Changes in Fauna of Wild Bees in Europe
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HOW TO RESTORE THE APOID DIVERSITY IN BELGIUM AND FRANCE? WRONG AND RIGHT WAYS, OR THE END OF PROTECTION PARADIGM!

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INTRODUCTION

Several European countries have included wild apoids in lists of strictly protected animals. This raises some questions.

Do wild bees really need conservation operations? Is strict protection an effective way for the conservation of wild bees? If not, is there a better way?

ECOLOGICAL IMPORTANCE OF WILD BEES

The ecological importance of wild bees is generally underestimated. Ecologists often forget that, in our climates, a majority of flowering plants are fertilized by Apoids.

The mutual dependence is particularly noticeable between long-tongued species and plants with zygomorphic flowers. Short-tongued bee plants are generally less linked with a particular pollinator and, if one bee species were to disappear, it could be easily replaced by another. On the contrary, long-tongued bee plants are far more specialised in their relation with pollinators. If one long-tongued bee species disappeared locally, its pollinating role could not be taken by another.

One family highly associated with wild bees must receive special consideration: leguminous plants are an essential link in the nitrogen cycle which is often the limiting factor of ecosystem productivity. They have nearly no multiplication by vegetative ways. They are generally allogamic and their floral conformation makes them nearly inaccessible to all short tongued insects.

An extinction, or strong rarefaction, of leguminous pollinators could be an ecological catastrophe leading to an alteration of one of the most limiting biogeochemical cycle.

SURVEY OF FRENCH AND BELGIAN WILD BEE FAUNA

The survey of Belgium and North of France has given 376 species with a good sampling since one century (Rasmont *et al.* 1993).

The survey of Gallia (France, Belgium, Luxembourg and Switzerland) is in progress. It comprises 913 wild bees species (France: 864; Switzerland: 587; Belgium: 376; Luxembourg: 274) (Rasmont *et al*, *in press*). Comparing with more or less equivalent territories, only the Iberian Peninsula and California have more diversified wild bees fauna (Tab. I.).

In Belgium and North France, nearly 40% of long-tongued bees are in strong regression while only 9% are expanding (Fig.1). As the regression criteria were very conservative, this probably means near extinction of two fifth of the group. An alteration of faunistic diversity of that magnitude is the sign of a serious disruption of ecosystems.

This strong regression seems to affect all the cultivated plains of temperate Western Europe. There is no indication of such a strong problem to concern Mediterranean Europe and mountain biotopes.

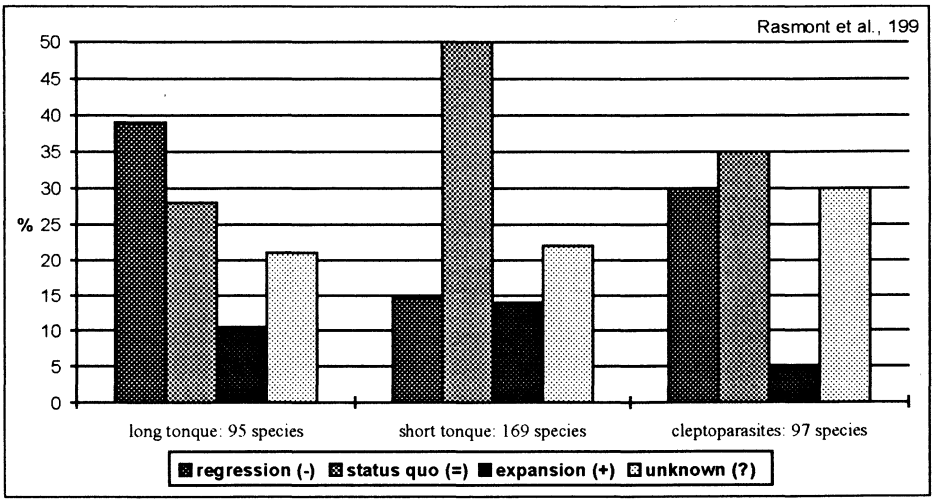

Figure 1. Status of Belgian *Apoidea*. Main guilds.

Table 1. Number of wild bees in different regions of the world.(* cited by Michener 1979, ** approximative number interpreted from Michener 1979)

Region	Reference	number of species	area (km^2)
North America	Krombein *et al.* 1979	3465	19 322 753
Australia	Michener 1965*	1618	7 704 159
West U.S.A.	Moldencke 1976*	1974	3 453 890
East U.S.A.	Mitchell 1960*,1962*	859	2 098 553
Gallia	Rasmont *et al.(press)*	913	658 039
France	Rasmont *et al.(press)*	864	551 208
Iberian penins.	Ceballos 1956	1043	503 486
California	Moldenke 1976*	1200**	411 012
Finland	Elfving 1968*	230	337 032
Poland	Banaszak 1991	454	311 730
Philippines	Baltazar 1966*	233	299 681
Wyoming	Lavigne *et al.* 1976*	663	253 597
West-Germany	Westrich 1984	509	247 960
United Kingdom	Richards 1937*	240	244 016

Table 2. Selection of great wild bees to be included in a list of species leading to habitats protection. (Underlined: species leading to habitats protection , (P) obligatory inquiline parasite)

Species	easily identifiable	localised	threatened	stenotopic
1	2	3	4	5
Bombus rupestris (Fabricius) (P)	+	-	?	-
Bombus vestalis (Fourcroy) (P)	-	-	-	-
Bombus bohemicus Seidl (P)	-	-	-	-
Bombus perezi (Schulthess (P)	-	+	-	-
Bombus campestris (Panzer) (P)	+	-	-	-
Bombus barbutellus (Kirby) (P)	-	+	?	?
Bombus maxillosus Klug (P)	-	+	-	-
Bombus quadricolor (Lepeletier) (P)	-	+	?	-
Bombus flavidus Eversmann (P)	-	+	+	+
Bombus sylvestris (Lepeletier) (P)	-	-	-	-
Bombus norvegicus (Sparre Schn.) (P)	-	+	-	-
Bombus confusus Schenck	-	+	+	+
Bombus mendax Gerstaecker	-	+	-	-
Bombus terrestris (L.)	-	-	+	-
Bombus lucorum (L.)	-	-	-	-
Bombus cryptarum (Fabricius)	-	+	-	+
Bombus magnus Vogt	-	+	-	+
Bombus wurfleini Radoszkowski	-	-	-	-

1	2	3	4	5
Bombus alpinus (L.)	+	++	-	+
Bombus hypnorum (L.)	+	-	-	-
Bombus pratorum (L.)	-	-	-	-
***Bombus jonellus* (Kirby)**	+/-	++	++	++
Bombus pyrenaeus Pérez	-	+	-	-
***Bombus brodmannicus* Vogt**	+	++	-	+
Bombus monticola Smith	+	+	-	-
Bombus lapidarius (L.)	-	-	-	-
Bombus sicheli Radoszkowski	-	+	-	-
Bombus cullumanus (Kirby)	-	++	++	++
Bombus soroeensis (Fabricius)	-	-	-	-
Bombus argillaceus (Scopoli)	+	+	-	-
Bombus ruderatus (Fabricius)	-	-	-	-
Bombus hortorum (L.)	-	-	-	-
***Bombus gerstaeckeri* Morawitz**	+	++	+	++
Bombus subterraneus (L.)	-	+	-	-
***Bombus distinguendus* Morawitz**	+	++	++	+
Bombus pomorum (Panzer)	-	+	+	+
Bombus mesomelas Gerstaecker	-	+	-	-
Bombus sylvarum (L.)	-	-	-	-
Bombus ruderarius (Müller)	-	-	-	-
Bombus veteranus (Fabricius)	-	+	+	-
Bombus inexspectatus (Tkalcu) (P)	-	++	-	-
Bombus muscorum (L.)	-	-	-	+
***Bombus bannitus* (Popov)**	+	++	?	+
Bombus pereziellus (Skorikov)	-	-	-	-
Bombus humilis Illiger	-	-	-	-
Bombus pascuorum (Scopoli)	-	-	-	-
Bombus laesus Morawitz	-	++	-	++
Bombus mucidus Gerstaecker	-	++	-	-
Xylocopa violacea (L.)	-	-	-	-
Xylocopa valga Gerstaecker	-	-	-	-
Xylocopa iris (Christ)	+	-	?	?
***Xylocopa cantabrica* Lepeletier**	+	+	+	+
Habropoda tarsata (Spinola)	+	+	-	-
Habropoda zonatula Smith	-	+	+	?

CAUSES OF THE REGRESSION

Proximal causes of regression are differently identified.

For Williams (1986), as the most endangered species are rare ones, the most probable cause of regression is the splitting and restriction of habitats.

For Westrich (1989), the fact that the ground nesting species are those that regress the most shows that the increasing lack of available nest sites is a major regression factor.

As the main endangered guild is the long-tongued wild bees group, some authors think that the decreasing availability of food sources is a main factor of regression.

For Rasmont & Mersch (1988), the main factor is the near extinction of the leguminous from crop-rotation.

For Corbet *et al.* (1991) all modern practices of landscape management strongly disadvantage perennial or biannual plants. The nectar productivity of those plants making them the basic food resource of long-tongued bees, their replacement by annual plants means a regression of those species.

The most probable is that all these authors are partly right (Bruneau 1993; Rasmont *et al.*1993).

Donath (1986) claimed that percussion by moving cars is an important mortality factor for bumble-bees while Rasmont & Mersch (1988) consider this as a minor factor, unable to explain the particular regression of long-tongued species.

Impact of insecticides, fungicides and herbicides remains enigmatic. However, Colin & Belzunces (1993) have shown that the toxicity of pyrethrenoids is strongly synergized by fungicides. The combination of these two agents have lethal or just sublethal effects at so low concentration level that any detection is impossible. Deltamethrin is used against rape (*Brassica napus*) insect pests at concentrations of 3 to 6 g of active matter per ha, while a very high *Apis mellifera* toxicity is observed with a concentration **30 times lower**, when it is synergized with fungicides. The relative innocuousness of pyrethrenoids and fungicides for warm-blooded animals leads unfortunately to generally neglect or underestimate their ecological impacts.

All these proximal causes can be reduced to a new and harmful conception of rural landscape. All marginally profitable cultures and agricultural practices disappear: tobacco, sainfoin, clover, lavender and so on... Marginal agriculture areas are progressively deserted. Some little farms remain now occupied thanks to an economical input from "green tourism" but it seems clear that this occupation can not survives a long time after the death of marginal agriculture.

ENTOMOLOGISTS

Rasmont & Mersch (1988) have compared the observed regression with numerical importance of entomological collects. A whole century of bumble bees collect have brought 200,000 to 300,000 specimens from France and Belgium in various collections, institutions and research institutions. This represent 2000 to 3000 specimens per year.

Duhayon (1992, 1993) have recently made an evaluation of bumble bee population density in *Ericaceae* heath of Belgium and in strawberry-tree scrub of South France. The instantaneous density for one species goes from to 1,000 to 10,000 specimens/ha.

It is clear that some stations are not as rich, as cultivated plains, but others can be much more dense and diversified, as some low mountains (700-1500 m) habitats. This gives a prudent estimation of 100.000 bumble bees / km^2. The present survey of bumble bees from Belgium and France has had a population cost of 1/23,200,000th of the total population supported by the territory for one century (580,000 km^2 area * 100 years * 100,000 spec./km^2 year / 250,000 specimens in collections).

Even in the extremely unfavourable case of estimations biased by more than one or two magnitudes orders, it seems obvious that entomological collect cannot be a major cause of regression. This is also true for other insect species (Hamon, 1994).

PRESENT SITUATION OF THE WILD BEES CONSERVATION LEGISLATION

An apparently easy way of enforce wild bees protection is to include some or all of them in the list of strictly protected species. This ways of protection has been used in Poland, in Germany (*Bundesgezetzblatt* 22.12.72) and in Paris region since 1993 (*Journal officiel de la République française*, 24 septembre 1993).

As for birds protection, the laws for wild bees protection do not give any information about reference books nor interpretation of taxa. For birds, it is not a problem, as every naturalist and even laymen can recognize readily a lot of species. Field guides of birds are also numerous, complete, easy to use and inexpensive. For wild bees, the identification is far more complicated.

In our countries, a main legal principle is that everybody must know the law. In the present case, however, even somebody knowing the text by heart cannot enforce it because he cannot identify taxa. He is placed in the situation of **good faith error** (*"erreur invincible"* or *"de bonne foi"*).

Only an expert is able to recognize wild bees taxa. This necessity of expertise is enforced by the absence of identification books in nearly all European languages and by the absolute necessity of optical tools.

All identification of the protected species requires: - capture of specimens, - killing, - dissection of genitalia and, - examination with a binocular lens. The expertise required to insure application of the law, needs to violate it!

The solution to this paradox seems to give a large interpretation to the taxonomic group involved. In Germany, for example, the protection laws concern the whole wild bees group. In this case, the expertise is no more a problem as everyone can recognize a bee or a bumble bee. The problem is that, because of the ubiquity of wild bees, the protected taxa are then so widely widespread that everybody can observe it in their own garden! How to really protect taxa present in population density of 1,000 to 10,000 specimens /ha, which are killed by cars, destroyed by plough, eaten by cats or chicken (do not forget that all citizens are responsible of violations of the law by their own domestic animals!), which penetrate in houses, nest in all gardens and, sometimes, can cause deadly stings?

In the European Union, the jurisprudence tends to cease legal proceedings against unwilling destructions (e.g. because of agricultural practices or of building). As only VOLUNTEER destruction can be punished, only a few bee-specialists can be victimized by law. However, as it is also important to establish **evil intent** (*"animus dolendi"*), even the specialists cannot really be the victims of legal proceedings.

Real possibilities of strict protection of wild bees by law are nearly nil.

What can be the potential effects of such strict protection laws?

- It brings the risk that, giving some "scarcity bonus" to wild bees collection, protection laws increase collection by non-naturalists.
- It establishes a guiltiness context for entomology. To young children making their first entomological experiences, it will be said a definite "*it's forbidden*".
- Law agents may confiscate entomological material (nets, traps, insects boxes, even cars,...). Even if real proceedings cannot be prolonged, it can be a real problem and lead to a lot of complications to retrieve all this material.
- Postal services can refuse to transport any entomological specimens without identification attestation. As current entomological practices involve continuous postal exchanges of specimens, this kind of regulation can be fatal for entomology.

It is not only a school case. One of the very few specialists of African Halictids, Alain Pauly, lives in Madagascar where such kind of postal regulations apply. Here is no problem to send him material for identification but it is impossible for him to send it back. Post services refuse any entomological invoices, even with only European specimens. Customs do not accept to provide authorization for exportations without an attestation that protected species are not included. As the only specialist is, precisely, Alain Pauly, the problem is not soluble. I lost so thousands of European Halictids specimens that I had send to my friend and that I could not receive back.

All these perverse effects can lead to a near suppression of entomological survey of wild bees.

For fighting against fever, the new laws restrict considerably the use of the thermometer!

Thinking that the simple publication of a law is sufficient to restore populations is a myth. With strict enforcement of the rule, present species protection prevents observations and sampling by entomologists and therefore stops all survey operations. With weak interpretation, it is without any efficiency on any regression causes.

FUTURE OF CONSERVATION: HABITATS PROTECTION

It is clear that strict protection laws are not well suited for all animals discreet or hard to identify. It would be much better to provide laws of habitat protection with lists of species indicators, including some wild bee species. The directive 92/43 (May 21th 1992) from the European Community concerning habitat protection, is a main step in this direction. This directive distinguishes carefully strictly protected species (appendix IV of CEE text) from species giving obligation of habitat protection (appendix II of CEE text). Habitat protection includes obligations of species survey, research of predilection sites and restoration of populations.

LACK OF WILD BEES TAXONOMISTS

The number of taxonomical specialists is dropping seriously: there are no more taxonomists in France for any Apoid group. This is astounding as the scientific history of the country is splendid. The scientific tradition initiated by Latreille and continued by Lepeletier, Giraud, Dufour, Dours, Pérez, Ferton, Vachal, Lichtenstein, Benoist and Delmas is now totally extinct.

There are to few specialists to insure the taxonomical identifications required for the current wild bees surveys. As there is nearly no good popularization or scientific literature in the great majority of European languages, the number of amateurs remains also too low.

There is a great emergency to train more taxonomical specialists as in the past.

PRACTICAL PROPOSITIONS

As the regression phenomenon of longue-tongued wild bees is very serious and as these animals are essential for plant fertilization, all must be done to permit conservation and restoration of populations.

Here are some propositions in order to initiate this programme.

1) Not to include any wild bee or bumble-bee in strict protected insects list to avoid perverse effects of increasing collection prices and difficulties in surveying species. As exception, it could be interesting to strictly protect one or two wild bee species but only with the imperative condition that they must be very easy to recognize, good ecological indicators and used in symbolic ways in a popularization campaign.
2) To include a few number of wild bee species **easy recognisable** and **really threatened** (Tab. I) in a list of taxa whose habitats must be protected (as in the appendix II of the European directive 92/43).
3) To Publish everywhere good taxonomic works about Apoids in vernacular languages.
4) To Encourage wild bees survey by some subsidies.
5) After identifying stations with a great concentration of taxa included in the list of the item 2, to propose for these places a protection directed NOT AGAINST entomological work but AGAINST excessive landscape or agriculture practices.
6) On the basis of ecological characteristics identified in these protected stations, to propose general recommendations concerning landscape management.

In all cases, it is very important **NOT** to include ubiquitous, ruderal or synanthropic species in habitat protection indicators lists.

It is also important to carefully choose a very low number of species to be included in such lists. This will permit a good training of forest or rural policemen. To avoid multiplication of different lists of taxa, increasing the total number of species to survey, it seems preferable to elaborate NATIONAL lists and not local or provincial ones.

In all cases, it is greatly preferable to include in such lists only species immediately recognizable by everybody. This is a very restrictive condition because of the great general difficulty level of wild bees taxonomy.

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