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Original article

The rare Chrysopidae (Neuroptera) of southwestern Europe

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ARTICLE INFO

Article history:

Received 18 August 2006

Accepted 19 December 2006

Published online 5 February 2007

Keywords:

Neuroptera

Chrysopidae

Green lacewing

Faunistics

Southwestern Europe

Biodiversity

ABSTRACT

Quantitative surveys of the chrysopid fauna from southwestern Europe, namely the Iberian and Italian peninsulas, France south of 46° N, and the west-Mediterranean Islands, were analysed. A total of 56 species of Chrysopidae were reported, of which three species were abundant. These, *Chrysoperla carnea* (Stephens, 1836) sensu lato, *Dichochrysa prasina* (Burmeister, 1839) and *D. flavifrons* (Brauer, 1850), comprised a large percentage of the specimens. For the rarer species, comments are made on their distributions, the enhanced geographic range of exotic ones, and on levels of endemism and stenotopy.

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1. Introduction

The European Neuropteran fauna is well known, and the data have been summarised in a major (Aspöck et al., 2001), and a variety of more recent accounts. Most reported surveys are qualitative, and the occasional encounters of rare species in the samples are often highlighted by collectors. Such disproportionate attention may give readers a biased perspective of the actual occurrence of the species. Studies quantifying the relative abundance and overall incidence of Neuroptera are scarce, probably because such work is deemed less rewarding.

The goal of this study is to give an accurate assessment of species abundance, and so to help typify the assemblages of Chrysopidae in southwestern Europe. The study examines

whether the common species are indeed as predominant as the literature purports.

2. Material and methods

The geographical zone on which the survey is based encompasses west to east from 9° W to the Adriatic and the Ionian Seas, and northward to 46° N in France and to the Swiss-Austrian northern border of Italy, southward to the Mediterranean Sea, running along the North African coast (Fig. 1). Several surveys large enough to provide the necessary quantitative data were analysed. The abundance scale chosen is the following: a species is considered

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doi:10.1016/j.actao.2006.12.004

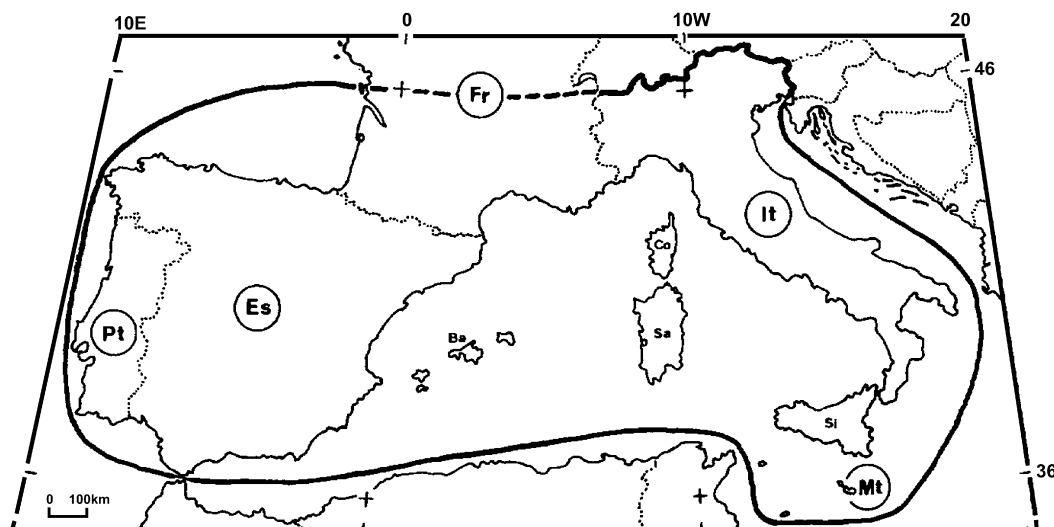


Fig. 1 – Southwestern Europe showing the surveyed zone.

dominant if its frequency (Q) exceeds 50% within the overall sample;

very common if $30 < Q \leq 50\%$;

common if $15 < Q \leq 30\%$;

uncommon if $5 < Q \leq 15\%$;

rare (RAR) if $1 < Q \leq 5\%$;

casual (CAS) if $0.1 < Q \leq 1\%$; and

exceptional (EXC) if $Q \leq 0.1\%$.

The results are grouped into four sub-zones, namely (i) Iberian Peninsula, (ii) southern France, (iii) peninsular Italy and (iv) the main west-Mediterranean islands: Balearic Islands, Corsica, Sardinia, Sicily and circumsicilian islets, Malta. They come from personal data (captures and revisions of collections) by the authors and colleagues, together with reappraisal of previously published surveys:

- Monserrat and Marín (1994) for Spain;
- Séméria (1978, 1980a, 1985, 1992), Alrouechdi et al. (1980), Grimal (1984), Sagné (1984), Canard (1987), Leraut (1992), Thierry and Canard (2007) for southern France;
- Monserrat (1980), Pantaleoni and collaborators (Comacchio 1984, Forlí 1985, Alto Appennino 1994), Pantaleoni (1984, 1990), Pantaleoni and Tisselli (1985), Pantaleoni et al. (1994), Letardi and Pantaleoni (1996), Pantaleoni and Letardi (1998) for peninsular Italy;
- Monserrat (1986, 2005), for the Balearic Islands; Séméria (1980b, 1982), Thierry et al. (2005) for Corsica; Duelli (1994) for Malta; Pantaleoni and Lo Valvo (1995), Nicoli Aldini and Baviera (2001) for Sicily and/or neighbouring islets.

Species richness and relative abundance can be appraised by several well-known indices. We computed (i) Margalef's index (I_M) to characterise the approximate faunistic richness, (ii) Shannon's diversity index (H') as the relative importance of each species and the ratio between the total number of species and individuals, and (iii) Hurlbert's equitability index (E_H) which measures the relative heterogeneity, featuring

the distribution of the species and specimens occurring in each unit and assessing the dominance of the more abundant species. Shannon's diversity index ranges from 0 to $\log S$ (S = number of species) being greatest in stables ecosystems; Hurlbert's equitability index varies from 0 to 1, being zero when almost all captured specimens belong to a single species and reaching one when each species is represented by the same number of individuals.

3. Results and discussion

A total of 56 species of Chrysopidae were found, listed in Table 1 together with the numbers of specimens collected in each of the four above-mentioned sub-zones. Tables 2 and 3 show ordinate data and relative frequencies of each species for the entire region of study and for each sub-zone, respectively. Table 4 gives the relevant biodiversity indices.

The three continental sub-zones harbour similar numbers of species ($S = 37\text{--}40$), with Spain having an additional three endemic species (see below). The breakdown of the fauna demonstrates that the Spanish Chrysopidae include species arrived from North Africa, whilst Italy has trans-Alpine taxa of Siberian species. Finally, peninsular Italy manifests both the highest faunistic richness I_M and diversity index H' , while islands are less rich ($S = 28$) but balanced as seen by the equitability indices E_H (Table 4) and frequency graphs (Fig. 2).

3.1. Abundance of species

Only three species are relatively abundant. They are, in decreasing order:

- very common: *Chrysoperla carnea* (Stephens, 1836), here treated sensu lato because of likely imprecise identifications in published accounts;
- common: *Dichochrysa prasina* (Burmeister, 1839);
- uncommon: *D. flavifrons* (Brauer, 1850).

Table 1 – List of southwestern European chrysopids and numbers of specimens recorded in the four surveyed sub-zones

#	Species	Spain	France	Italy	Islands	Total
1	<i>Nothochrysa fulviceps</i> (Stephens, 1836)	18	1	4	1	24
2	<i>Nothochrysa capitata</i> (Fabricius, 1793)		50	200	9	259
3	<i>Hypochrysa elegans</i> (Burmeister, 1839)	3	28	118	7	156
4	<i>Italochrysa italica</i> (Rossi, 1790)	42	39	117	37	235
5	<i>Italochrysa stigmatica</i> (Rambur, 1842)	9			2	11
6	<i>Nineta flava</i> (Scopoli, 1763)	28	41	26		95
7	<i>Nineta guadaramensis</i> (Pictet, 1865)	131				131
8	<i>Nineta principiae</i> Monserrat, 1980		1	41	2	44
9	<i>Nineta vittata</i> (Wesmael, 1841)		3	7		10
10	<i>Nineta carinthiaca</i> (Hölzel, 1965)			1		1
11	<i>Nineta inpunctata</i> (Reuter, 1894)			10		10
12	<i>Nineta pallida</i> (Schneider, 1846)	26	64	29		119
13	<i>Chrysotropia ciliate</i> (Wesmael, 1841)	40	50	65		155
14	<i>Chrysopa perla</i> (Linnaeus, 1758)	54	47	218		319
15	<i>Chrysopa walkeri</i> McLachlan, 1893		76	32		108
16	<i>Chrysopa dorsalis</i> Burmeister, 1839		8	63	20	91
17	<i>Chrysopa regalis</i> Navàs, 1915	40				40
18	<i>Chrysopa abbreviata</i> Curtis, 1834		17	63		80
19	<i>Chrysopa formosa</i> Brauer, 1850	147	155	389	101	792
20	<i>Chrysopa nierembergi</i> Navàs, 1908	15				15
21	<i>Chrysopa phyllochroma</i> Wesmael, 1841	2		1		3
22	<i>Chrysopa viridana</i> Schneider, 1845	513	79	254	11	857
23	<i>Chrysopa nigricostata</i> Brauer, 1850	68	4	15		87
24	<i>Chrysopa pallens</i> (Rambur, 1838)	191	151	274	30	646
25	<i>Chrysopa gibbeauxi</i> Leraut, 1989		9			9
26	<i>Dichochrysa flavifrons</i> (Brauer, 1850)	1012	2055	424	130	3621
27	<i>Dichochrysa granadensis</i> (Pictet, 1865)	324				324
28	<i>Dichochrysa picteti</i> (McLachlan, 1880)	389	375	72	40	876
29	<i>Dichochrysa inornata</i> (Navàs, 1901)	45	87	3	8	143
30	<i>Dichochrysa iberica</i> (Navàs, 1903)	296	211		8	515
31	<i>Dichochrysa subcubitalis</i> (Navàs, 1901)	258				258
32	<i>Dichochrysa alarconi</i> (Navàs, 1915)	34				34
33	<i>Dichochrysa prasina</i> (Burmeister, 1839)	3009	3637	950	194	7790
34	<i>Dichochrysa abdominalis</i> (Brauer, 1850)		1			1
35	<i>Dichochrysa mariana</i> (Navàs, 1905)			16	5	21
36	<i>Dichochrysa benedictae</i> (Séméria, 1976)		15			15
37	<i>Dichochrysa zelleri</i> (Schneider, 1851)		233	82	49	364
38	<i>Dichochrysa ventralis</i> (Curtis, 1834)	80	79	18		177
39	<i>Dichochrysa genei</i> (Rambur, 1842)	335	6	42	161	544
40	<i>Dichochrysa venosa</i> (Rambur, 1842)	176			11	187
41	<i>Dichochrysa venusta</i> (Hölzel, 1974)			1	35	36
42	<i>Dichochrysa clathrata</i> (Schneider, 1845)	22	22	79	53	176
43	<i>Cunctochrysa albolineata</i> (Killington, 1935)	33	27	41	23	124
44	<i>Cunctochrysa bellifontensis</i> Leraut, 1988		21			21
45	<i>Cunctochrysa baetica</i> (Hölzel, 1972)	125	43	23	13	204
46	<i>Peyerhimoformis gracilis</i> (Schneider, 1851)	29	3	11		43
47	<i>Chrysoperla carnea</i> (Stephens, 1836) s.l.	8604	1926	3143	770	14443
48	<i>Chrysoperla mutata</i> (McLachlan, 1898)	3				3
49	<i>Chrysoperla ankylopteryformis</i> Monserrat & Diaz-Aranda, 1989	5				5
50	<i>Chrysoperla mediterranea</i> (Hölzel, 1972)	332	102	2	8	444
51	<i>Brinckochrysa chlorosoma</i> (Navàs, 1914)				8	8
52	<i>Brinckochrysa nachoi</i> Monserrat, 1977	106	14	1	1	122
53	<i>Rexa lordina</i> Navas, 1919	5	2	41	1	49
54	<i>Suarius walsinghami</i> Navàs, 1914	19				19
55	<i>Suarius tigridis</i> (Morton, 1921)	39				39
56	<i>Suarius iberiensis</i> Hölzel, 1974	7				7
No. of specimens		16614	9682	6876	1738	34910

These make up for more than three-quarters of the total number of specimens, except on the islands where they did not exceed 62%. *Chrysoperla carnea* or more precisely all true species of the complex, was actually dominant only in Spain and was not the most abundant green lacewing in

southern France, where it was second to *Dichochrysa prasina*.

All other species are scarce, recognized as rare (8 species), casual (28 species) and exceptional (17 species), so-called RAR, CAS and EXC, respectively. Thus, 95% of the species account

Table 2 – Ordinate data for the entire zone and relative frequency of each species (%)

Species	n	Q %	Species	n	Q %
<i>Chrysoperla carnea</i> s.l.	14443	41.37	<i>Nineta flava</i>	95	0.27
<i>Dichochrysa prasina</i>	7790	22.32	<i>Chrysopa dorsalis</i>	91	0.26
<i>Dichochrysa flavifrons</i>	3621	10.37	<i>Chrysopa nigricostata</i>	87	0.25
Rare:			<i>Chrysopa abbreviata</i>	80	0.23
<i>Dichochrysa picteti</i>	876	2.51	<i>Rexa lordina</i>	49	0.14
<i>Chrysopa viridana</i>	857	2.45	<i>Nineta principiae</i>	44	0.13
<i>Chrysopa formosa</i>	792	2.27	<i>Peyerimhoffina gracilis</i>	43	0.12
<i>Chrysopa pallens</i>	646	1.85	<i>Chrysopa regalis</i>	40	0.11
<i>Dichochrysa genei</i>	544	1.56	<i>Suarius tigridis</i>	39	0.11
<i>Dichochrysa iberica</i>	515	1.48	<i>Dichochrysa venusta</i>	36	0.10
<i>Chrysoperla mediterranea</i>	444	1.27	<i>Dichochrysa alarconi</i>	34	0.10
<i>Dichochrysa zelleri</i>	364	1.04	Exceptional:		
Casual:			<i>Nothochrysa fulviceps</i>	24	0.07
<i>Dichochrysa granadensis</i>	324	0.93	<i>Dichochrysa mariana</i>	21	0.06
<i>Chrysopa perla</i>	319	0.91	<i>Cunctochrysa bellifontensis</i>	21	0.06
<i>Nothochrysa capitata</i>	259	0.74	<i>Suarius walsinghamsi</i>	19	0.05
<i>Dichochrysa subcubitalis</i>	258	0.74	<i>Chrysopa nierembegi</i>	15	0.04
<i>Italochrysa italica</i>	235	0.67	<i>Dichochrysa benedictae</i>	15	0.04
<i>Cunctochrysa baetica</i>	204	0.58	<i>Italochrysa stigmatica</i>	11	0.03
<i>Dichochrysa venosa</i>	187	0.54	<i>Nineta vittata</i>	10	0.03
<i>Dichochrysa ventralis</i>	177	0.51	<i>Nineta inpunctata</i>	10	0.03
<i>Dichochrysa clathrata</i>	176	0.50	<i>Chrysopa gibeauxi</i>	9	0.03
<i>Hypochrysa elegans</i>	156	0.45	<i>Brinckochrysa chlorosoma</i>	8	0.02
<i>Chrysotropia ciliata</i>	155	0.44	<i>Suarius iberiensis</i>	7	0.02
<i>Dichochrysa inornata</i>	143	0.41	<i>Chrysoperla ankylopteryformis</i>	5	0.01
<i>Nineta guadaramensis</i>	131	0.38	<i>Chrysopa phyllochroma</i>	3	0.01
<i>Cunctochrysa albolineata</i>	124	0.36	<i>Chrysoperla mutata</i>	3	0.01
<i>Brinckochrysa nachoi</i>	122	0.35	<i>Nineta carinthiaca</i>	1	0.01
<i>Nineta pallida</i>	119	0.34	<i>Dichochrysa abdominalis</i>	1	0.01
<i>Chrysopa walkeri</i>	108	0.31	Total	34910	

for only 25% of the total number of specimens (Fig. 2). This may reflect a variety of causes. Some chrysopid species, known and more or less common in other biogeographical regions, reach the extreme limit of their distribution in south-western Europe (Fig. 3).

3.2. Scarce species coming from north

A large part of the green lacewing fauna represents southern elements of populations considered pan-European, or Siberian elements commonly occurring in Central Europe and northern countries. They are *Nothochrysa fulviceps* (Stephens, 1836) (EXC) (which is scarce elsewhere), *Hypochrysa elegans* (Burmeister, 1839) (CAS), *Italochrysa italica* (Rossi, 1790) (CAS), *Chrysopa formosa* Brauer, 1859 (the only species reaching the “uncommon” level of occurrence in Italy on both mainland and islands and RAR everywhere else), *Chrysopa viridana* Schneider, 1845 (RAR), *Chrysopa pallens* (Rambur, 1838) (RAR), *Dichochrysa inornata* (Navás, 1901) (CAS) and *Cunctochrysa albolineata* (Killington, 1935) (RAR). Some others (i) do not extend to the Iberian Peninsula: *Nothochrysa capitata* (Fabricius, 1793) (RAR), (ii) are missing on the islands: *Nineta flava* (Scopoli, 1763) (CAS), *Chrysotropia ciliata* (Wesmael, 1841) (CAS), *Chrysopa perla* (Linnaeus, 1758) (CAS), *Chrysopa nigricostata* Brauer, 1850 (CAS), *Dichochrysa ventralis* (Curtis, 1834) (CAS) and

Peyerimhoffina gracilis (Schneider, 1851) (CAS), (iii) or do not occur either in the islands or on the Iberian Peninsula: *Chrysopa walkeri* McLachlan, 1893 (CAS), *Chrysopa abbreviata* Curtis, 1834 (CAS). *Chrysopa phyllochroma* Wesmael, 1841 (EXC) is of northern origin, reaching the UK, northern France (Trouvé et al., 2002) and northern Italy, while the closely related *Chrysopa commata* Kis & Újhelyi, 1965 was not collected south of 46° N. *Nineta pallida* (Schneider, 1846) (CAS) and *N. inpunctata* (Reuter, 1894) (EXC) are western Palaearctic and occur south to Alpine Italy; only the first reaches southwest to the Pyrenees (Canard, 2004). *Nineta vittata* (Wesmael, 1841) (EXC) and *N. carinthiaca* (Hölzel, 1965) (EXC) are considered holo-Palaearctic, occurring from far-Eastern Asia to West Europe, the latter not extending west beyond the Italian Alps.

3.3. Scarce species only occurring in south Europe

Dichochrysa genei (Rambur, 1842) (RAR) is a holo-Mediterranean species whose abundance reaches the “uncommon” level on islands. *Dichochrysa iberica* (Navás, 1903) (RAR), *D. granadensis* (Pictet, 1865) (CAS) and *D. subcubitalis* (Navás, 1901) (CAS) are restricted to the Iberian Peninsula and southern France, and *D. clathrata* (Schneider, 1845) (CAS) occurs in Italy and France but does not extend westwards to Spain. *Chrysoperla*

Table 3 – Ordinate data, relative frequency (%) and number of taxa for each geographic zone

Spain			France			Italy			Islands		
Species	n	Q %	Species	n	Q %	Species	n	Q %	Species	n	Q %
<i>Ch. carnea</i> s.l.	8604	51.79	<i>D. prasina</i>	3637	37.56	<i>Ch. carnea</i> s.l.	3143	45.71	<i>Ch. carnea</i> s.l.	770	44.33
<i>D. prasina</i>	3009	18.11	<i>D. flavifrons</i>	2055	21.22	<i>D. prasina</i>	950	13.82	<i>D. prasina</i>	194	11.17
<i>D. flavifrons</i>	1012	6.09	<i>Ch. carnea</i> s.l.	1926	19.89	<i>D. flavifrons</i>	424	6.17	<i>D. genei</i>	161	9.27
<i>Ch. viridana</i>	513	3.09	<i>D. picteti</i>	375	3.87	<i>Ch. formosa</i>	389	5.66	<i>D. flavifrons</i>	130	7.48
<i>D. picteti</i>	389	2.34	<i>D. zelleri</i>	233	2.41	<i>Ch. pallens</i>	274	3.98	<i>Ch. formosa</i>	101	5.81
<i>D. genei</i>	335	2.02	<i>D. iberica</i>	211	2.18	<i>Ch. viridana</i>	254	3.69	<i>D. clathrata</i>	53	3.05
<i>Ch. mediterranea</i>	332	2.00	<i>Ch. formosa</i>	155	1.60	<i>Ch. perla</i>	218	3.17	<i>D. zelleri</i>	49	2.82
<i>D. granadensis</i>	324	1.95	<i>Ch. pallens</i>	151	1.56	<i>N. capitata</i>	200	2.91	<i>D. picteti</i>	40	2.30
<i>D. iberica</i>	296	1.78	<i>Ch. mediterranea</i>	102	1.05	<i>H. elegans</i>	118	1.72	<i>I. italica</i>	37	2.13
<i>D. subcubitalis</i>	258	1.55	<i>D. inornata</i>	87	0.90	<i>I. italica</i>	117	1.70	<i>D. venusta</i>	35	2.01
<i>Ch. pallens</i>	191	1.15	<i>Ch. viridana</i>	79	0.82	<i>D. zelleri</i>	82	1.19	<i>Ch. pallens</i>	30	1.73
<i>D. venosa</i>	176	1.06	<i>D. ventralis</i>	79	0.82	<i>D. clathrata</i>	79	1.15	<i>C. albolineata</i>	23	1.32
<i>Ch. formosa</i>	147	0.88	<i>Ch. walkeri</i>	76	0.78	<i>D. picteti</i>	72	1.05	<i>Ch. dorsalis</i>	20	1.15
<i>N. guadaramensis</i>	131	0.79	<i>N. pallida</i>	64	0.66	<i>Ch. ciliata</i>	65	0.95	<i>C. baetica</i>	13	0.75
<i>C. baetica</i>	125	0.75	<i>N. capitata</i>	50	0.52	<i>Ch. dorsalis</i>	63	0.92	<i>Ch. viridana</i>	11	0.63
<i>B. nachoi</i>	106	0.64	<i>Ch. ciliata</i>	50	0.52	<i>Ch. abbreviata</i>	63	0.92	<i>D. venosa</i>	11	0.63
<i>D. ventralis</i>	80	0.48	<i>Ch. perla</i>	47	0.49	<i>D. genei</i>	42	0.61	<i>N. capitata</i>	9	0.52
<i>Ch. nigricostata</i>	68	0.41	<i>C. baetica</i>	43	0.44	<i>N. principiae</i>	41	0.60	<i>D. inornata</i>	8	0.46
<i>Ch. perla</i>	54	0.33	<i>N. flava</i>	41	0.42	<i>C. albolineata</i>	41	0.60	<i>D. iberica</i>	8	0.46
<i>D. inornata</i>	45	0.27	<i>I. italica</i>	39	0.40	<i>R. lordina</i>	41	0.60	<i>Ch. mediterranea</i>	8	0.46
<i>I. italica</i>	42	0.25	<i>H. elegans</i>	28	0.29	<i>Ch. walkeri</i>	32	0.47	<i>B. chlorosoma</i>	8	0.46
<i>Ch. ciliata</i>	40	0.24	<i>C. albolineata</i>	27	0.28	<i>N. pallida</i>	29	0.42	<i>H. elegans</i>	7	0.40
<i>Ch. regalis</i>	40	0.24	<i>D. clathrata</i>	22	0.23	<i>N. flava</i>	26	0.38	<i>D. mariana</i>	5	0.28
<i>S. tigridis</i>	39	0.23	<i>C. bellifontensis</i>	21	0.22	<i>C. baetica</i>	23	0.33	<i>I. stigmatica</i>	2	0.11
<i>D. alarconi</i>	34	0.20	<i>Ch. abbreviata</i>	17	0.18	<i>D. ventralis</i>	18	0.26	<i>N. principiae</i>	2	0.11
<i>C. albolineata</i>	33	0.20	<i>D. benedictae</i>	15	0.15	<i>D. mariana</i>	16	0.23	<i>N. fulviceps</i>	1	0.05
<i>P. gracilis</i>	29	0.17	<i>B. nachoi</i>	14	0.14	<i>Ch. nigricostata</i>	15	0.22	<i>R. lordina</i>	1	0.05
<i>N. flava</i>	28	0.17	<i>Ch. gibeauxi</i>	9	0.09	<i>P. gracilis</i>	11	0.16	<i>B. nachoi</i>	1	0.05
<i>N. pallida</i>	26	0.16	<i>Ch. dorsalis</i>	8	0.08	<i>N. inpunctata</i>	10	0.15			
<i>D. clathrata</i>	22	0.13	<i>D. genei</i>	6	0.06	<i>N. vittata</i>	7	0.10			
<i>S. walsinghami</i>	19	0.11	<i>Ch. nigricostata</i>	4	0.04	<i>N. fulviceps</i>	4	0.06			
<i>N. fulviceps</i>	18	0.11	<i>N. vittata</i>	3	0.03	<i>D. inornata</i>	3	0.04			
<i>Ch. nierembegi</i>	15	0.09	<i>P. gracilis</i>	3	0.03	<i>Ch. mediterranea</i>	2	0.03			
<i>I. stigmatica</i>	9	0.05	<i>R. lordina</i>	2	0.02	<i>N. carinthiaca</i>	1	0.01			
<i>S. iberiensis</i>	7	0.04	<i>N. fulviceps</i>	1	0.01	<i>Ch. phyllochroma</i>	1	0.01			
<i>Ch. ankylopteryformis</i>	5	0.03	<i>N. principiae</i>	1	0.01	<i>D. venusta</i>	1	0.01			
<i>R. lordina</i>	5	0.03	<i>D. abdominalis</i>	1	0.01	<i>B. nachoi</i>	1	0.01			
<i>H. elegans</i>	3	0.02									
<i>Ch. mutata</i>	3	0.02									
<i>Ch. phyllochroma</i>	2	0.01									
Total	16614			9682			6876			1738	
No. of taxa	40			37			37			28	

Table 4 – Indices of biodiversity calculated for the full zone and the four surveyed sub-zones

Indices	Spain	France	Italy	Islands	Total zone
Richness of Margalef (I_M)	2.78	2.72	2.82	2.42	3.64
Diversity of Shannon (H')	2.71	2.83	3.09	3.04	3.08
Equitability of Hurlbert (E_H)	0.51	0.54	0.59	0.63	0.53

mediterranea (Hölzel, 1972) (RAR) has a large distribution, to judge by its courtship song (Henry et al., 1999).

3.4. Coming from east and south by the north African path

Some species considered Afro-Syrian faunal elements come from the east by the southern border of the Mediterranean Sea and their range extends westwards to Morocco and

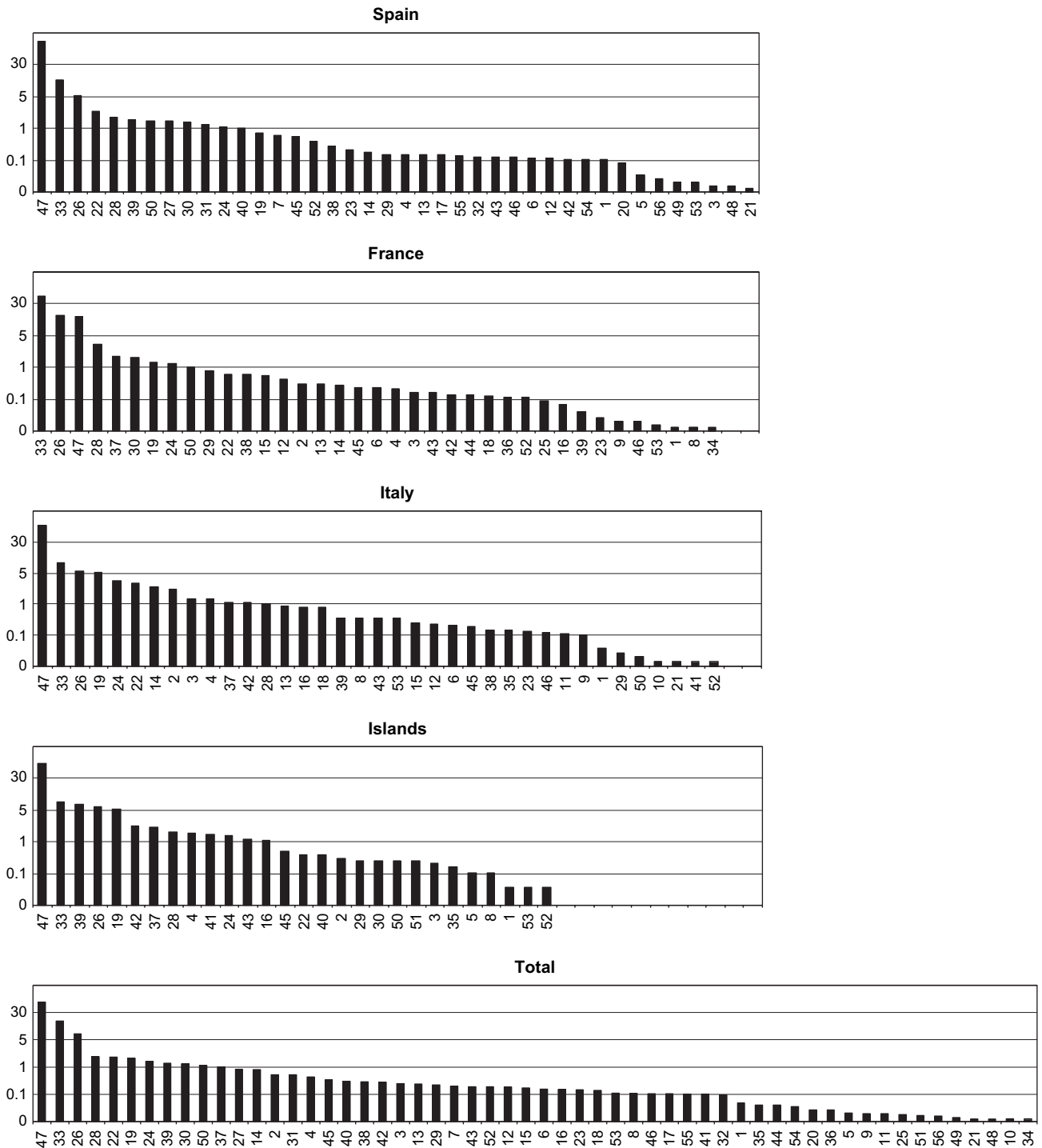


Fig. 2 – Relative frequency (%) of each chrysopid species collected in Spain, in France, in Italy, in the main Mediterranean Islands and in the entire zone.

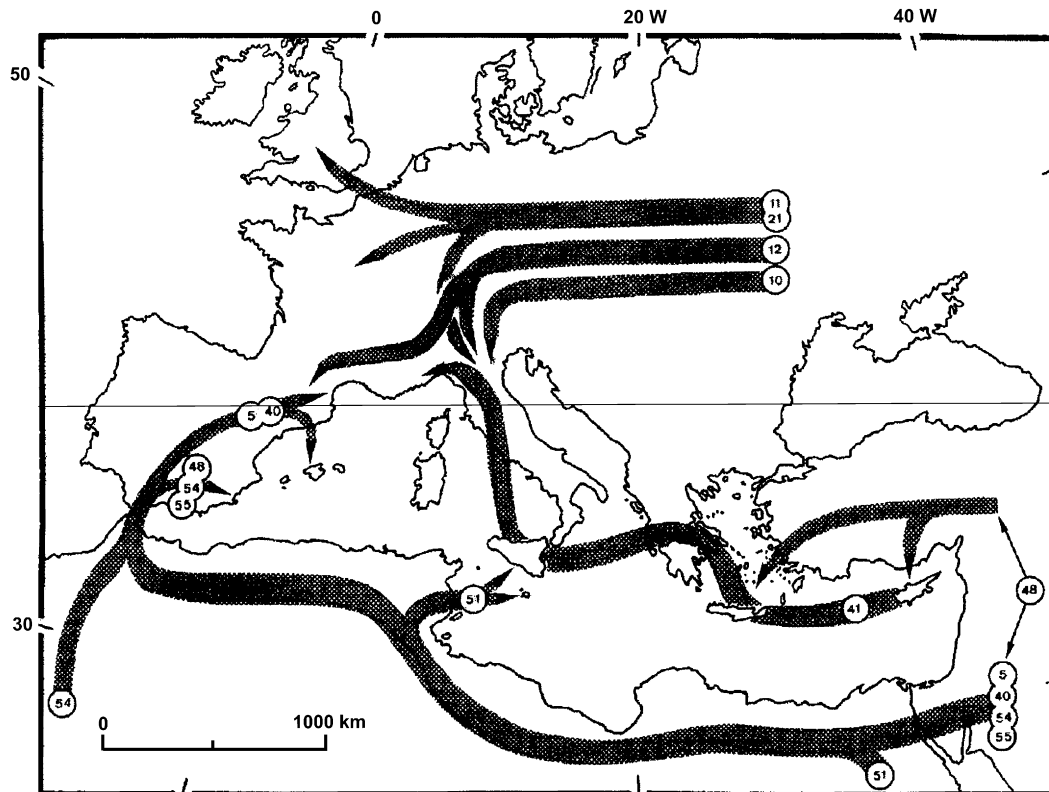


Fig. 3 – Distributional pathways of green lacewings reaching southwestern Europe. Species are identified as numbered in Table 1.

southern Spain. They are *Chrysoperla mutata* (McLachlan, 1898) (EXC), *Suarius tigridis* (Morton, 1921) (CAS), and *Suarius walsinghami* Navás, 1914 (EXC), all localized in southern Spain in low numbers; *Dichochrysa venosa* (Rambur, 1848) (CAS) and *Italo-chrysa stigmatica* (Rambur, 1842) (EXC) occur in the Balearic Islands (Monserrat, 1986, 2005) and reach north to French Roussillon.

3.5. Coming from east by the Balkanic path

Another species, *Dichochrysa venusta* (Hölzel, 1974) (CAS) exhibits a rather reduced distribution area through islands and the northern path. It occurs from Cyprus, Crete, continental Greece: Peloponnesus and Attiki (Canard, 2001) to peninsular Italy: Liguria and Calabria (Bernardi Iori et al., 1995), Monte Cristo Island: (Hölzel, 1974), Sicily, but does not go westwards beyond southern France.

3.6. Coming from Africa

Brinckochrysa chlorosoma (Navás, 1914) (EXC), an extreme northern extension of an Afro-tropical and eremian element originating from sub-Saharan Africa, was already known in some dry biotopes of Europe (Canard and Laudého, 1977).

3.7. Specialized Mediterranean species

Brinckochrysa nachoi Monserrat, 1977 (CAS) is only recorded on the northern shores of the Mediterranean Sea, from Spain to

Italy, including Sardinia. However, this species may be considered a distant component of the south-African green lacewing *B. stenoptera* Navás, 1910, as suggested by Aspöck et al. (2001). *Rexa lordina* Navás, 1919 (CAS) is widely distributed, but scarce, possibly due to its probable specificity to Oleaceae as plant hosts (Canard and Labrique, 1989). *Chrysoperla ankylopteryformis* Monserrat & Díaz-Aranda, 1989 (EXC) is also a strictly localised species, stenotopic of sub-desert Spanish biotopes. However, its endemic status is not well established, due to reports of this green lacewing in Israel (Hölzel, personal communication).

3.8. Endemic Iberian or Atlanto-Mediterranean species

Among rare green lacewings, there are true endemic species, either of the southeastern Iberian Peninsula: *Suarius iberiensis* Hölzel, 1974 (EXC), or within the Atlanto-Mediterranean zone (Morocco and Spain): *Chrysopa nierembergi* Navás, 1908 (EXC) and *Dichochrysa alarconi* (Navás, 1915) (CAS). *Nineta gadaramensis* (Pictet, 1865) sensu stricto (CAS) may also be considered an Atlanto-Mediterranean endemic species paralleling *Nineta principiae* Monserrat, 1980 (CAS) in other parts of Europe. *Chrysopa regalis* Navás, 1915 (CAS) is a vicariant Iberian strain of *Chrysopa dorsalis* Burmeister, 1839 (CAS) with similar biological characteristics (Canard, 1986; Volkovich, 1998).

3.9. Other poorly known species

Some green lacewings are probably underestimated because they have been confused with other, closely related, species,

such as *Dichochrysa abdominalis* (Brauer, 1856) (EXC) reinstated by Hölzel (1998) and *D. mariana* (Navás, 1905) (EXC) within the *prasina*-group. Others are not recognized unanimously by authors: *Dichochrysa benedictae* (Séméria, 1980) (EXC) is sometimes treated as a synonym of *D. zelleri* (Schneider, 1851) (RAR), and *Chrysopa gibeauxi* Leraut, 1989 (EXC) and *Cunctochrysa bellifontensis* Leraut, 1988 (EXC) with the ubiquitous *Ch. pallens* (RAR), and *C. albolineata* (RAR), respectively.

Two green lacewings did not appear in surveys. *Chrysopa dubitans* McLachlan, 1887 was categorised as a polycentric Palaearctic element by Aspöck et al. (2001). Its distribution area is essentially Asiatic, ranging from Mongolia and China in the east, to Cyprus. It extends as far west as Greece where it is common, both in the mainland and on islands (Crete) (Neuenschwander et al., 1981); it also occurs in Algeria and is expected to reach the south of Spain. However, its actual occurrence in the Iberian Peninsula was considered doubtful by Monserrat and Marín (1994) as well as in France where it was mentioned without any precise location by Aspöck et al. (2001). The other species lacking in the survey is *Chrysoperla renoni* (Lacroix, 1912), a (highly?) stenotopic species from wetlands. It was originally described from southwestern France, within the arena of our study. It is thus an actual part of the chrysopid fauna of southwestern Europe, but its great rarity did not allow it to be recorded in the above-mentioned papers.

Acknowledgements

Thanks are due to Bruno Deutsch (Angers, France) for his help with graphs, and to Samuel Danflous (Mauressac, Haute-Garonne, France) and Tim New (Bundoora, Australia) for linguistic improvement.

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