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Red Lists in Flanders: scale effects and trend estimation

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INTRODUCTION

It is estimated that about 40,000 to 50,000 species (2.8% of the world's biodiversity) occur in Belgium (viruses, Bacteria, Protista, 'Algae' not included), 80% can be found in Flanders (Gysels 1999; Van Goethem 1998). Of these, 75% are invertebrates (insects, spiders, a.o.), 24% are 'plants' (vascular plants, mosses, lichens and fungi), whereas vertebrates (birds, mammals, reptiles and amphibians) constitute the remaining 1%. Most likely, the reported figures are substantial underestimations, especially for invertebrates. As an example we can cite the insect order Diptera (Flies, mosquitoes, midges). At present, about 4,500 species of Diptera are reported for the Belgian fauna (Grootaert *et al.* 1991). However, based on the checklists of the surrounding countries, it is estimated that the total species richness could amount to over 6,000 species. This implies that for about 1,500 to 2,000 species it is even uncertain whether or not they occur in Flanders. If we extrapolate this to the other insect orders and invertebrate groups, this would imply that thousands of organisms still remain to be discovered.

For Flanders, Red Lists have been compiled for mammals (Criel 1994), carabids and cicindelids (Desender *et al.* 1995), amphibians and reptiles (Bauwens and Claus 1996), dragonflies (De Knijf and Anselin 1996), spiders (Maelfait *et al.* 1998), freshwater fish (Vandelannoote *et al.* 1998), breeding birds (Devos and Anselin 1999), butterflies (Maes and Van Dyck 1999), mosses (Hoffmann 1999a), lichens (Hoffmann 1999b), mushrooms (Walleyn and Verbeke 2000), grasshoppers and crickets (Decleer *et al.* 2000), long-legged flies (Pollet 2000) and vascular plants (Biesbroek *et al.* 2001). The Red List categories are those proposed by the IUCN Species Survival Commission (IUCN Species Survival Commission 1994), adapted for Flanders (Maes *et al.* 2003; Maes and Van Swaay 1997). The knowledge on the status of Flemish biodiversity is strongly biased towards vertebrates and vascular plants of which the status of respectively 100% and 58-70% of the species has been established. On the other hand, the status for fungi and invertebrates is only known for respectively 10% and 5-6% (Table 1).

Table 1 – Estimated number of species and number of species with known Red List status for the major taxa of Flemish flora and fauna

	Estimated # species	**Red List status known**		
		% of total fauna in Belgium	Number with known status	% of total with known status
Belgium	40 000-50 000[1]			
Flanders	32 000-40 000	80%		
Fungi	5000-6000	16%	552	10%
'Flora'[2]	2 680-3 600	8%	2 089	58-78%
Invertebrates	24 000-30 000	75%	1 365	5-6%
Vertebrates	295 (± 500[3])	1%	295	(100%)

1 Not included: Virusses, Bacteria, Protista, 'Algae'

2 Flora includes vascular plants, mosses, lichens

3 ± 500 species includes non breeding, migratory birds

Overall, for all Red-Listed taxa combined (4,264 species), one third is extinct in Flanders or threatened (Red List categories critically endangered, endangered and vulnerable) (Fig. 1, De Bruyn 2001). About 7.5% (319 species) are locally extinct, i.e. no records since 1980. About 30%, or 1,279 species (or 47% – 2004 species, if one includes susceptible species), are threatened in one way or an-other. When we extrapolate these relative figures to the estimated numbers of organisms that should occur in Flanders (taking into account the proportion of 'Belgian' species living in Flanders, and the number of 'undiscovered' invertebrates), we get a rough estimate on the status of biodiversity in Flanders. Of the 42,000 species occurring on the Flemish territory, about 14,000 should occur on the Red Lists, of which 5,000 are extinct in Flanders. This implies that many species went extinct before they were discovered in Flanders. In all probability, these figures are an underestimation of the real situation because groups such as algae, unicellular organisms (± 5,000 in the Netherlands) or Bacteria (>1,000 in the Netherlands) were not taken into account.

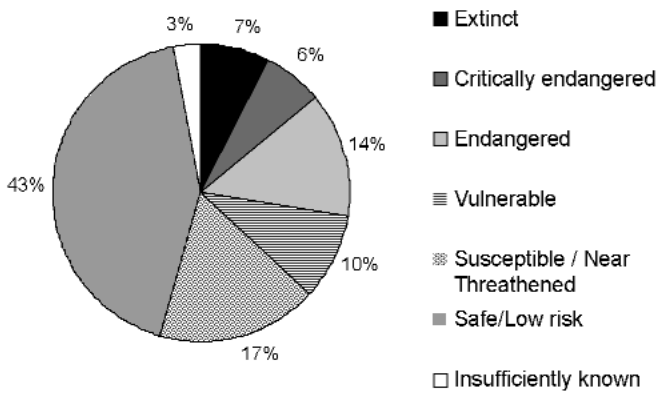

Figure 1 – Relative distribution over Red List categories of the screened Flemish biota. Data are based on the Red Lists of mammals, breeding birds, amphibians, reptiles, fish, dolichopodids, butterflies, carabids, dragonflies, spiders, grasshoppers, vascular plants, mosses, lichens and a number of mushroom groups.

The previous paragraphs treated the state of nature based on long-term data collected during the previous century (since 1900). Trend analyses are based on relatively large sample surfaces (e.g. 4 x 4 km, 5 x 5 km UTM grids). However, it was shown that for common species, population losses fail to be detected on these grid maps. For species of intermediate rarity, grid maps may identify species decline, but usually underestimate population losses (Thomas and Abery 1995; Van Dyck 2000). Larger grid cells may contain several populations of a species. When some of these disappear, this is not reflected in the distribution maps since a grid square only becomes empty when the last population gets extinct. Therefore it is proposed to monitor changes of species status more intensely on a finer scale (Thomas and Abery 1995). The latter is illustrated with data from two vertebrate groups and one invertebrate, viz., breeding birds, amphibians and butterflies.

BREEDING BIRDS

In 1994, a project started to census rare (45 species) and colonial (15 species) breeding birds in Flanders (Devos and Anselin 1996). Since then, the target birds are monitored annually using the standardised and detailed territory mapping method as described in Hustings *et al.* (1985) and van Dijk (1993). The research areas are visited several times during the breeding season (March-July). All territories are mapped and the breeding pairs and/or nests are counted. The results are reported at regular intervals (Anselin *et al.* 1998; Devos and Anselin 1996).

At present, 31 of the 62 species are only represented by less than 10 breeding pairs (Fig. 2a). Between 1994 and 1996, the number of breeding pairs decreased for 12 species, increased for 22 species, while it was stable or fluctuating for 28 species. Most species that were represented with only few breeding pairs in 1994 showed a decreasing trend (Fig. 2b) (examples are Great Grey Shrike – *Lanius excubitor,* Penduline tit – *Remiz pendulinus*) or showed no clear trend. However, many of the latter are already so rare (e.g. Wryneck – *Jynx torquilla,* Corncrake – *Crex crex,* Melodious warbler – *Hippolais polyglotta*) that the slightest decrease would wipe them out. For only few (e.g. Bittern – *Botauris stellaris,* Common gull – *Larus canus,* Little bittern – *Ixobrychus minutus*) the situation seems to improve. All birds with over 100 breeding pairs are stable or increase (Blue heron – *Ardea cinerea,* Rook – *Corvus frugilegus,* Cormorant – *Phalacrocorax carbo,* Herring gull – *Larus argentatus*). Important to notice is that for some of the more common colony breeders (e.g. Little Tern – *Sterna albifrons* and Sandwich Tern – *Sterna sandvicensis*) all breeding pairs are confined to a single colony, which also makes them vulnerable. For example, the Sandwich Tern decreased from over 1,500 breeding pairs in 2001 to ± 40 in 2002!

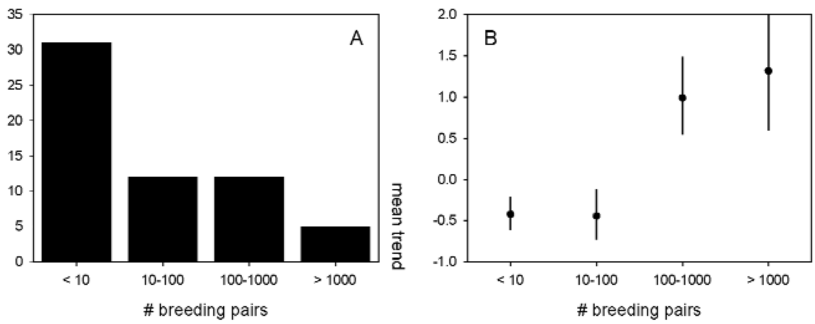

Figure 2 – Breeding success of 62 monitored rare and colony breeding birds in Flanders. **2a** – Breeding density frequency distribution (number of breeding pairs); **2b** – Mean trend for the period 1994-1996 in the number of breeding pairs (data are mean ± S.E.).

AMPHIBIANS

Presence/absence data in 4 x 4 km Universal Transverse Mercator (UTM) squares of species distribution maps, showed that several species declined significantly or even became extinct during the last century (Bauwens and Claus

1996). The Yellow-bellied Toad – *Bombina variegata* is extinct since 1984, while only few populations (most very small with less than 10 calling males!) of the Tree Frog – *Hyla arborea* are left at present. The rare species such as Midwife Toad – *Alytes obstetricans* or Common Spadefoot – *Pelobates fuscus* were the first to show decline (except for Palmate Newt – *Triturus helveticus* and Great Crested Newt – *Triturus cristatus,* which show a modest upward trend). On the other hand, populations of species with relative wide distributions (e.g. Alpine Newt – *Triturus alpestris,* Common Newt – *Triturus vulgaris*) appear to show stable or even increasing numbers of occupied grid cells (Fig. 3a).

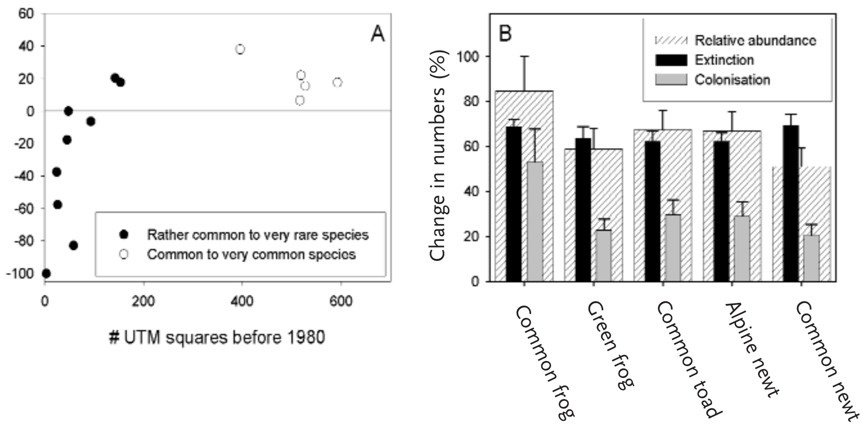

Figure 3 – Distribution and trends for Flemish amphibian species. **3a** – Relationship between abundance and trend (# 4 x 4 km UTM squares before and after 1980); **3b** – Mean amphibian species specific turnover between 1975-1989 and 1999-2001 (detailed pool inventarisation) (data are mean ± S.E.).

In 1999-2001, a detailed inventory campaign was set up in Flanders (Colazzo *et al.* 2001). The research was focussed on areas for which detailed inventories from the near past were available (period 1975-1989: De Fonseca 1980; Sanders 1987). This made it possible to get well-documented abundance and distribution trends over the last decennium for a number of species (Colazzo *et al.* 2002). Overall, about 1600 ponds, scattered over 9 regions, were examined, of which 750 were visited during both time periods. Analyses of distribution changes were carried out only for common amphibian species, since these species were the most likely not to have shown significant changes with the grid counting method. The study focussed on the Common Toad – *Bufo*

bufo, the Green Frog – *Rana esculenta-synklepton,* the Common Frog – *Rana temporaria*, the Alpine Newt and the Common Newt.

The combined data for all species and regions showed that the actual number of local populations was only 64% of the formerly recorded number, which implies a reduction of about $^1/_3$ over the past 15-25 years. All species studied show a decreasing trend (Fig. 3b). This trend was strongest for the Green Frog (-41%) and the Common Newt (-48%). The reduction for the Common Toad is only moderate (-15%) and does not indicate a significant reduction in the number of local populations.

BUTTERFLIES

The Flemish butterfly atlas contains about 190,000 records, collected since 1830 (Maes and Van Dyck 1999; 2001). Butterfly presence is recorded in 5 x 5 km UTM squares. Distribution and trend analyses were performed with the year 1991 as a pivotal date. During the last century, butterfly diversity continuously decreased, at first slowly, but later much faster (8-fold!) during the second part of the 20th century (Maes and Van Dyck 2001). As a result, butterfly species richness declined with 30% from 62 in 1900 to 47 species at present. Another 50% is threatened (Maes and Van Dyck 2001). Compared to the period before 1991, the distribution range of 17 species shrunk (decline of at least one Red List category), 20 species were more or less stable (no category change) and 11 have extended their range (Maes and Van Dyck 1999). These changes are not equal for different Red List categories (Fig. 4a). In general, species that were common to very common in the past (e.g. Meadow Brown – *Maniola jurtina*, Holly Blue – *Celastrina argiolus*, Map – *Araschnia levana*), are stable, or even increase their distribution further (except for Small Copper – *Lycaena phlaeas*, Wall Brown – *Lasiommata megera* and Small Heath – *Coenonympha pamphilus*). On the other hand, rare species such as Queen of Spain Fritillary – *Issoria lathonia*, Purple Emperor – *Apatura iris*, or White Admiral – *Ladoga camilla*, further decline (except for Small Skipper – *Thymelicus sylvestris*, Brown Argus – *Aricia agestis* and Marbled White – *Melanargia galathea*).

The distribution of the Alcon blue, *Maculinea alcon*, is restricted to the Campine Region in Flanders (Maes and Van Dyck 2001). Before 1991, it occurred in 39 (20%) of the 194 5 x 5 km UTM squares of the Campine Region (Fig. 4b). Between 1991 and 1998 this reduced to 20 squares (10%). In 1999-2000 this species only occured in 12 squares (6%). Overall, the distribution area of the Alcon blue declined by 69%. However, a recent study of the ecology and distribution of the Alcon blue showed that the situation is even worse (Van Reusel *et al.* 2000). During this study, all known existing populations were recorded. The distribution was assessed at three levels. On the 5 x 5 km scale, the butterfly occurs in 13 of the 644 Flemish UTM squares,

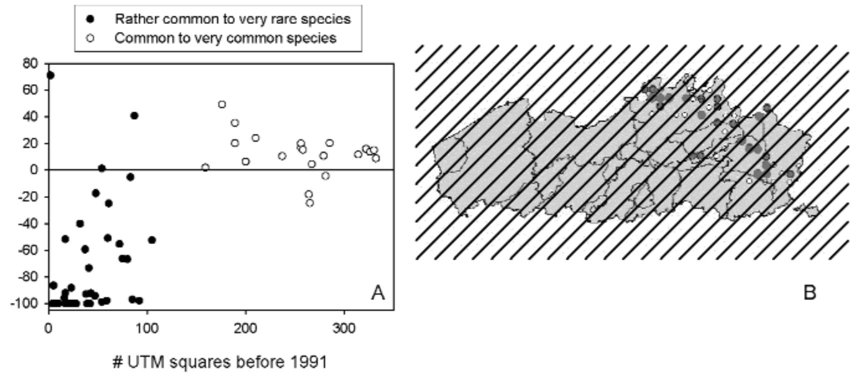

Figure 4a – Relationship between abundance and trend for Flemish butterfly species (ratio # 5 x 5 km UTM squares before and after 1991). **4b** – Distribution map of the Alcon Blue (white = before 1991, grey = 1991-1998, black = 1999-2000).

or 1.84%. On the 1 x 1 km scale, *M. alcon* occurs in 23 of the 14,325 UTM squares (or 0.16%). Finally, the effective number of populations (35) covers 42.33 ha of the total Flemish territory of 1,378,767 ha, or 0.003%. In other words, the distribution figure based on the 5 x 5 km squares (area of occupancy) overestimates the real distribution by 600% (area of occurrence).

The causes of the biodiversity crisis are well known and include human impacts on habitats (habitat destruction, degradation, fragmentation, and restructuring) and on organisms (overexploitation, introduction of exotic competitors, predators and parasites, and creating new pests) (Mooney and Cleland 2001; Pimm *et al.* 1995; Vitousek *et al.* 1996; Wilson 1991). For Flanders, the same disturbance factors were cited (e.g. Bauwens and Claus 1996; Dumortier *et al.* 2003; Kuijken *et al.* 2001; Maes and Van Dyck 2001). Environmental pressure on nature is strong in Flanders due to the high population densities, leaving only about 11% of the territory for nature (De Bruyn *et al.* 2002). The remaining surface suffers strongly due to environmental pressures (Van Steertegem 2001). One of the main impacts is from agricultural practice. Agriculture is extremely intensive in Flanders, emitting Europe's highest levels of nutrients into the environment (OECD database for 2001 at www.oecd.org). This over-fertilization is causing species extinctions; for example it is one of the main reasons why nearly a third of the area's butterfly species have been wiped out during the past century (Maes and Van Dyck 2001). The farming system also influences the distribution and abundance of farmland birds (Alford and Richards 1999; Chamberlain and Fuller 2001; Donald *et al.* 2001). For instance, agricultural intensification is blamed for the plummeting populations of the House Sparrow, *Passer domesticus*, in Western Europe in recent decades (Hole *et al.* 2002).

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