

Trends in dragonfly occurrence in Belgium (Odonata)

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Abstract

The group 'Gomphus' collected 65 000 records of 69 species of Odonata, more or less equally scattered over Belgium. The best-investigated areas are the northern part and some river valleys in the south. Most hot spots can be found in the northeastern part, with a maximum of 48 species for 25 km². Remarkable is the fact that 50% of the species occurs in less than 7% of the 5 km grid cells (UTM). We determined trends in occurrence by comparing three periods: before 1950, 1950-1989 and 1990-2000. Four species show a clear decline over the three periods, eight species give evidence of a historical decline but survive on a limited number of sites and eight species also display a historical decline but have been increasing during the last decade. Six species show a (very) clear increase over the three periods and two species display their increase only during the last ten years.

Key words: Odonata, dragonflies, Belgium, atlas, hot spot, abundance class shift, habitat.

Introduction

One of the aims of the Belgian Dragonfly Group 'Gomphus', a volunteer organisation founded in 1983, is to collect all distribution data of Odonata in Belgium with the intention to publish an atlas of the Belgium Odonata. For that reason we set up an Atlas Project and developed a network of more than 400 field-workers.

A special effort has been made to achieve a good coverage of the territory during the last ten years. Since 1990, all 10 km grid cells (UTM) and nearly 60% of the 5 km grid cells of Belgium have been visited at least once. In the Flemish region, little less than half the area of Belgium, more than 1700 localities were visited at least once since 1990. Nearly 65 000 records are available, two thirds of them collected since 1990, on 66 species (on a total of 69 species for Belgium). As early as in the 19th century, the Odonata fauna of Belgium was very well investigated. A first review by De Sélys-Longchamps (1888) already mentioned 65 species for Belgium. Figure 1 shows the coverage of all 1 km grid cells in which Odonata were observed since 1990. The northern part of Belgium (the Flemish region) and some river valleys in the south are very well investigated.

Species diversity

For each 5 km grid cell we calculated the number of observed species since 1990. The highest species diversity (fig. 2) is found on the poor sandy

soils with heathlands and moors in the northeastern part, the Kempen and in some river valleys, peat moors and fens in the south. The maximum number for a single grid cell is 48 species or 73% of the actual Odonata fauna of Belgium. Even in a European perspective, with only 130 species (Wasscher & Bos 2000), this is a relatively high percentage of 37%. Fig. 3 gives the number of species for Log (2) of the number of the investigated 5 km grid cells ($n = 908$). We show that 33 (50 %) of the species occur in less than 7% of the grid cells and can be considered as rare in Belgium. On the other hand, 15 species (22%) occur in more than a quarter (28%) of the grid cells.

Trend analysis

To determine the change in occurrence of Odonata in Belgium, we make use of three major time periods: 1. before 1950, which we consider to be the historical species distribution; 2. 1950-1989, being the time of the great change in land use and the deterioration of the environment and the natural habitats and 3. 1990-2000, or the actual distribution. We calculate for each species the number of 10 km grid cells in which a certain species was observed. To compensate for the differences in recording effort, we made a correction for the total in recording effort per area. This means that the actual number of 10 km grid cells for each species is related to the total amount of

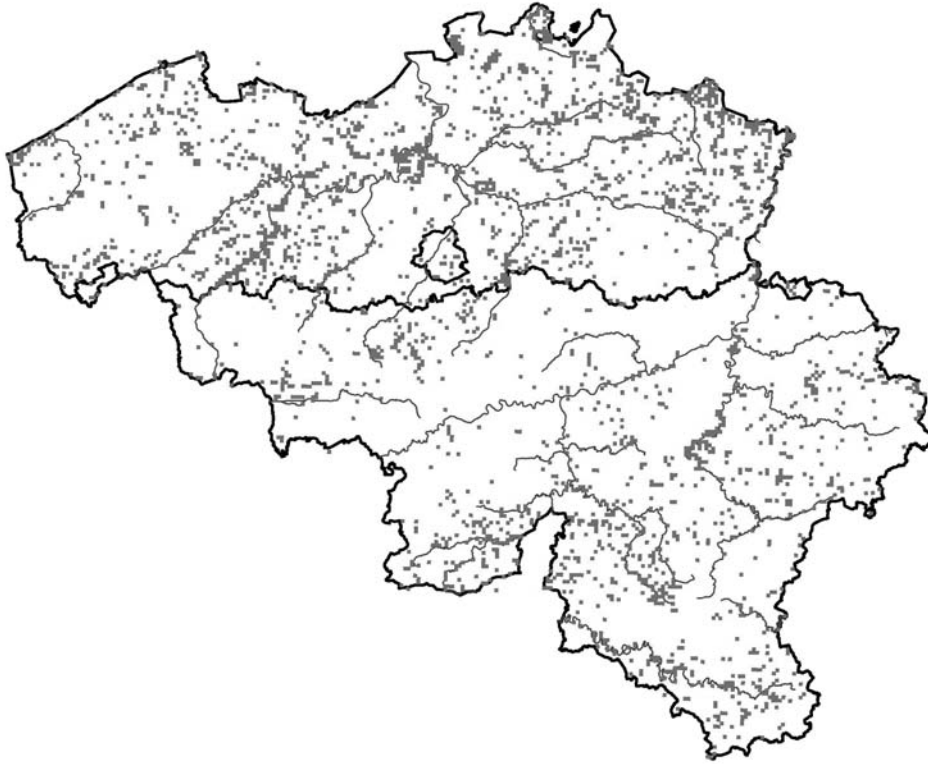


Figure 1
Geographic distribution of the localities with data since 1990, 1 km grid cells (UTM).

investigated 10 km grid cells for each period (before 1950: $n = 178$; 1950-1989: $n = 327$; 1990-2000: $n = 339$). By comparing the percentages of each period, we obtained a measurement of change (%) in the occurrence for each species in Belgium (table 1).

The Belgian Odonata

Out of a total of 69 species the indigenous status of eight is dubious. These are marked with an * in table 1. For four of them, *Aeshna affinis*, *Anax parthenope*, *Sympetrum fonscolombii* and *Sympetrum meridionale*, proof of reproduction in Belgium is available (Goffart 1999, Van den Berghe 1999, Versonnen et al. 2002), but there are no indications that populations exist already for at least ten consecutive years. For that reason we classify them as not indigenous. Despite the increased effort and the higher number of investi-

gated 10 km grid cells, some species show an obvious decrease.

Extinct and declining species

Only two species, *Leucorrhinia caudalis* and *Nehalennia speciosa*, are extinct in Belgium, the former already around 1900 and the latter since 1970. This is the lowest number in comparison with our surrounding countries: five extinct species in the Netherlands (Wasscher 1999), four in the former West-Germany (Clausnitzer et al. 1984), four in France (Dommanget 1987) and three in the United Kingdom and Ireland (Merritt et al. 1996). Four species show an obvious decline of more than 25% over the three periods: *Aeshna isocles*, *A. subarctica*, *Coenagrion hastulatum* and *Leucorrhinia pectoralis*. This means that they not only display a historical decline but that their decrease has still been going on during

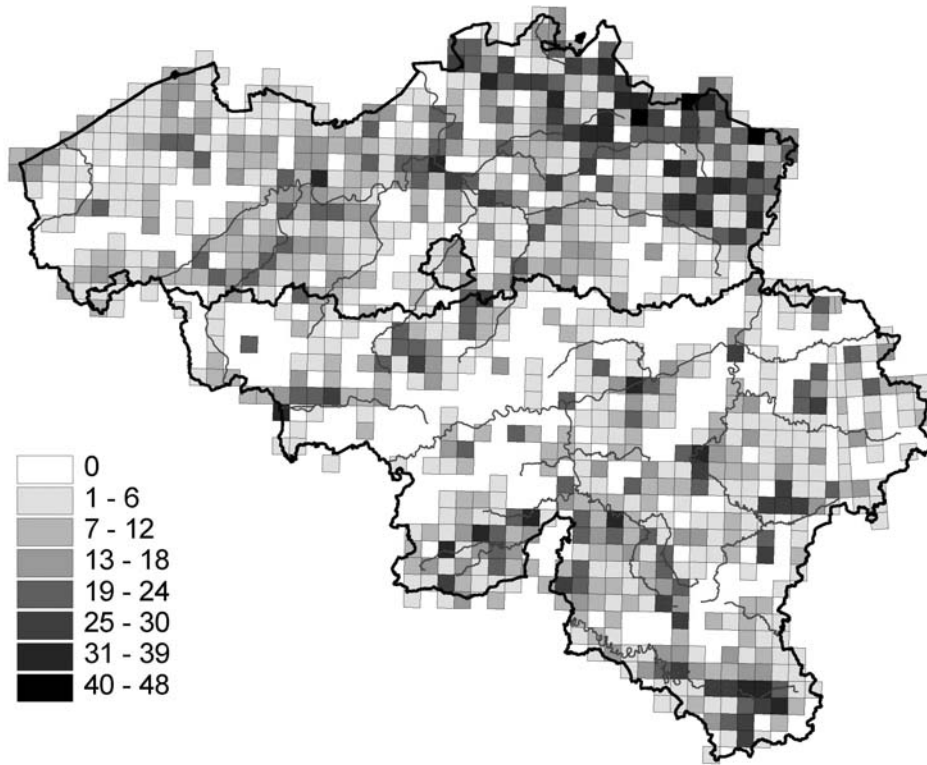


Figure 2
Total number of Odonata species in Belgium since 1990, 5 km grid cells (UTM).

the last decades. If the appropriate measures are not taken to protect and conserve the last populations and the habitats of these species, this will in a short term inevitably lead to the extinction of those four species in Belgium.

Comparing the periods before 1950 and 1950-1989, eight species (*Brachytron pratense*, *Epitheca bimaculata*, *Gomphus vulgatissimus*, *Leucorrhinia rubicunda*, *Libellula fulva*, *Orthetrum coerulescens*, *Oxygastra curtisii*, and *Sympetrum depressiusculum*) show a historical decrease (>25%), but a stabilisation comparing the latter period with 1990-2000. This means that they can survive in a limited number of grid cells or that they were able to colonise new grid cells or formerly abandoned ones. Those species are here in the centre of their geographical distribution or have a more eastern range (Askew 1988).

Another group consists of species, which display

a historical decrease of more than 25% (comparing the periods before 1950 and 1950-1989) but for which the number of 10 km grid cells the last ten years clearly augmented. This group contains seven species: *Cercion lindenii*, *Coenagrion mercuriale*, *C. scitulum*, *Lestes barbarus*, *L. dryas*, *Onychogomphus forcipatus*, and *Sympecma fusca*. With the exception of *Lestes dryas*, they all have their main distribution in southern parts of Europe (Askew 1988). We suppose that recent changes in temperature in Europe favour the occurrence and distribution of these species, at the northern limits of their ranges.

Because of the differences in recording effort between the three periods, especially between on the one hand the first (before 1950) and on the other the second (1950-1989) and third period (1990-2000), it is expected that most species, with the exception of all the threatened ones, are

Table 1

Odonata species list of Belgium, ordered alphabetically. For each species the number of 10 km grid cells is given for three periods: P1= before 1950, P2 = 1950-1989 and P3 = 1990-2000. The percentage of occurrence (P1%, P2% and P3%) of all investigated grid cells is calculated by considering the total number of investigated grid cells per period: P1 (n = 178), P2 (n = 327) and P3 (n = 339). The measurement of change (%) in the occurrence for each species is obtained by comparing P2 with P1 (P21), P3 with P1 (P31) and P3 with P2 (P32).

Species		P1	P1%	P2	P2%	P3	P3%	P21	P31	P32
<i>Aeshna affinis</i> *	Vander Linden, 1820	3	1.7	2	0.6	23	6.8	-64	303	1009
<i>Aeshna cyanea</i>	(O.F.Müller, 1764)	45	25.3	208	63.6	238	70.2	152	178	10
<i>Aeshna grandis</i>	(Linnaeus, 1758)	18	10.1	91	27.8	115	33.9	175	235	22
<i>Aeshna isoclees</i>	(O.F.Müller, 1767)	13	7.3	15	4.6	9	2.7	-37	-64	-42
<i>Aeshna juncea</i>	(Linnaeus, 1758)	21	11.8	52	15.9	56	16.5	35	40	4
<i>Aeshna mixta</i>	Latreille, 1805	18	10.1	101	30.9	200	59.0	205	483	91
<i>Aeshna subarctica</i>	Walker, 1908	6	3.4	8	2.4	3	0.9	-27	-74	-64
<i>Anax imperator</i>	Leach, 1815	20	11.2	167	51.1	262	77.3	355	588	51
<i>Anax parthenope</i> *	(Selys, 1839)	1	0.6	4	1.2	14	4.1	118	635	238
<i>Brachytron pratense</i>	(O.F.Müller, 1764)	25	14.0	19	5.8	24	7.1	-59	-50	22
<i>Calopteryx splendens</i>	(Harris, 1782)	47	26.4	114	34.9	151	44.5	32	69	28
<i>Calopteryx virgo</i>	(Linnaeus, 1758)	44	24.7	119	36.4	131	38.6	47	56	6
<i>Cercion lindenii</i>	(Selys, 1840)	14	7.9	13	4.0	83	24.5	-49	211	516
<i>Ceragrion tenellum</i>	(de Villers, 1789)	11	6.2	19	5.8	28	8.3	-6	34	42
<i>Coenagrion hastulatum</i>	(Charpentier, 1825)	18	10.1	21	6.4	10	2.9	-36	-71	-54
<i>Coenagrion lunulatum</i>	(Charpentier, 1840)	4	2.2	15	4.6	12	3.5	104	58	-23
<i>Coenagrion mercuriale</i>	(Charpentier, 1840)	10	5.6	3	0.9	5	1.5	-84	-74	61
<i>Coenagrion puella</i>	(Linnaeus, 1758)	43	24.2	210	64.2	252	74.3	166	208	16
<i>Coenagrion pulchellum</i>	(Vander Linden, 1825)	31	17.4	66	20.2	54	15.9	16	-9	-21
<i>Coenagrion scitulum</i>	Rambur, 1842	5	2.8	1	0.3	6	1.8	-89	-37	479
<i>Cordulegaster bidentata</i>	Selys, 1843	2	1.1	7	2.1	8	2.4	91	110	10
<i>Cordulegaster boltonii</i>	(Donovan, 1807)	22	12.4	54	16.5	79	23.3	34	89	41
<i>Cordulia aenea</i>	(Linnaeus, 1758)	32	18.0	76	23.2	120	35.4	29	97	52
<i>Crocothemis erythraea</i>	(Brullé, 1832)	1	0.6	12	3.7	70	20.6	553	3576	463
<i>Enallagma cyathigerum</i>	(Charpentier, 1840)	30	16.9	195	59.6	253	74.6	254	343	25
<i>Epitheca bimaculata</i>	(Charpentier, 1825)	3	1.7	2	0.6	2	0.6	-64	-65	-4
<i>Erythronma najas</i>	(Hansemann, 1823)	14	7.9	90	27.5	126	37.2	250	373	35
<i>Erythronma viridulum</i>	(Charpentier, 1840)	14	7.9	71	21.7	159	46.9	176	496	116
<i>Gomphus flavipes</i> *	(Charpentier, 1825)	0	0.0	0	0.0	2	0.6	-	-	-
<i>Gomphus pulchellus</i>	Selys, 1840	11	6.2	70	21.4	125	36.9	246	497	72
<i>Gomphus simillimus</i> *	Selys, 1840	2	1.1	1	0.3	2	0.6	-73	-47	93
<i>Gomphus vulgatissimus</i>	(Linnaeus, 1758)	20	11.2	20	6.1	27	8.0	-46	-29	30
<i>Hemianax ephippiger</i> *	(Burmeister, 1839)	1	0.6	1	0.3	1	0.3	-46	-47	-4
<i>Ischnura elegans</i>	(Vander Linden, 1820)	41	23.0	253	77.4	300	88.5	236	284	14
<i>Ischnura pumilio</i>	(Charpentier, 1825)	11	6.2	31	9.5	50	14.7	53	139	56
<i>Lestes barbarus</i>	(Fabricius, 1798)	7	3.9	5	1.5	77	22.7	-61	478	1385
<i>Lestes dryas</i>	Kirby, 1890	16	9.0	22	6.7	33	9.7	-25	8	45
<i>Lestes sponsa</i>	(Hansemann, 1823)	38	21.3	130	39.8	156	46.0	86	116	16
<i>Lestes virens</i>	(Charpentier, 1825)	8	4.5	15	4.6	15	4.4	2	-2	-4
<i>Lestes viridis</i>	(Vander Linden, 1825)	18	10.1	122	37.3	199	58.7	269	480	57
<i>Leucorrhinia caudalis</i>	(Charpentier, 1840)	4	2.2	0	0.0	0	0.0	-100	-100	-
<i>Leucorrhinia dubia</i>	(Vander Linden, 1825)	22	12.4	46	14.1	48	14.2	14	15	1
<i>Leucorrhinia pectoralis</i>	(Charpentier, 1825)	14	7.9	13	4.0	5	1.5	-49	-81	-63
<i>Leucorrhinia rubicunda</i>	(Linnaeus, 1758)	17	9.6	16	4.9	17	5.0	-49	-47	2
<i>Libellula depressa</i>	Linnaeus, 1758	36	20.2	172	52.6	218	64.3	160	218	22
<i>Libellula fulva</i>	O.F.Müller, 1764	18	10.1	20	6.1	22	6.5	-40	-36	6
<i>Libellula quadrimaculata</i>	Linnaeus, 1758	32	18.0	104	31.8	146	43.1	77	140	35
<i>Nehalennia speciosa</i>	(Charpentier, 1840)	6	3.4	1	0.3	0	0.0	-91	-100	-100
<i>Onychogomphus forcipatus</i>	(Linnaeus, 1758)	19	10.7	13	4.0	35	10.3	-63	-3	160
<i>Onychogomphus uncatus</i> *	(Charpentier, 1840)	0	0.0	2	0.6	0	0.0	-	-	-100
<i>Orthetrum brunneum</i>	(Fonscolombe, 1837)	2	1.1	4	1.2	20	5.9	9	425	382
<i>Orthetrum cancellatum</i>	(Linnaeus, 1758)	25	14.0	179	54.7	256	75.5	290	438	38
<i>Orthetrum coerulescens</i>	(Fabricius, 1798)	24	13.5	23	7.0	28	8.3	-48	-39	17
<i>Oxygastra curtisii</i>	(Dale, 1834)	4	2.2	2	0.6	3	0.9	-73	-61	45
<i>Platycnemis pennipes</i>	(Pallas, 1771)	26	14.6	129	39.4	160	47.2	170	223	20
<i>Pyrrhosoma nymphula</i>	(Sulzer, 1776)	42	23.6	178	54.4	200	59.0	131	150	8
<i>Somatochlora arctica</i>	(Zetterstedt, 1840)	6	3.4	11	3.4	15	4.4	0	31	32
<i>Somatochlora flavomaculata</i>	(Vander Linden, 1825)	3	1.7	11	3.4	13	3.8	100	128	14
<i>Somatochlora metallica</i>	(Vander Linden, 1825)	20	11.2	79	24.2	118	34.8	115	210	44
<i>Sympetma fusca</i>	(Vander Linden, 1820)	20	11.2	19	5.8	54	15.9	-48	42	174
<i>Sympetrum danae</i>	(Sulzer, 1776)	30	16.9	119	36.4	139	41.0	116	143	13
<i>Sympetrum depressiusculum</i>	(Selys, 1841)	14	7.9	17	5.2	23	6.8	-34	-14	31
<i>Sympetrum flaveolum</i>	(Linnaeus, 1758)	39	21.9	76	23.2	120	35.4	6	62	52
<i>Sympetrum fonscolombii</i> *	(Selys, 1840)	9	5.1	9	2.8	49	14.5	-46	186	425
<i>Sympetrum meridionale</i> *	(Selys, 1841)	7	3.9	0	0.0	3	0.9	-100	-77	-
<i>Sympetrum pedemontanum</i>	(Allioni, 1766)	4	2.2	8	2.4	24	7.1	9	215	189
<i>Sympetrum sanguineum</i>	(O.F.Müller, 1764)	27	15.2	135	41.3	221	65.2	172	330	58
<i>Sympetrum striolatum</i>	(Charpentier, 1840)	43	24.2	117	35.8	186	54.9	48	127	53
<i>Sympetrum vulgatum</i>	(Linnaeus, 1758)	16	9.0	100	30.6	139	41.0	240	356	34

going to demonstrate an increase in terms of percentage of occupied 10 km grid cells. Most records from the period before 1950 are based on collected specimens, which we suppose to give an overrepresentation of the rare species and an underestimation of the common species in this period. This means that the decrease of the species mentioned above is likely to be more severe than our analysis indicates.

Increasing species

We consider a species as increasing in case of a very obvious increase of more than 100% over the three periods or an increase of more than 200% between the periods before 1950 and 1950-1989 and an increase of at least 25% over the periods 1950-1989 and 1990-2000. Three species, *Aeshna mixta*, *Crocothemis erythraea* and *Erythromma viridulum*, show an increase in terms of percentage of occupied 10 km grid cells of nearly 100% or more for each period. The last two species are southern species that were able to shift their range of distribution to the north during the last decades (De Knijf 1995, Ott 1996, Wasscher 1999). Both have now become fairly common. Even a new species, *Gomphus flavipes*, was recently recorded in Belgium (Gubbels 2001).

Comparing the period before 1950 with the period 1950-1989, we note that ten species show an increase of more than 200% (table 1) and 13 more species display an increase of more than 100%. This is partly due to the factors mentioned above: differences in recording effort and old records based on voucher specimens. *Anax imperator*,

Gomphus pulchellus and *Lestes viridis* are three species from which the number of 10 km grid cells not only increased with more than 200% over the first two periods but also with more than 50% over the periods 1950-1989 and 1990-2000, despite nearly the same number of investigated grid cells for both periods. We expect that their expansion is still going on and that they will be found at more and more sites.

Orthetrum brunneum and *Sympetrum pedemontanum* are two species that display an increase during the last decade. Both show an increase of 380% and 190%, respectively, over the last two periods and their absolute number of 10km grid cells multiplied by five or three. This change is not so conspicuous as between the periods before 1950 and 1950-1989, when their number of grid cells doubled but their relative frequencies don't differ much.

Habitats

Analysing the species composition and the distribution of some Odonata for several kinds of threatened habitat types in Belgium we notice that the species which inhabit rivers, rivulets and brooks are *Calopteryx splendens*, *C. virgo*, *Coenagrion mercuriale*, *Cordulegaster bidentata*, *C. boltonii*, *Gomphus vulgatissimus*, *Onychogomphus forcipatus*, *Orthetrum coerulescens* and *Oxygastra curtisii*. Those species can be found along many rivers in the southern part of Belgium and in the northeastern part. Species of oligotrophic waters and bogs in Belgium are *Aeshna juncea*, *A. subarctica*, *Coenagrion hastulatum*, *C. lunulatum*, *Leucorrhinia dubia*, *L. rubicunda* and *Somatochlora arctica*. They are restricted to the northeast and the high altitudes of the Ardennes in Southeast-Belgium. Species of mesotrophic and natural eutrophic ponds and marshes occur in the whole northern part and in the very south of Belgium. They are *Aeshna isosceles*, *Brachytron pratense*, *Coenagrion pulchellum*, *Erythromma najas*, *Lestes dryas*, *Leucorrhinia pectoralis*, *Libellula fulva* and *Somatochlora flavomaculata*.

Acknowledgements

This project would not have been possible without the help of more than 400 people who were so kind to send us their observations of Odonata.

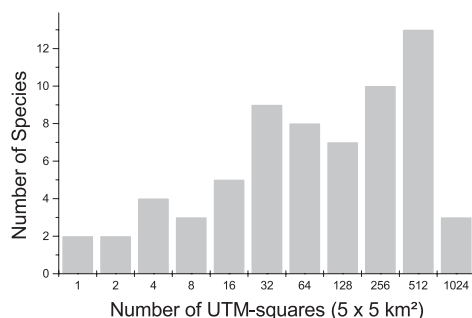


Figure 3
Number of species per 5 km grid cell (UTM).

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