability of open areas through afforestation, urbanization or agricultural intensification. The regression which strongly affects long tongue species seriously threatens the maintain of an appropriate pollination level of wild and cultivated plants.

INTRODUCTION

Among the Apoidea, only bumblebees were subjected to a quantitative estimation of the faunistic drift (Williams et al., 1991) and this, just in two European areas: Great Britain (Williams, 1985, 1986), Belgium and North of France (Rasmont, 1988; Rasmont & Mersch, 1988). An estimation of this faunistic drift for solitary bees is so missing.

Leclercq et al. (1980) points out 13 species of Apoidea among the ones that make up their "*first red list of threatened insects in the Belgian fauna*". However, the method used then to determine the status of the populations of these species does not include the abundance criterion. This short list is just the outcome of the consideration of the geographical spreading of taxa. A species was added to this "*first red list*" only if the number of occupied 10 km UTM squares since 1950 indicates a regression of 10 units in relation with the number of squares occupied before this year. This criterion allowed the useful determination of the 13 most threatened species. Nonetheless, the examination of old documents and the comparison of entomologists' recollections indicate that the Apoidea entomofauna has been much more deeply modified. Very often, the regression of a species isn't marked by a heavy fall in its distribution but by a decrease in its relative frequency.

Moreover, something can be added: the fact that a great part of the fauna is decreasing while another one is expanding can be seen as quite normal. The regression and expansion phenomena could be just the expression of a random variation of the fauna.

Therefore, it is very important to study not only the geographical distribution but also the numerical variations of the species: the faunistic drift.

By "***faunistic drift***" we mean any modification of the relative specific composition of local faunae along time. This change is, in general but not always, linked to variations in the geographical distribution of species. "*Faunistic drift*" is a locution which has the advantage of being presumptively neutral, unlike the words "*expansion*" or "*regression*". Moreover, it reminds, by analogy with "*genetic drift*", that a great part of the population changes estimation can be stochastic or comes out of a sampling bias.

Thanks to a recent update of the Gembloux and Mons faunistic data bank, an estimation of the faunistic drift of Apoidea in Belgium can be provided.

MATERIAL AND METHODS

The Gembloux faunistic data bank has encoded all the data concerning Apoidea of Belgium, Luxembourg, the North of France and neighbouring areas till 1988. Since then, the University of Mons-Hainaut is also taking part in this collection of information.

The data are managed by the Microbanque faunique 2.0 (Rasmont & Barbier, 1991) software.

For Belgium alone, 48.654 data on 79.765 solitary bees specimens of the 1900-1991 period are now available. The main authors of these data are: J.Leclercq, A.Jacob-Remacle, A.Pauly, V.Lefeber, P.Mathot, J.Petit, K.Janssens, C.Thirion, L.Verleysen and P.Rasmont. The other authors are (in decreasing order of contribution) K.Warncke, Liongo li Enkulu, M.Schwarz, A.Ruwet, G.Vander Zanden, L. et C.Verlinden, H.M.Warlet, H.Wiering, D.Gryffroy, J.J.Pasteels, Y.Barbier, C.Verstraeten, G.Pagliano, J.Decelle, J.Van Schepdael, C.Burgeon, C.Luyts, P.M.F.Verhoeff, J.Beaulieu and C.Gaspar.

Only data including at least the year and the province are taken into account.

Origin of data	before1900 or without date	before 1950	since 1950
field	9	3	1.214
litterature	1.583	1.495	728
collection	6.210	12.573	63.752
Total number of specimens	7.802	14.071	65.694
Data of the present study		79.765	

Table I. Solitary Apoidea studied

All distribution maps of solitary bees of Belgium were published from 1971 to 1982 (Jacob-Remacle, 1982; Leclercq & Rasmont, 1985; Leclercq, 1971, 1972a,b, 1982; Liongo li Enkulu, 1982; Mathot, 1982; Pauly, 1978,1982a,b,c). Those of Apidae Bombinae were published by Rasmont (1988).

We use the Stroot & Depiereux (1989) method to estimate the faunistic drift. This method is very attractive as it puts forward an objective estimation criterion which takes into account differences of sampling effort during the different periods.

For bumblebees (Apidae Bombinae), the data of Rasmont & Mersch (1988) are reinterpreted thanks to the Stroot & Depiereux (1989) method. However, the estimation criterion for this family is the number of specimens in collection and not the number of occurrences.

Origin of data	before 1950	since 1950
field	20	2.284
litterature	914	324
collection	78.003*	12.282
Total number of specimens	78.937	14.890

* all specimens are not yet encoded but they have been all identified and counted.

Table II. Apidae Bombinae data from Rasmont & Mersch, 1988

The *Apis mellifera* (L.) case has not at all been considered here as it is known in Belgium just as a domestic insect. Therefore, Apidae include here bumblebees (Bombinae) only.

The data cover is detailed in the tables I and II. The survey seems to have been comprehensive for both periods (fig.1), except for the West-Vlaanderen province and the Gent surroundings.

For each species, the status calculated by the Stroot & Depiereux (1989) method is compared with the distribution map of the species. This lead first to the correction of the status of most species determined as " *significantly*" (*) or "*highly significantly decreasing*" (**) then, to the conclusion that they are "*more or less stable*". Are particularly concerned the species which are very confined and whose number of occupied UTM squares did not decrease nor increase by more than 25% (apparently stable distribution). The explanation of this systematic bias is that because of the sharp increase in the total number of occurrences for the second period, such a stability has been computed as a relative regression.

In the opposite, all species in significant (*) or highly significant (**) expansion actually indicate a distinct increase in the number of occupied UTM squares (more than 25% increase).

Incontestably all species computed as very highly significantly decreasing or increasing (***) present respectively a sharp regression or expansion. (at least 25% of difference in the observed UTM squares number).

	observed estimator			expected estimator			
	before 1950	since 1950	TOTAL	before 1950	since 1950	chi^2	trend
species 1	p_{11}	p_{12}	$T_{1.}$	e_{11}	e_{12}	I_1	(-)
species 2	p_{21}	p_{22}	$T_{2.}$	e_{21}	e_{22}	I_2	+
species 3	p_{31}	p_{32}	$T_{3.}$	e_{31}	e_{32}	I_3	=
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
species i	p_{i1}	p_{i2}	$T_{i.}$	e_{i1}	e_{i2}	I_i	.
TOTAL	$T_{.1}$	$T_{.2}$	T	$T_{.1}$	$T_{.2}$		

Table III. Estimating faunistic drift using the Stroot & Depiereux (1989) method

population estimator can be:
- number of specimens in collections
- number of lines in data bank
- number of grid squares
- number of sample units
- number of occurrences (1 occurrence = at least one observation of the taxa in a given grid square during a given year).

Expected estimator

$$E_{ij} = \frac{T_{i.} * T_{.j}}{T}$$

$$I_i = \sum_{j=1}^{2} \frac{(p_{ij} - e_{ij})^2}{e_{ij}}$$

The value I_i is compared with the value of chi^2 distribution (1 d° of freedom).
- : species in relative regression
= : species in relative status quo
+ : species in relative expansion
() : species with an expected estimator < 5 for the "since" period.

For the present study, the population estimators are

- occurrences by UTM(10km) * year, for the solitary Apoidea;
- number of specimens, for the bumblebees.

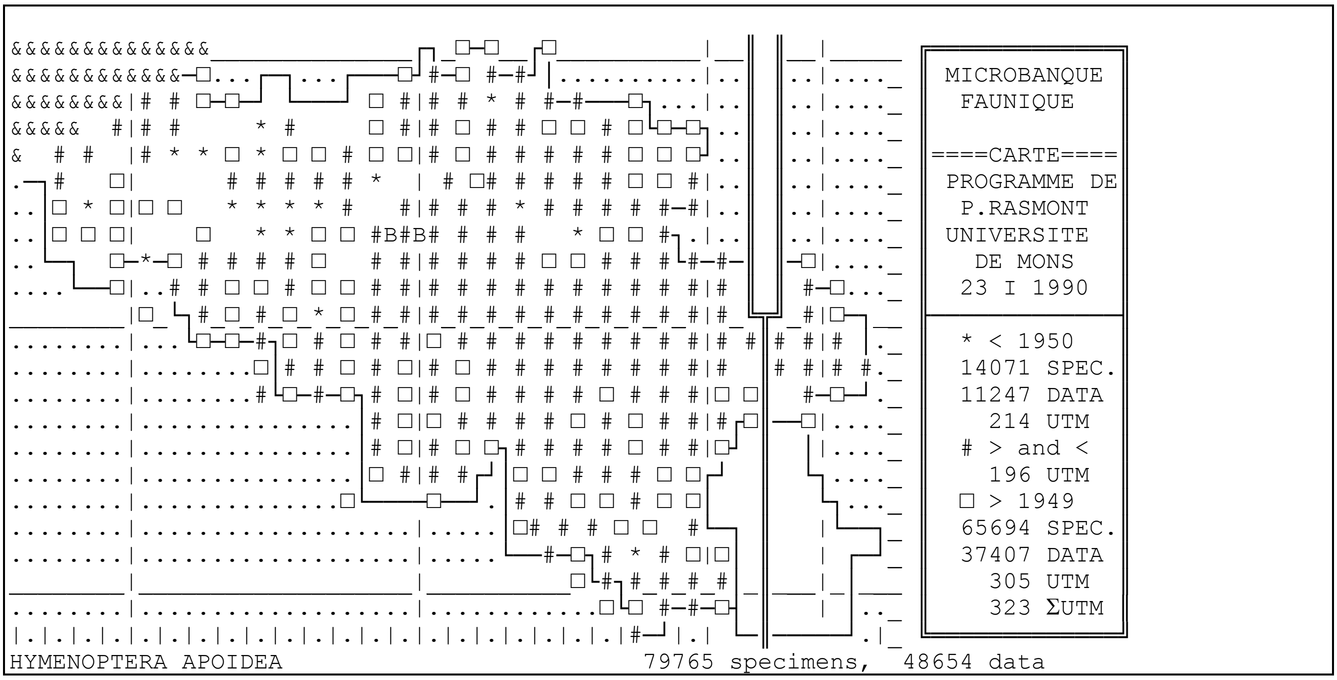

Figure 1. Solitary Apoidea of Belgium; covering of the survey 1.III.1992
(B: localisation of Brussels)

RESULTS

330 species of solitary Apoidea are observed in Belgium for the 1900-1992 period. Rasmont & Mersch (1988) point out for the same period 30 species of bumblebees. The detailled list of taxa is annexed.

On the 360 Apoid species known in Belgium for the studied period, 91 are decreasing (25,2%), 145 are more or less stable (40,2%), 39 are expanding (10,8%), and 85 are in an undetermined situation (rare species: 23,5%) (fig.2).

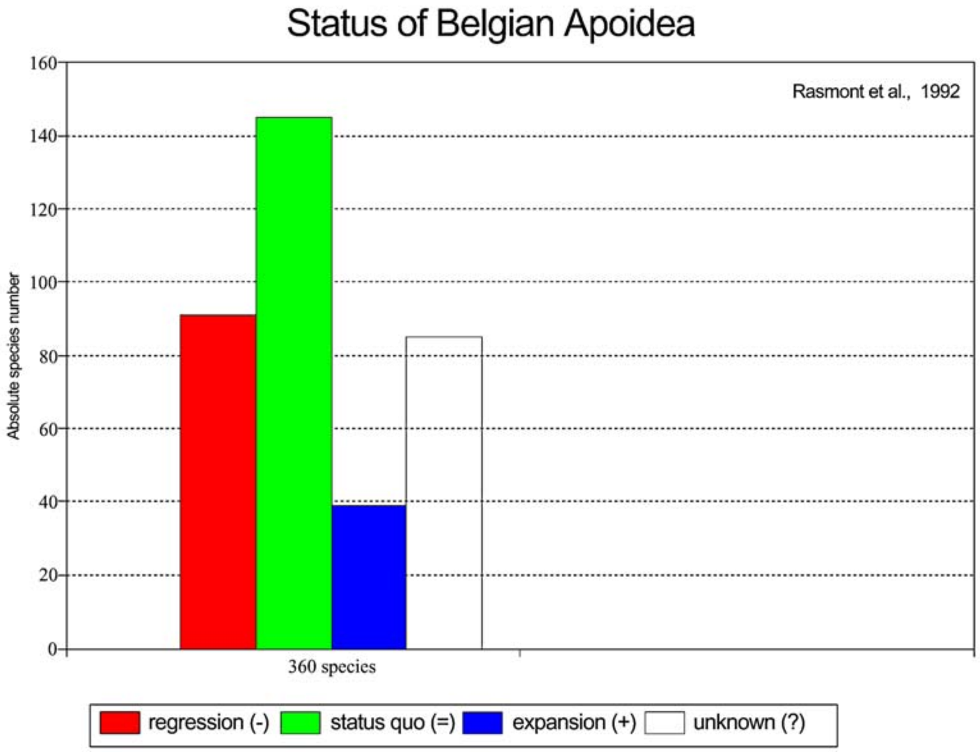

Figure 2.

DISCUSSION

The present study confirms the status of the 13 species pointed as decreasing by Leclercq et al. (1980).

For solitary bees, the relative regression of species cannot be explained by a shortage in the observations (14.071 specimens before 1950 and 65.694 since 1950).

Besides, the regression rate of bumblebees is probably a bit overestimated (19 taxa in regression on 28 studied: 68%). According to Rasmont (1988) and Rasmont & Mersch (1988), the regression is less pronounced than following the present criteria (14 taxa in regression on 28: 50%) (table IV).

Table IV.
Apoidea Bombinae: comparison between the trend estimated by the Stroot & Depiereux method and the trend estimated by Rasmont & Mersch, 1988

	estimator				chi2	trend	Rasmont & Mersch,1988
	observed		expected				
Psithyrus rupestris	590	14	509	95	82.24	-***	-
Psithyrus vestalis	867	38	762	143	91.17	-***	-
Psithyrus bohemicus	245	166	346	65	187.67	+***	+
Psithyrus campestris	1417	181	1346	252	23.70	-***	=
Psithyrus barbutellus	669	17	578	108	91.20	-***	-
Psithyrus quadricolor	1	0	1	0	0.19	(=)	?
Psithyrus sylvestris	688	531	1027	192	709.19	+***	+
Psithyrus norvegicus	4	24	24	4	103.17	(+)	+
Confusibombus confusus	153	1	130	24	26.50	-***	-
*Bombus s.s.**	20791	3330	20318	3803	69.75	-***	=
Alpigenobombus wurfleini	3	0	3	0	0.56	(=)	-
Pyrobombus hypnorum	1384	772	1816	340	652.15	+***	+
Pyrobombus pratorum	3603	3597	6065	1135	6339.15	+***	+
Pyrobombus jonellus	286	25	262	49	13.98	-***	=
Pyrobombus lapidarius	10714	971	9843	1842	489.05	-***	=
Pyrobombus cullumanus	9	0	8	1	1.68	(=)	-
Pyrobombus soroeensis	526	49	484	91	22.72	-***	=
Megabombus ruderatus	2504	8	2116	396	451.33	-***	-
Megabombus hortorum	5529	865	5386	1008	24.09	-***	=
Megabombus subterraneus	338	16	298	56	33.71	-***	-
Megabombus distinguendus	796	3	673	126	142.50	-***	-
Megabombus pomorum	400	1	338	63	72.69	-***	-
Megabombus sylvarum	622	35	553	104	53.90	-***	-
Megabombus veteranus	3786	31	3215	602	642.66	-***	-
Megabombus ruderarius	1599	185	1503	281	39.10	-***	=
Megabombus muscorum	1003	8	852	159	170.70	-***	-
Megabombus humilis	857	27	745	139	107.55	-***	-
Megabombus pascuorum	20176	3995	20359	3812	10.60	+**	=
	79560	14890	79561	14890			

* ***Bombus terrestris*** auct., ***B.lucorum*** (L.), ***B.cryptarum*** (Fabr.) and ***B.magnus*** Vogt are not separated for this study.

The regression is not equal for the different taxa (fig. 3).

The regression is sharp for Apidae and Anthophoridae (species with a long tongue preferring zygomorphic flowers with a long corolla): the number of decreasing species is prevailing and is far more greater than the number of stable or expanding ones. The regression is also sharp for Megachilidae (medium to long tongue): almost 25% of species are decreasing. However, almost 50% of the species are stable.

For Halictidae (short tongue), the regression is sharper than the expansion. Above all, however the majority of species are stable.

For Andrenidae and Colletidae (very short to short tongue), many species are stable and the number of increasing species is greater than the number of decreasing ones. In Melittidae (7 taxa with short tongue) and Rasmont & Mersch (1988), species are stable, except *Macropis europaea* which is distinctly decreasing (this has already been noticed by Leclercq et al., 1980).

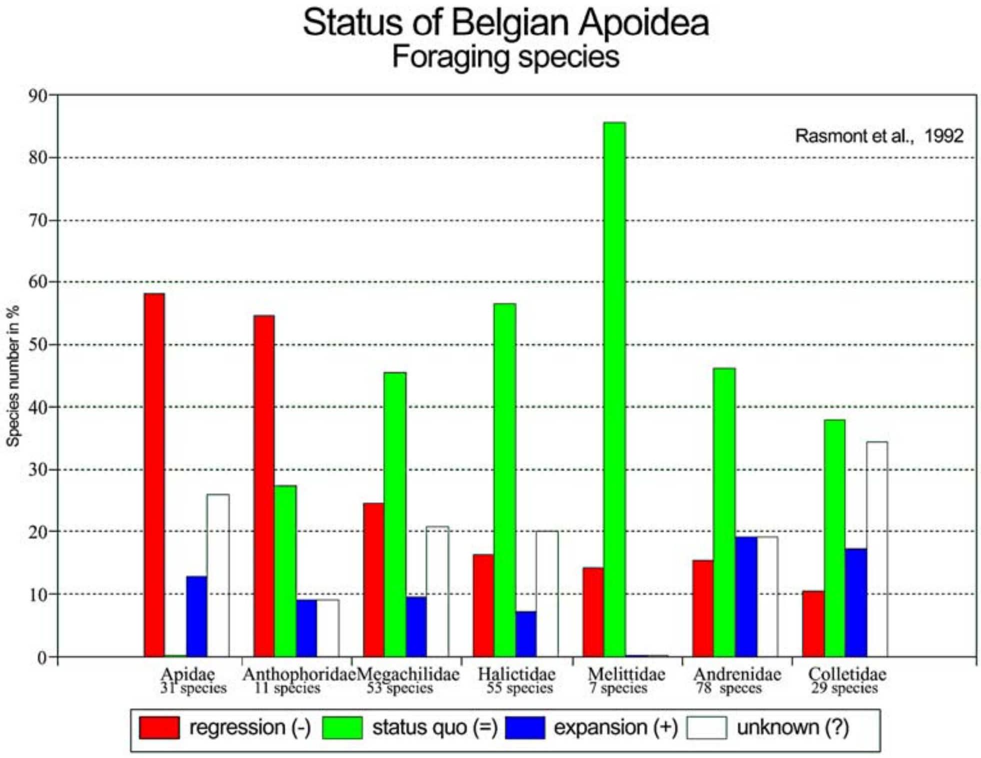

Figure 3.

It seems so that the foraging taxa with a long tongue show a relative decrease particularly in comparison with species with a short one. The latter seem to be more or less stable or even in a relative small increase. The number of decreasing species is smaller than the number of increasing ones but the most important fact is that the stable species have a clear majority. This appears clearly in fig.4 where taxa have been gathered in three categories: species with a medium to a long tongue, species with a very short to a short tongue, and cleptoparasitic species.

This leads us to believe that the Apoidea regression is due first of all to the loss of floral resources which would be particularly marked for plants with long corollae (Fabaceae, Lamiaceae, Scophulariaceae, Boraginaceae). Rasmont (1988) and Rasmont & Mersch (1988) have already noticed that the decrease of legume crops (Fabaceae) seems enough to explain the regression of most bumblebees species in Belgium (table V). The study of the data on the other wild Apoidea confirms this hypothesis. It must be added the excessive maintenance and erasing of embankments, side roads and public areas, which are privileged locations for Lamiaceae (e.g. *Lamium* spp., *Ballota nigra*) and Boraginaceae (e.g. *Echium vulgare, Symphytum officinale*).

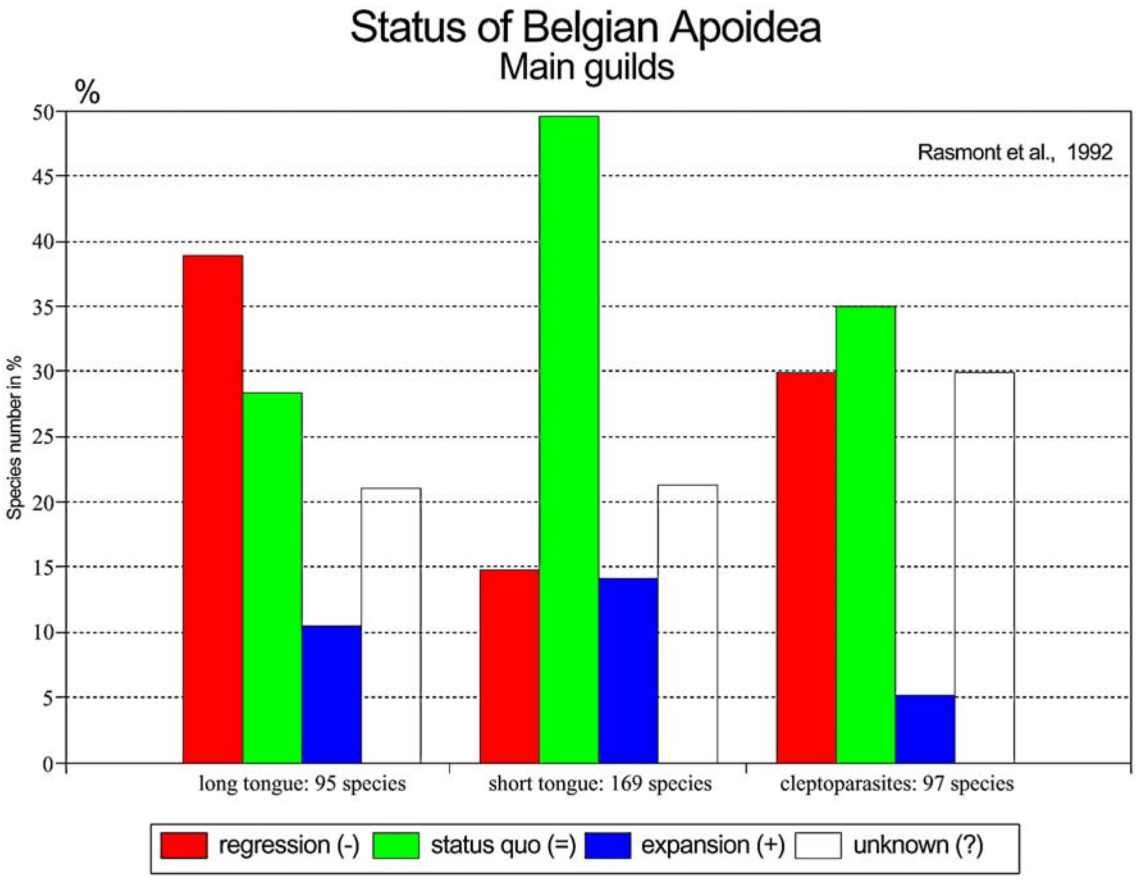

Figure 4.

Table V

Cultivated area of legumes in Belgium

(thousands ha)	1908	1913	1929	1950	1959	1970	1985
Alfalfa (*Medicago sativa*)	13,9	13,3	7,6	13,0	8,7	6,1	1,3
Clovers (*Trifolium* spp.)	141,9	128,6	78,1	31,5	29,1	7,0	1,1
Sainfoin (*Onobrychis viciifolia*)	7,9	5,2	2,2	0,4	0,1	0,0	0,0
Pea (*Pisum sativum*) and bean (*Vicia faba*)	14,5	13,3	10,2	9,7	11,1	5,6	0,8
Total area	178,2	160,4	98,1	54,6	49,0	18,7	3,2

Sources: Statistique de la Belgique, 1910, 1914; Office central de la Statistique, 1937; Institut National des Statistiques, 1953, 1961-1964, 1976, 1986.

The very sharp regression of most of cleptoparasitic species (fig.5) is noticed too, especially in Megachilidae and Anthophoridae. This is curious since Anthophoridae parasite especially Andrenidae and Colletidae, taxa with short tongue, stable or in relative increase. The only hypothesis that could be put forward to explain this cleptoparasites regression is that it probably expresses an absolute numerical decrease of the hosts. Indeed, the survival of a cleptoparasitic species needs that the populations of its host are numerous. In case of a numerical regression of the host, even if its geographical distribution is not affected, its cleptoparasitic species would undergo a more than proportional decrease. Besides the relative regression of the long tongue species, an absolute regression of whole Apoidea superfamily must be feared.

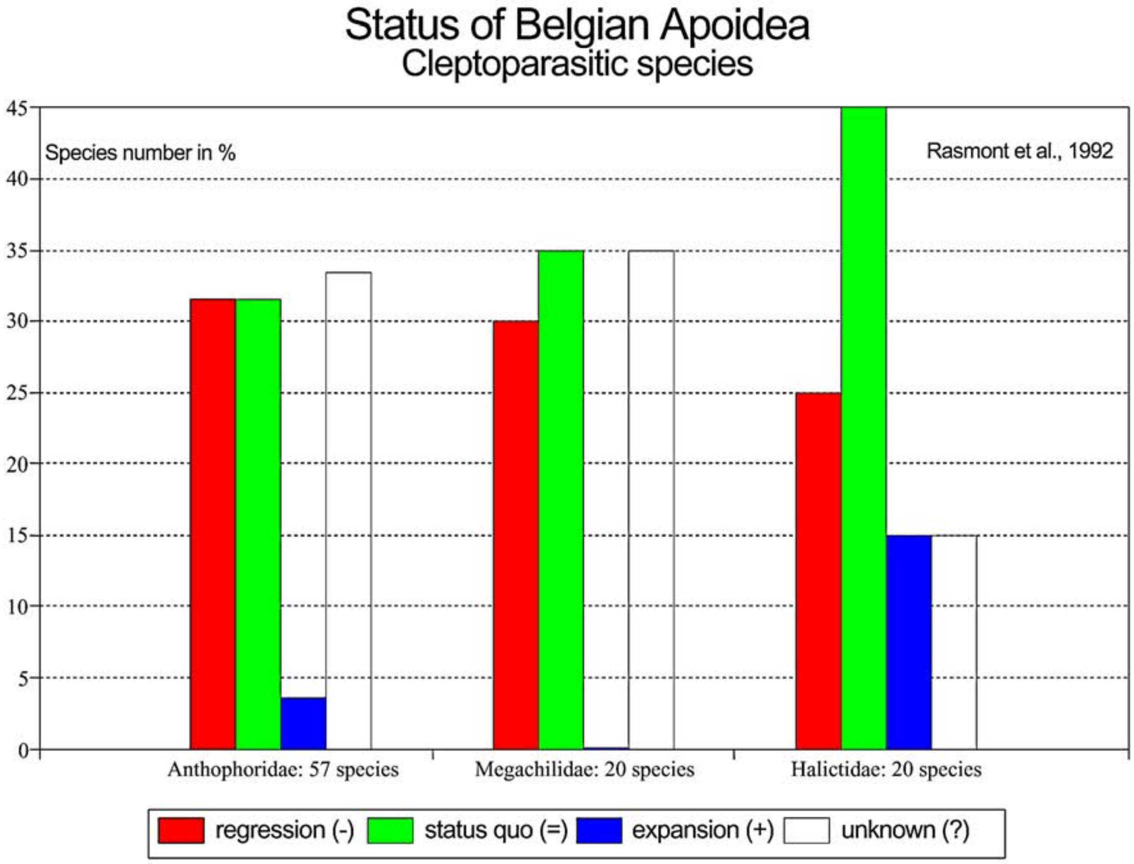

Figure 5.

Some nesting habits (listed by Westrich, 1990) seem to be correlated to the regression (fig.6). The few Belgian species nesting in snail shells are not worth discussing here as their number is too small. Species with nests in ground holes seem to be more threatened than the ones nesting in wood or plant stems, what had already been noticed by Westrich (1989). Michener (1979) point out that the nidification in ground holes would be an adaptation to open or xeric areas. In the opposite, species which are nesting in wood or in plant stems are rather adapted to woody or wet environments, as the nesting out of the ground avoids a great part of the mortality due to cryptogamic diseases in wet conditions. This relative regression of ground nesting species can be interpreted as a increasing lack of the availability or suitability of the open areas. Several mechanisms can be relied on this: afforestation, which was very important in some areas of Belgium (particularly in the province of Namur, where the greatest part of chalkland grasses, formerly used for cattle is now planted with pine woods); weeding of crops; conversion of lands into housing areas.

Among the factors whose role is difficult to estimate, the one of insecticides, herbicides and fungicides seems to be particularly problematic. The acute poisoning does not seem to have played a big role apart from local and limited cases. However, nearly nothing is known about the chronic intoxication_and the influence of sublethal doses. The latter could have brought selective pressure variations in different ways. As generations of wild bees are short, small interspecific differences in the selective pressure could have led in few years to the replacement of sensitive species by others.

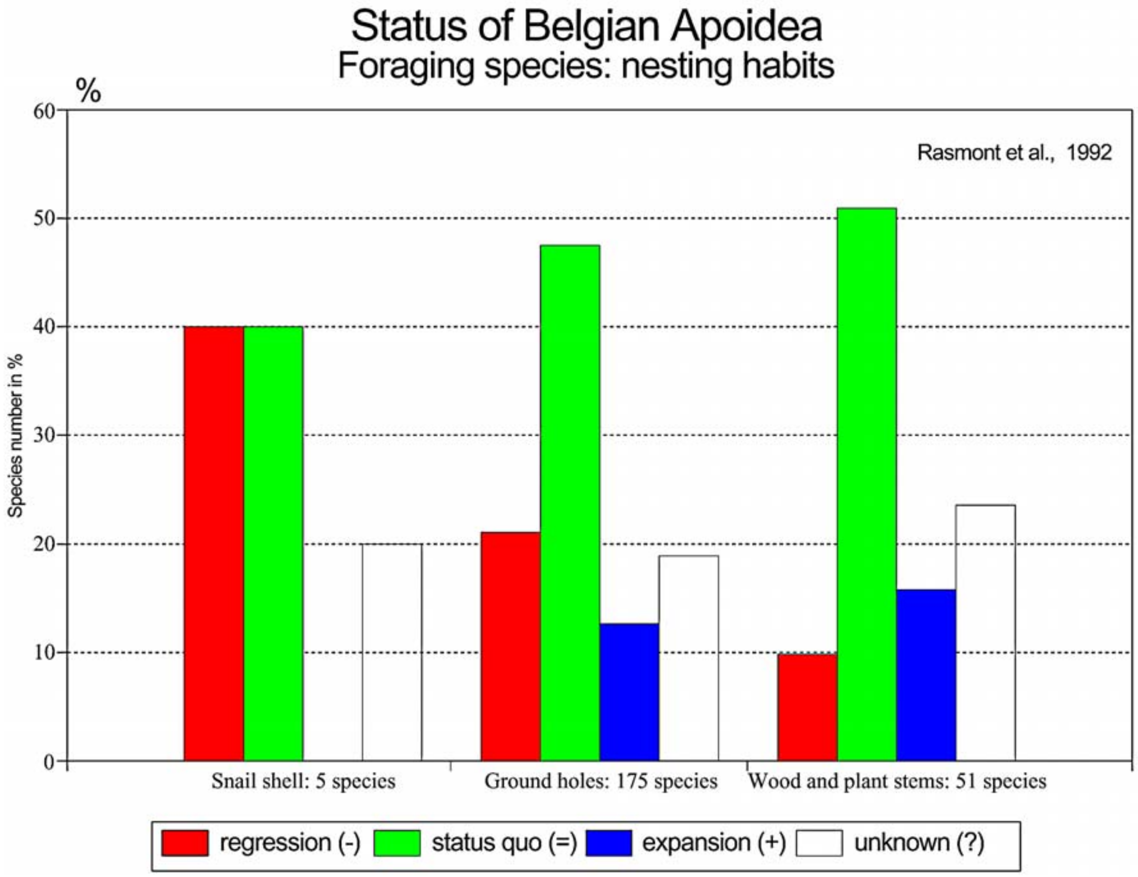

Figure 6.

The conclusions of this study strongly remind those of Corbet et al.(1991), Osborne et al. (1991) and Williams et al. (1991), whereas these authors studied especially the case of the honey bee and bumblebees (Apidae). So it seems that the regression phenomenon of Apidae affects all kinds of wild bees too. Even short tongue species seem to undergo a regression despite their relative number increases. The whole regression phenomenon affects more strongly species with a long tongue. This must be considered as being serious as they are the most efficient and specialised pollinators. In an untouched wild bee fauna, the isolated regression of a long tongue species could probably be ecologically compensated thanks to the spontaneous substitution of competing species. However, in the present situation, it is the whole guild which is threatened. Therefore, we can fear that the linked regression of species will not allow a spontaneous replacement. It is likely that the density and the diversity of these pollinators fall under the population level needed to insure the pollination requirement of many agricultural and horticultural productions.

There is another big danger: the regression of key species would lead to the disappearance of great parts of the wild flora.

Very few European countries have a long tradition to collect and study Apoidea. It is therefore unlikely that a long and constant survey - as in Belgium - could become widespread in the whole Europe. However, the progressive dying out of legume crops, breeding intensification, afforestation of agricultural areas economically marginal and urbanization are general in Europe. Therefore, this faunistic drift of the Apoidea fauna should also appears everywhere.

CONCLUSIONS

On 360 species observed in Belgium since 1900, 25% are decreasing and only 11% are expanding. This regression especially affects long tongue species, which are precious specialised pollinators, auxiliaries of agriculture and horticulture. This can be seen as the result of the dying out of legume crops and of the destruction of wild long corolla flowers like labiate, borage and figwort families.

The strong relative regression of cleptoparasites can be seen as the outcome of an absolute numerical decrease of the whole Apoidea superfamily.

The relative regression of the species nesting in ground holes can be interpreted as a consequence of a lacking availability or suitability of open areas through afforestation, urbanization and agriculture intensification.

The general wild bees regression, which strongly affects long tongue species, seriously threatens the maintain of an adequate pollinating level of wild and cultivated plants.

REFERENCES

CORBET, S.A., I.H. WILLIAMS & J.L. OSBORNE, 1991. Bees and the pollination of crops and wild flowers in the European Community. *Bee World*, 72(2): 47-59.

JACOB-REMACLE, A., 1982. Hymenoptera Apoidea Andrenidae, carte 1783 in J.Leclercq, C.Gaspar & C.Verstraeten.

LECLERCQ, J. & P. RASMONT, 1985. Hymenoptera Apoidea Xylocopidae, carte 1963 in J.Leclercq, C.Gaspar & C.Verstraeten.

LECLERCQ, J., 1971. Hymenoptera Apoidea Melittidae, Megachilidae et Anthophoridae, cartes 535-550 in J.Leclercq, *Atlas provisoire des Insectes de Belgique.* Cartographie des Invertébrés européens, Faculté des Sciences agronomiques de l'Etat, Gembloux.

LECLERCQ, J., 1972a. Hymenoptera Apoidea Andrenidae, cartes 601-681 in J.Leclercq, *Atlas provisoire des Insectes de Belgique.* Cartographie des Invertébrés européens, Faculté des Sciences agronomiques de l'Etat, Gembloux.

LECLERCQ, J., 1972b. Hymenoptera Apoidea Xylocopidae, cartes 682-683 in J.Leclercq, C.Gaspar & C.Verstraeten.

LECLERCQ, J., 1982. Hymenoptera Apoidea Colletidae, Halictidae, Melittidae, Megachilidae et Anthophoridae (partim), cartes 1483-1571 in J.Leclercq, C.Gaspar & C.Verstraeten.

LECLERCQ, J., C. GASPAR & C. VERSTRAETEN, 1972-1985. *Atlas provisoire des Insectes de Belgique (et des régions limitrophes).* Cartographie des Invertébrés européens, Faculté des Sciences agronomiques de l'Etat, Gembloux.

LECLERCQ, J., C. GASPAR, J.-L. MARCHAL, C. VERSTRAETEN & C. WONVILLE, 1980. Analyse des 1600 premières cartes de l'Atlas provisoire des Insectes de Belgique, et première liste rouge d'Insectes menacés dans la faune belge. *Notes fauniques de Gembloux*, 4: 1-104.

LIONGO LI ENKULU, 1982. Hymenoptera Apoidea Megachilidae, Genres *Chalicodoma* Lepeletier et *Megachile* Latreille. cartes 1786-1800 in J.Leclercq, C.Gaspar & C.Verstraeten.

MATHOT, P., 1982. Hymenoptera Apoidea Anthophoridae, genre *Nomada* Scopoli, cartes 1701-1748 in J.Leclercq, C.Gaspar & C.Verstraeten.

MICHENER, C.D., 1979. Biogeography of the bees. *Annals of the Missouri botanical Garden*, 66: 277-347.

OSBORNE, J.L., I.H. WILLIAMS & S.A. CORBET, 1991. Bees, pollination and habitat change in the European Community. *Bee World*, 72(3): 99-116.

PAULY, A., 1978. Hymenoptera Apoidea Halictidae, cartes 1102-1153 in J.Leclercq, C.Gaspar & C.Verstraeten.

PAULY, A., 1982a. Hymenoptera Apoidea Anthophoridae, genre *Anthophora* Latreille, cartes 1749-1756bis in J.Leclercq, C.Gaspar & C.Verstraeten.

PAULY, A., 1982b. Hymenoptera Apoidea Megachilidae, genre *Osmia* Panzer, sensu lato, cartes 1757-1780 in J.Leclercq, C.Gaspar & C.Verstraeten.

PAULY, A., 1982c. Hymenoptera Apoidea Halictidae, cartes 1781-1782f in J.Leclercq, C.Gaspar & C.Verstraeten.

RASMONT, P., 1988. *Monographie écologique et zoogéographique des Bourdons de France et de Belgique (Hymenoptera, Apidae, Bombinae).* Phd. thesis, Faculté des Sciences agronomiques de l'Etat, Gembloux, 309+LXII pp.

RASMONT, P. & P. MERSCH, 1988. Première estimation de la dérive faunique chez les bourdons de la Belgique (Hymenoptera: Apidae). *Annales de la Société royale zoologique de Belgique*, 118: 141-147.

RASMONT, P. & Y.BARBIER, 1990-1991. *Microbanque faunique, a software for management of faunistic data bank. Version 1* (1990), *version 2* (1991). Fédération des Banque de Données Biogéographique, Université de Mons-Hainaut.

STROOT, P. & E. DEPIEREUX, 1989. Proposition d'une Méthodologie pour établir des Listes Rouges d'Invertébrés Menacés. *Biological Conservation*, 48: 163-179.

WESTRICH, P., 1989. *Die Wildbienen Baden-Württembergs*. vol.1, pp.1-431, Ulmer Verlag, Stuttgart.

WESTRICH, P., 1990. *Die Wildbienen Baden-Württembergs*. vol.2, pp.432-972, Ulmer Verlag, Stuttgart.

WILLIAMS, I.H., S.C. CORBET & J.L. OSBORNE, 1991. Beekeeping, wild bees and pollination in the European Community. *Bee World*, 72(4): 170-180.

WILLIAMS, P.H., 1985. *On the distribution of bumble bees (Hymenoptera, Apidae) with particular regard to patterns within the British Isles*. Pd D thesis, Cambridge University, 180 pp.

WILLIAMS, P.H., 1986. Environmental changes and the distributions of British bumble bees (*Bombus* Latr.). *Bee World*, 67(2): 50-61.

Annex

List of solitary bee of Belgium observed during the period 1900-1992 and estimation of their status

Nesting habits :

g = nest in ground hole
w = nest in wood
p = nest in plant stem
h = nest in snail shell

nest	species	number of occurences				chi^2	computed trend	corrected trend
		observed		expected				
		befor	sinc	befor	sinc			
	Foraging Anthophoridae							
g	*Anthophora aestivalis* Schenck	24	1	7	18	55.63	- ***	
g	*Anthophora bimaculata* (Panzer)	23	6	8	21	36.53	- ***	
g	*Anthophora furcata* (Panzer)	56	32	25	62	54.53	- ***	
g	*Anthophora plagiata* (Illiger)	6	2	2	6	8.44	- **	-
g	*Anthophora plumipes* (Pallas)	104	634	211	527	76.02	+ ***	
g	*Anthophora quadrimaculata* (Panzer)	52	51	29	74	24.17	- ***	
g	*Anthophora retusa* (L.)	51	51	29	73	22.89	- ***	
p	*Ceratina cyanea* (Kirby)	27	60	25	62	0.25	=	
g	*Eucera longicornis* (L.)	26	56	23	59	0.39	=	
g	*Eucera nigrescens* Pérez (=*tuberculata*)	19	23	12	30	5.70	- *	=
p	*Xylocopa violacea* (L.)	0	2	1	1	0.80	= (=)	
	Foraging Megachilidae							
	Anthidium diadema Latreille	0	1	0	1	0.40	= (=)	
g	*Anthidium manicatum* (L.)	50	79	37	92	6.53	- *	=
g	*Anthidium oblongatum* Illiger	11	10	6	15	5.82	- *	=
g	*Anthidium punctatum* Latreille	28	26	15	39	14.30	- ***	
p	*Anthidium strigatum* (Panzer)	14	23	11	26	1.55	=	
g	*Chalicodoma ericetorum* (Lepeletier)	38	71	31	78	2.10	=	
	Chalicodoma rufescens Lichtenstein	0	1	0	1	0.40	= (=)	
w	*Chelostoma campanularum* (Kirby)	35	110	41	104	1.41	=	
w	*Chelostoma distinctum* (Stöckhert)	15	41	16	40	0.09	=	
w	*Chelostoma florisomme* (L.)	35	101	39	97	0.54	=	
w	*Chelostoma fuliginosum* (Panzer)	37	183	63	157	14.94	+ ***	
w	*Heriades truncorum* (L.)	30	127	45	112	6.92	+ **	+
w	*Megachile alpicola* Alfken	11	29	11	29	0.02	=	
g	*Megachile analis* Nylander	3	0	1	2	7.49	- (-)	
p	*Megachile buyssoni* Pérez	1	2	1	2	0.03	= (=)	
w	*Megachile centuncularis* (L.)	66	149	61	154	0.47	=	
g	*Megachile circumcincta* (Kirby)	35	33	19	49	17.43	- ***	
g	*Megachile lagopoda* (L.)	12	2	4	10	22.37	- ***	
w	*Megachile lapponica* Thomson	0	13	4	9	5.21	+ *	
g	*Megachile leachella* Curtis	7	15	6	16	0.11	=	
w	*Megachile ligniseca* (Kirby)	41	25	19	47	36.33	- ***	
w	*Megachile maritima* (Kirby)	13	10	7	16	8.79	- **	=
g	*Megachile pilidens* Alfken	0	2	1	1	0.80	= (=)	
g	*Megachile pyrenaea* Pérez	23	7	9	21	33.95	- ***	
w	*Megachile rotundata* (Fabricius)	0	1	0	1	0.40	= (=)	
w	*Megachile versicolor* Smith	23	45	19	49	0.91	=	
w	*Megachile willughbiella* (Kirby)	28	63	26	65	0.21	=	

Foraging Megachilidae (continued)								
		number of occurences						
		observed		expected				
nest	species	befor	sinc	befor	sinc	chi^2	computed trend	corrected trend
w	*Osmia adunca* (Panzer)	48	54	29	73	17.03	- ***	
h	*Osmia andrenoides* Spinola	0	5	1	4	2.00	= (=)	
g	*Osmia anthocopoides* Schenck	22	5	8	19	36.99	- ***	
h	*Osmia aurulenta* (Panzer)	51	54	30	75	20.52	- ***	
h	*Osmia bicolor* (Schrank)	15	55	20	50	1.76	=	
w	*Osmia brevicornis* (Fabricius)	0	1	0	1	0.40	= (=)	
w	*Osmia caerulescens* (L.)	50	87	39	98	4.19	- *	=
p	*Osmia claviventris* (Thomson)	24	34	17	41	4.64	- *	=
w	*Osmia cornuta* (Latreille)	92	348	126	314	12.73	+ ***	
w	*Osmia fulviventris* (Panzer)	35	53	25	63	5.38	- *	=
g	*Osmia inermis* (Zetterstedt)	1	0	0	1	2.50	= (=)	
w	*Osmia leaiana* (Kirby)	17	25	12	30	2.90	=	
p	*Osmia leucomelana* (Kirby)	23	42	19	46	1.47	=	
g	*Osmia mitis* Nylander	1	0	0	1	2.50	= (=)	
g	*Osmia mustelina* Gerstäcker	2	0	1	1	4.99	- (-)	
g	*Osmia papaveris* (Latreille)	25	6	9	22	41.13	- ***	
w	*Osmia parietina* (Curtis)	5	14	5	14	0.05	=	
w	*Osmia pilicornis* (Smith)	20	5	7	18	32.35	- ***	
g	*Osmia ravouxi* Pérez	11	40	15	36	1.23	=	
w	*Osmia rufa* (L.)	93	620	204	509	84.45	+ ***	
h	*Osmia rufohirta* Latreille	22	23	13	32	9.08	- **	=
h	*Osmia spinulosa* (Kirby)	22	18	11	29	13.66	- ***	
w	*Osmia uncinata* Gerstäcker	9	19	8	20	0.17	=	
g	*Osmia villosa* (Schenck)	16	10	7	19	13.82	- ***	
g	*Osmia xanthomelana* (Kirby)	18	3	6	15	33.56	- ***	
g	*Trachusa byssina* (Panzer)	17	22	11	28	4.29	- *	=
Foraging Halictidae								
g	*Dufourea dentiventris* (Nylander)	16	35	15	36	0.19	=	
g	*Dufourea inermis* (Nylander)	2	9	3	8	0.58	=	
g	*Dufourea minuta* Lepeletier(=*halictula*)	4	1	1	4	6.47	- (-)	
g	*Dufourea vulgaris* Schenck	6	2	2	6	8.44	- **	(-))
g	*Halictus confusus* Smith	26	71	28	69	0.15	=	
g	*Halictus eurygnathus* Blüthgen	4	3	2	5	2.79	= (=)	
g	*Halictus leucaheneus* Ebmer	22	19	12	29	12.61	- ***	
g	*Halictus maculatus* Smith	26	28	15	39	10.11	- **	-
g	*Halictus quadricinctus* (Fabricius)	17	7	7	17	20.97	- ***	
g	*Halictus rubicundus* (Christ)	86	227	90	223	0.19	=	
g	*Halictus scabiosae* (Rossi)	5	15	6	14	0.13	=	
g	*Halictus sexcinctus* (Fabricius)	48	19	19	48	60.80	- ***	
g	*Halictus simplex* Blüthgen	15	5	6	14	21.09	- ***	
g	*Halictus tetrazonianellus* Strand	1	0	0	1	2.50	= (=)	
g	*Halictus tomentosus* (Eversmann)	12	24	10	26	0.40	=	
g	*Halictus tumulorum* (L.)	70	296	105	261	16.07	+ ***	
g	*Lasioglossum albipes* (Fabricius)	82	206	82	206	0.00	=	
g	*Lasioglossum brevicorne* (Schenck)	6	10	5	11	0.62	=	
g	*Lasioglossum breviventre* (Schenck)	1	0	0	1	2.50	= (=)	
g	*Lasioglossum calceatum* (Scopoli)	144	444	168	420	4.85	+ *	+
g	*Lasioglossum costulatum* (Kriechbaumer)	3	1	1	3	4.22	- (-)	
g	*Lasioglossum fratellum* (Pérez)	21	36	16	41	1.90	=	
g	*Lasioglossum fulvicorne* (Kirby)	88	215	87	216	0.03	=	
g	*Lasioglossum interruptum* (Panzer)	1	0	0	1	2.50	= (=)	
g	*Lasioglossum laeve* (Kirby)	2	0	1	1	4.99	- (-)	
g	*Lasioglossum laevigatum* (Kirby)	29	42	20	51	5.22	- *	=
g	*Lasioglossum laticeps* (Schenck)	56	113	48	121	1.71	=	
g	*Lasioglossum lativentre* (Schenck)	62	35	28	69	59.27	- ***	
g	*Lasioglossum leucopus* (Kirby)	28	98	36	90	2.51	=	
g	*Lasioglossum leucozonium* (Schrank)	102	187	83	206	6.35	- *	=
g	*Lasioglossum lineare* (Schenck)	4	13	5	12	0.21	=	
g	*Lasioglossum lucidulum* (Schenck)	6	19	7	18	0.26	=	

nest	species	number of occurences				chi^2	computed trend	corrected trend
		observed		expected				
		befor	sinc	befor	sinc			
	Foraging Halictidae (continued)							
g	*Lasioglossum malachurum* (Kirby)	40	69	31	78	3.50	=	
g	*Lasioglossum minutissimum* (Kirby)	15	45	17	43	0.38	=	
g	*Lasioglossum minutulum* (Schenck)	15	21	10	26	3.01	=	
g	*Lasioglossum morio* (Fabricius)	97	237	96	238	0.03	=	
g	*Lasioglossum nitidiusculum* (Kirby)	28	66	27	67	0.07	=	
g	*Lasioglossum nitidulum* (Fabricius)	49	274	92	231	28.51	+ ***	
g	*Lasioglossum parvulum* (Schenck)	47	102	43	106	0.63	=	
g	*Lasioglossum pauxillum* (Schenck)	35	56	26	65	4.34	- *	=
g	*Lasioglossum politum* (Schenck)	0	5	1	4	2.00	= (=)	
g	*Lasioglossum prasinum* (Smith)	7	8	4	11	2.40	=	
g	*Lasioglossum punctatissimum* (Schenck)	25	102	36	91	4.94	+ *	+
g	*Lasioglossum pygmaeum* (Schenck)	12	6	5	13	12.78	- ***	
g	*Lasioglossum quadrinotatulum* (Schenck)	26	53	23	56	0.72	=	
g	*Lasioglossum quadrinotatum* (Kirby)	13	12	7	18	6.71	- **	=
g	*Lasioglossum rufitarse* (Zetterstedt)	29	72	29	72	0.00	=	
g	*Lasioglossum semilucens* (Alfken)	13	51	18	46	2.15	=	
g	*Lasioglossum sexnotatum* (Kirby)	68	47	33	82	52.52	- ***	
g	*Lasioglossum sexstrigatum* (Schenck)	35	108	41	102	1.19	=	
g	*Lasioglossum tarsatum* (Schenck)	2	1	1	2	2.13	= (=)	
g	*Lasioglossum villosulum* (Kirby)	64	189	72	181	1.35	=	
g	*Lasioglossum xanthopus* (Kirby)	36	21	16	41	33.35	- ***	
g	*Lasioglossum zonulum* (Smith)	68	139	59	148	1.84	=	
g	*Rophites quinquespinosus* Spinola	2	1	1	2	2.13	= (=)	
	Melittidae (all foraging species)							
g	*Dasypoda hirtipes* (Fabricius)	26	56	23	59	0.39	=	
g	*Macropis europaea* Warncke	26	42	19	49	3.10	=	
g	*Macropis fulvipes* (Fabricius)	13	16	8	21	3.74	=	
g	*Melitta haemorrhoidalis* (Fabricius)	47	98	41	104	1.04	=	
g	*Melitta leporina* (Panzer)	22	20	12	30	11.64	- ***	
g	*Melitta nigricans* Alfken	13	19	9	23	2.27	=	
g	*Melitta tricincta* Kirby	19	31	14	36	2.17	=	
	Andrenidae (all foraging species)							
g	*Andrena agilissima* (Scopoli)	27	19	13	33	20.41	- ***	
g	*Andrena angustior* (Kirby)	38	222	74	186	24.89	+ ***	
g	*Andrena anthrisci* Blüthgen	1	2	1	2	0.03	= (=)	
g	*Andrena apicata* Smith	5	19	7	17	0.71	=	
g	*Andrena argentata* Smith	8	24	9	23	0.20	=	
g	*Andrena barbilabris* (Kirby)	29	150	51	128	13.47	+ ***	
g	*Andrena bicolor* Fabricius	65	367	124	308	38.84	+ ***	
g	*Andrena bimaculata* (Kirby)	0	3	1	2	1.20	= (=)	
g	*Andrena carbonaria* (L.)	28	28	16	40	12.57	- ***	
g	*Andrena chrysopyga* Schenck	10	2	3	9	17.61	- ***	
g	*Andrena chrysosceles* (Kirby)	37	242	80	199	32.13	+ ***	
g	*Andrena cineraria* (L.)	39	90	37	92	0.17	=	
g	*Andrena clarkella* (Kirby)	29	103	38	94	2.84	=	
g	*Andrena coitana* (Kirby)	12	21	9	24	0.98	=	
g	*Andrena combinata* (Christ)	22	20	12	30	11.64	- ***	
g	*Andrena curvungula* Thomson	7	6	4	9	4.06	- *	=
g	*Andrena denticulata* (Kirby)	28	9	11	26	40.17	- ***	
g	*Andrena dorsata* (Kirby)	11	39	14	36	1.07	=	
g	*Andrena falsifica* Perkins	8	6	4	10	5.59	- *	=
g	*Andrena ferox* Smith	3	2	1	4	2.42	= (=)	
g	*Andrena flavipes* Panzer	70	326	113	283	23.12	+ ***	
g	*Andrena florea* Fabricius	37	79	33	83	0.62	=	
g	*Andrena fucata* Smith	29	136	47	118	9.81	+ **	+
g	*Andrena fuligula* Warncke	0	1	0	1	0.40	= (=)	
g	*Andrena fulva* (Müller)	66	672	211	527	139.59	+ ***	

Andrenidae (continued)

nest	species	number of occurences				chi^2	computed trend	corrected trend
		observed		expected				
		befor	sinc	befor	sinc			
g	***Andrena fulvago*** (Christ)	24	36	17	43	3.82	=	
g	***Andrena fulvida*** Schenck	11	5	5	11	12.64	- ***	
g	***Andrena fuscipes*** (Kirby)	36	78	33	81	0.50	=	
g	***Andrena gelriae*** van der Vecht	1	1	1	1	0.45	= (=)	
g	***Andrena glabriventris*** Alfken	2	6	2	6	0.05	=	
g	***Andrena gravida*** Imhoff	46	94	40	100	1.25	=	
g	***Andrena haemorrhoa*** (Fabricius)	101	854	273	682	151.86	+ ***	
g	***Andrena hattorfiana*** (Fabricius)	53	87	40	100	5.88	- *	=
g	***Andrena helvola*** (L.)	41	224	76	189	22.35	+ ***	
g	***Andrena humilis*** Imhoff	42	129	49	122	1.36	=	
g	***Andrena intermedia*** Thomson	3	1	1	3	4.22	- (-)	
g	***Andrena labialis*** (Kirby)	39	55	27	67	7.65	- **	=
g	***Andrena labiata*** Fabricius	24	37	17	44	3.45	=	
g	***Andrena lapponica*** Zetterstedt	26	41	19	48	3.42	=	
g	***Andrena lathyri*** Alfken	52	97	43	106	2.90	=	
g	***Andrena limata*** Smith	4	1	1	4	6.47	- (-)	
g	***Andrena marginata*** Fabricius	25	10	10	25	31.45	- ***	
g	***Andrena minutula*** (Kirby)	41	189	66	164	13.06	+ ***	
g	***Andrena minutuloides*** Perkins	9	34	12	31	1.24	=	
g	***Andrena mitis*** Schmiedeknecht	8	32	11	29	1.45	=	
g	***Andrena nana*** (Kirby)	1	0	0	1	2.50	= (=)	
g	***Andrena nigriceps*** (Kirby)	2	1	1	2	2.13	= (=)	
g	***Andrena nigroaenea*** (Kirby)	56	205	75	186	6.51	+ *	+
g	***Andrena nitida*** (Müller)	75	311	110	276	15.88	+ ***	
g	***Andrena nitidiuscula*** Schenck	1	0	0	1	2.50	= (=)	
g	***Andrena niveata*** Friese	5	1	2	4	8.80	- (-)	
g	***Andrena nycthemera*** Imhoff	0	6	2	4	2.40	= (=)	
g	***Andrena ovatula*** (Kirby)	85	111	56	140	20.95	- ***	
g	***Andrena pandellei*** Pérez	9	14	7	16	1.25	=	
g	***Andrena polita*** Smith	4	18	6	16	1.17	=	
g	***Andrena potentillae*** Panzer	0	4	1	3	1.60	= (=)	
g	***Andrena praecox*** (Scopoli)	35	69	30	74	1.30	=	
g	***Andrena proxima*** (Kirby)	29	47	22	54	3.40	=	
g	***Andrena rosae*** Panzer	21	11	9	23	21.49	- ***	
g	***Andrena ruficrus*** Nylander	17	48	19	46	0.19	=	
g	***Andrena sabulosa*** (Scopoli)	76	512	168	420	70.71	+ ***	
g	***Andrena schencki*** Morawitz	45	15	17	43	63.28	- ***	
g	***Andrena semilaevis*** Pérez	34	116	43	107	2.58	=	
g	***Andrena similis*** Smith (=***ocreata***)	30	40	20	50	6.97	- **	=
g	***Andrena spreta*** Pérez	3	10	4	9	0.19	=	
g	***Andrena strohmella*** Stöckhert	14	26	11	29	0.80	=	
g	***Andrena subopaca*** Nylander	64	302	105	261	22.12	+ ***	
g	***Andrena synadelpha*** Perkins	3	25	8	20	4.38	+ *	+
g	***Andrena tarsata*** Nylander	20	4	7	17	35.22	- ***	
g	***Andrena thoracica*** (Fabricius)	5	1	2	4	8.80	- (-)	
g	***Andrena tibialis*** (Kirby)	27	95	35	87	2.50	=	
g	***Andrena vaga*** Panzer	15	33	14	34	0.17	=	
g	***Andrena varians*** (Rossi)	27	92	34	85	2.03	=	
g	***Andrena ventralis*** Imhoff	13	24	11	26	0.78	=	
g	***Andrena wilkella*** (Kirby)	48	147	56	139	1.51	=	
g	***Panurgus banksianus*** (Kirby)	14	44	17	41	0.56	=	
g	***Panurgus calcaratus*** (Scopoli)	37	41	22	56	13.56	- ***	
g	***Panurgus dentipes*** Latreille	2	1	1	2	2.13	= (=)	
	Colletidae (all foraging species)							
g	***Colletes cunicularius*** (L.)	8	3	3	8	10.49	- **	-
g	***Colletes daviesanus*** Smith	34	213	71	176	26.60	+ ***	
g	***Colletes fodiens*** (Fourcroy)	6	9	4	11	0.96	=	
g	***Colletes halophilus*** Verhoeff	0	12	3	9	4.81	+ *	+
g	***Colletes marginatus*** Smith	1	5	2	4	0.42	= (=)	

Colletidae (continued)

nest	species	number of occurences				chi^2	computed trend	corrected trend
		observed		expected				
		befor	sinc	befor	sinc			
g	*Colletes similis* Schenck	2	1	1	2	2.13	= (=)	
g	*Colletes succinctus* (L.)	22	63	24	61	0.31	=	
p	*Hylaeus angustatus* (Schenck)	0	2	1	1	0.80	= (=)	
p	*Hylaeus annularis* (Kirby)	9	51	17	43	5.43	+ *	+
p	*Hylaeus bifasciatus* (Jurine)	1	0	0	1	2.50	= (=)	
p	*Hylaeus bipunctatus* (Fabricius)	48	114	46	116	0.08	=	
p	*Hylaeus bisinuatus* Förster	17	13	9	21	11.58	- ***	
p	*Hylaeus brevicornis* Nylander	38	101	40	99	0.11	=	
p	*Hylaeus clypearis* (Schenck)	1	0	0	1	2.50	= (=)	
p	*Hylaeus communis* Nylander	48	194	69	173	9.10	+ **	+
p	*Hylaeus conformis* Förster	10	9	5	14	5.38	- *	=
p	*Hylaeus cornutus* Curtis	4	10	4	10	0.00	=	
p	*Hylaeus difformis* (Eversmann)	1	1	1	1	0.45	= (=)	
p	*Hylaeus gibbus* Saunders	54	180	67	167	3.49	=	
p	*Hylaeus gracilicornis* (Morawitz)	1	0	0	1	2.50	= (=)	
p	*Hylaeus Hyalinatus* Smith	56	219	79	196	9.13	+ **	+
p	*Hylaeus nigritus* (Fabricius)	0	2	1	1	0.80	= (=)	
p	*Hylaeus pectoralis* Förster	2	7	3	6	0.18	=	
p	*Hylaeus pictipes* Nylander	38	76	33	81	1.25	=	
p	*Hylaeus punctulatissimus* Smith	20	42	18	44	0.41	=	
p	*Hylaeus rinki* (Gorski)	4	21	7	18	1.94	=	
p	*Hylaeus sinuatus* (Schenck)	0	1	0	1	0.40	= (=)	
p	*Hylaeus styriacus* Förster	1	3	1	3	0.03	= (=)	
p	*Hylaeus variegatus* (Fabricius)	17	10	8	19	15.62	- ***	
	Cleptoparasitic Anthophoridae							
g	*Ammobates punctatus* (Fabricius)	10	2	3	9	17.61	- ***	
g	*Biastes truncatus* (Nylander)	1	6	2	5	0.70	= (=)	
g	*Epeoloides caecutiens* (Fabricius)	5	1	2	4	8.80	- (-)	
g	*Epeolus cruciger* (Panzer)	17	53	20	50	0.64	=	
g	*Epeolus variegatus* (L.)	7	5	3	9	5.20	- *	=
g	*Melecta albifrons* (Förster)	21	155	50	126	23.93	+ ***	
g	*Melecta luctuosa* (Scopoli)	29	4	9	24	56.80	- ***	
g	*Nomada alboguttata* Herrich-Schäffer	37	81	34	84	0.44	=	
g	*Nomada argentata* Herrich-Schäffer	2	0	1	1	4.99	- (-)	
g	*Nomada armata* Herrich-Schäffer	10	6	5	11	9.01	- **	=
g	*Nomada baccata* Smith	1	2	1	2	0.03	= (=)	
g	*Nomada bifasciata lepeletieri* Pérez	26	14	11	29	25.96	- ***	
g	*Nomada castellana* Dusmet (=*baeri*)	0	1	0	1	0.40	= (=)	
g	*Nomada conjungens* Herrich-Schäffer	6	9	4	11	0.96	=	
g	*Nomada distinguenda* Morawitz	20	11	9	22	19.59	- ***	
g	*Nomada emarginata* Morawitz	5	18	7	16	0.53	=	
g	*Nomada fabriciana* (L.)	78	168	70	176	1.17	=	
g	*Nomada femoralis* Morawitz	23	18	12	29	15.19	- ***	
g	*Nomada ferruginata* (L.)	10	14	7	17	2.01	=	
g	*Nomada flava* Panzer	104	573	194	483	58.06	+ ***	
g	*Nomada flavoguttata* Kirby	38	117	44	111	1.26	=	
g	*Nomada flavopicta* Kirby	53	37	26	64	40.45	- ***	
g	*Nomada fucata* Panzer	64	78	41	101	18.88	- ***	
g	*Nomada fulvicornis* Fabr. (=*lineola*)	57	31	25	63	56.41	- ***	
g	*Nomada fulvicornis* Fabricius	27	100	36	91	3.35	=	
g	*Nomada furva* Panzer	1	5	2	4	0.42	= (=)	
g	*Nomada fuscicornis* Nylander	16	11	8	19	12.43	- ***	
g	*Nomada glabella* Thomson	9	9	5	13	4.04	- *	=
g	*Nomada goodeniana* Kirby	62	85	42	105	13.28	- ***	
g	*Nomada guttulata* Schenck	3	4	2	5	0.70	= (=)	
g	*Nomada integra* Brullé(=*cinctiventris*)	28	30	17	41	11.00	- ***	
g	*Nomada lathburtiana* Kirby	26	35	17	44	5.88	- *	=
g	*Nomada leucophthalma* Kirby	41	25	19	47	36.33	- ***	
g	*Nomada marshamella* Kirby	55	174	65	164	2.35	=	

	Cleptoparasitic Anthophoridae (continued)							
		number of occurences						
		observed		expected			compu ted	corre cted
nest	species	befor	sinc	befor	sinc	chi^2	trend	trend
g	*Nomada melathoracica* Imhoff	7	5	3	9	5.20	- *	(-)
g	*Nomada mutabilis* Morawitz	3	1	1	3	4.22	- (-)	
g	*Nomada mutica* Morawitz	2	0	1	1	4.99	- (-)	
g	*Nomada obscura* Zetterstedt	1	8	3	6	1.35	=	
g	*Nomada obtusifrons* Nylander	0	5	1	4	2.00	= (=)	
g	*Nomada opaca* Alfken	0	1	0	1	0.40	= (=)	
g	*Nomada panzeri* Lepeletier	62	105	48	119	5.95	- *	=
g	*Nomada piccioliana* Magretti	1	1	1	1	0.45	= (=)	
g	*Nomada pleurosticta* Herrich-Schäffer	0	1	0	1	0.40	= (=)	
g	*Nomada rhenana* Morawitz	2	5	2	5	0.00	= (=)	
g	*Nomada roberjeotiana* Panzer	31	1	9	23	73.07	- ***	
g	*Nomada roberjeotiana* Panzer	0	2	1	1	0.80	= (=)	
g	*Nomada ruficornis* (L.) (=*bifida*)	102	106	59	149	42.57	- ***	
g	*Nomada rufipes* Fabricius	47	69	33	83	8.08	- **	=
g	*Nomada sexfasciata* Panzer	30	13	12	31	35.70	- ***	
g	*Nomada sheppardana* Panzer	47	61	31	77	11.78	- ***	
g	*Nomada signata* Kirby	52	26	22	56	55.37	- ***	
g	*Nomada similis* Morawitz	17	15	9	23	9.43	- **	=
g	*Nomada stigma* Fabricius	0	1	0	1	0.40	= (=)	
g	*Nomada striata* Fabricius	47	77	35	89	5.26	- *	=
g	*Nomada villosa* Thomson	1	6	2	5	0.70	= (=)	
g	*Nomada zonata* Panzer	2	1	1	2	2.13	= (=)	
g	*Thyreus orbatus* (Lepeletier)	14	1	4	11	30.79	- ***	
	Cleptoparasitic Megachilidae							
	Coelioxys afra Lepeletier	0	3	1	2	1.20	= (=)	
	Coelioxys alata Förster	3	0	1	2	7.49	- (-)	
	Coelioxys aurolimbata Förster	25	16	12	29	21.05	- ***	
	Coelioxys conoidea Klug	16	1	5	12	35.74	- ***	
	Coelioxys elongata Lepeletier	6	13	5	14	0.08	=	
	Coelioxys emarginata Förster	2	0	1	1	4.99	- (-)	
	Coelioxys inermis (Kirby)	28	32	17	43	9.60	- **	=
	Coelioxys mandibularis Nylander	6	6	3	9	2.69	=	
	Coelioxys quadridentata (L.)	19	19	11	27	8.53	- **	=
	Coelioxys rufescens Lepeletier	29	11	11	29	37.76	- ***	
	Coelioxys rufocaudata Smith	0	1	0	1	0.40	= (=)	
	Dioxys tridentata Nylander	0	2	1	1	0.80	= (=)	
	Stelis breviuscula (Nylander)	22	48	20	50	0.28	=	
	Stelis minima Schenck	0	3	1	2	1.20	= (=)	
	Stelis minuta Lep.& Serv.	1	8	3	6	1.35	=	
	Stelis odontopyga Noskiewicz	0	1	0	1	0.40	= (=)	
	Stelis ornatula (Klug)	10	6	5	11	9.01	- **	=
	Stelis phaeoptera (Kirby)	25	25	14	36	11.22	- ***	
	Stelis punctulatissima (Kirby)	12	10	6	16	7.26	- **	
	Stelis signata (Latreille)	6	2	2	6	8.44	- **	-
	Cleptoparasitic Halictidae							
g	*Sphecodes albilabris* (Fabricius)	7	3	3	7	8.40	- **	-
g	*Sphecodes alternatus* Smith	0	2	1	1	0.80	= (=)	
g	*Sphecodes crassus* Thomson	7	47	15	39	6.46	+ *	+
g	*Sphecodes ephippius* (L.)	52	107	45	114	1.32	=	+
g	*Sphecodes ferruginatus* von Hagens	10	31	12	29	0.36	=	
g	*Sphecodes geoffrellus* (Kirby)	11	65	22	54	7.42	+ **	+
g	*Sphecodes gibbus* (L.)	34	68	29	73	1.12	=	
g	*Sphecodes hyalinatus* von Hagens	12	40	15	37	0.78	=	
g	*Sphecodes longulus* von Hagens	16	39	16	39	0.01	=	
g	*Sphecodes marginatus* von Hagens	4	27	9	22	3.74	=	
g	*Sphecodes miniatus* von Hagens	8	38	13	33	2.83	=	
g	*Sphecodes monilicornis* (Kirby)	33	111	41	103	2.27	=	

Cleptoparasitic Halictidae (continued)

nest	species	number of occurences				chi^2	computed trend	corrected trend
		observed		expected				
		befor	sinc	befor	sinc			
g	*Sphecodes niger* von Hagens	1	5	2	4	0.42	= (=)	
g	*Sphecodes pellucidus* Smith	15	77	26	66	6.81	+ **	+
g	*Sphecodes puncticeps* Thomson	19	48	19	48	0.00	=	
g	*Sphecodes reticulatus* Thomson	23	23	13	33	10.32	- **	-
g	*Sphecodes rubicundus* von Hagens	15	2	5	12	29.61	- ***	
g	*Sphecodes rufiventris* (Panzer)	4	2	2	4	4.26	- (-)	
g	*Sphecodes scabricollis* Wesmael	12	3	4	11	19.41	- ***	
g	*Sphecodes spinulosus* von Hagens	11	3	4	10	17.13	- ***	

TOTAL number of occurences for the period before 1950: 7791
TOTAL number of occurences for the period since 1950: 19453
GRAND TOTAL : 27244

The present version is corrected and adapted to PDF format for Acrobat Reader 6.0.