Bulletin S.R.B.E./K.B.V.E., 147 (2011) : 30-38

The impact of nature restoration of the river IJzer estuary (Belgian coast) on the spider fauna

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Abstract

At the turn of the century a major restoration project was realised on the right bank of the estuarine part of the river IJzer (Belgian coast). The first two phases consisted of the demolition of the buildings and roads of the former naval bases and the removal of the jetties and the quays of the former military harbour and slipway. The excavated sandy soil from the quays was used to build dune like hills above the pits left by the removal of the buildings and a dune like dike along the tidal mud flat created after the removal of the harbour and the slipway. These works ended in 2001 and immediately afterwards a multidisciplinary monitoring was started. In this paper we report the results of six years of monitoring of the dune-like dike on which a dune grassland gradually developed. We assess the spider assemblages having colonised this newly created habitat in comparison with the assemblages occurring in adjoining old dune habitats, which were sampled in the same way (pitfall traps) during the same period (2002-2008). The two old dune habitats were a well-stabilised dune grassland and the seaward side of a fore dune.We shortly describe the life cycle timing of the most abundant species and classify them according to their phenological pattern (e.g. summer active species like *Haplodrassus dalmatensis*, winter active species like *Centromerita concinna*). By comparing the species composition of the newly created dune grassland with that of the old dune habitats we can asses which type of species have already colonize that new habitat.

Keywords: Spiders, IJzer estuary, Phenology, restoration.

Introduction

During the twentieth century, a large-scale restoration programme (Life project) started in the nature reserve "De IJzermonding" in which all raised land and a disused naval base were removed for the restoration of the original mud and sand flats, salt marshes and its transition to coastal sand dunes and polders (HOFFMANN *et al.*, 2005). In order to evaluate the changes in this natural reserve, the Department of Entomology (RBINS, Brussels) is continuously monitoring spider and carabid populations in the river IJzer estuary coastal dunes and salt marshes, mainly by means of uninterrupted long term pitfall trapping on several sites (DESENDER *et al.*, 2005; DESENDER *et al.*, 2006; MAELFAIT *et al.*, 2007). In this article, we will explain the changes in spider assemblages in three sampled sites: sites A, E and F which were sampled between 2002-2008. We will give some typical species for each site and will present graphics of female activity for *Haplodrassus dalmatensis* and *Centromerita concinna*.

Management

The nature restoration of the River IJzer estuary was realized with the support of the LIFE-project which is a fund for the restoration of Natura 2000 habitats of European importance. The area has decreased in area during the past years due to the establishment of a yacht harbour. As a consequence, the salt marsh eco-system became very vulnerable due to coastal squeezing. Hence, restoration was very important for the Flemish Community. The first phase of the restoration of the river IJzer estuary (the 'dry phase'; 13/09/1999 – 28/01/2000) was realised with the support of the European Community by

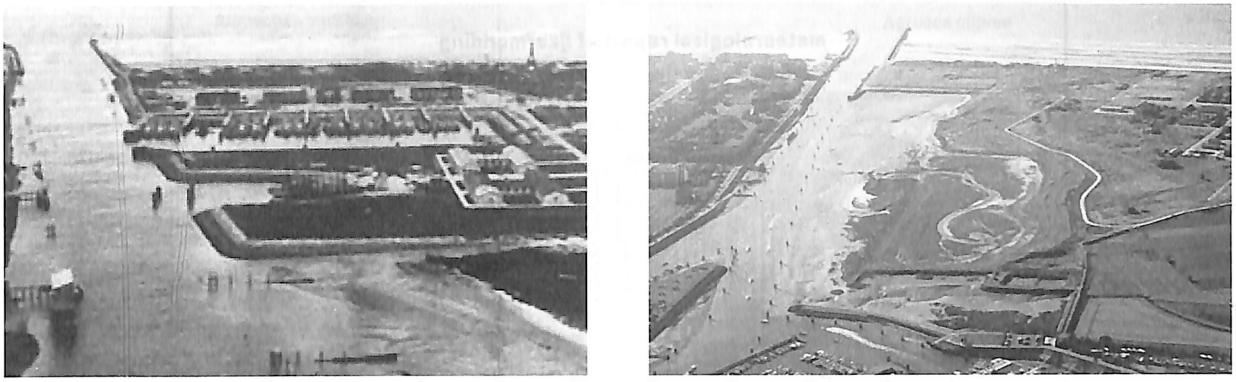

Fig.1: The picture on the left was taken at the River IJzer estuary in the year 1953. The picture on the right was taken on 23 July 2006.

the complete removal of the former Naval base. 50,000 m³ buildings, 14,000 m² concrete roads and 3,600 m underground pipelines were removed. Before demolishing, all kinds of toxic and dangerous materials within and around the building were cleared out. The second phase (the 'wet phase' or disposal of port infrastructure of the former military port; 18/09/2000 - 18/03/2001) was the dismantlement of the docks and quays.

This entire works resulted in the expansion of the mudflat, salt marsh and dune surface to the dimensions of many times their former remnant and in the return of the jagged natural pattern of the transitions between each environment (HOFFMANN *et al.*, 2005).

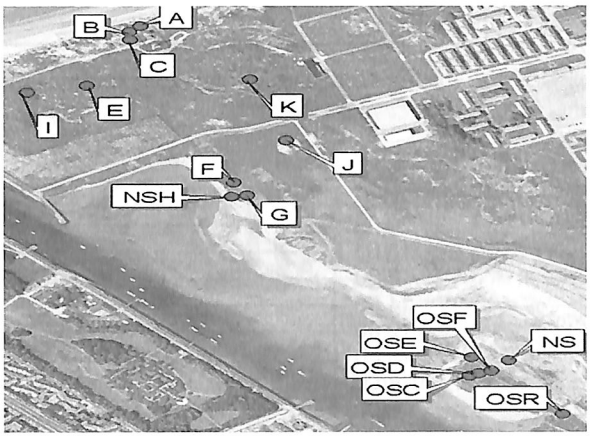

Fig. 2: The River IJzer estuary. A, B, C: first dune ridge; E: grey dune and dune grassland; I: sea buckthorn; K: dune grassland highly disturbed by trampling; J: higher banks of dune pond; F: new dike with top-layer of clay enriched sand; G: new dike, sandy top-soil, planted with marram; NS, OS: sampled new and old saltmarsh habitats

Material and methods

The area was sampled continuously by means of pitfall traps (three glass jam jars per sampling site with a 9.5 cm diameter). They are filled with a 4% formalin solution as fixative and emptied and refilled at fortnightly intervals. This paper deals with the material sampled during six consecutive years between March 2002 and March 2008.

Statistical analyses

The ordination was based on the data of the most numerous species (caught with more than 40 individuals) (Table 1). For each separate sampling year, data were of three pitfalls were pooled and transformed to relative densities (MC CUNE & GRACE, 2002).

Studied areas

We analysed three different sites: (i) at the seaward side of the first dune ridge, a sandy soil overgrown with Marram grass *Ammophila arenaria* (L.) LINK (1827) (Site A), (ii) the grey dune or dune grassland (Site E) and (iii) a the new raised dike (Site F). In total, we collected and identified 25,862 spiders belonging to 135 species.

Results and discussion

Climatic features

The monthly mean temperatures, measured in the two nearby climatologic stations (Middelkerke and Koksijde) during the six years of sampling are given in Fig. 3.

The winters were not harsh, with medium temperatures well above zero. The summers were moderate with average August temperatures around 17.5 degrees Celsius. The climate is a buffered Atlantic sea climate. The winters were colder than usual in 2003 and 2006, while highest July temperatures were noted in 2006.

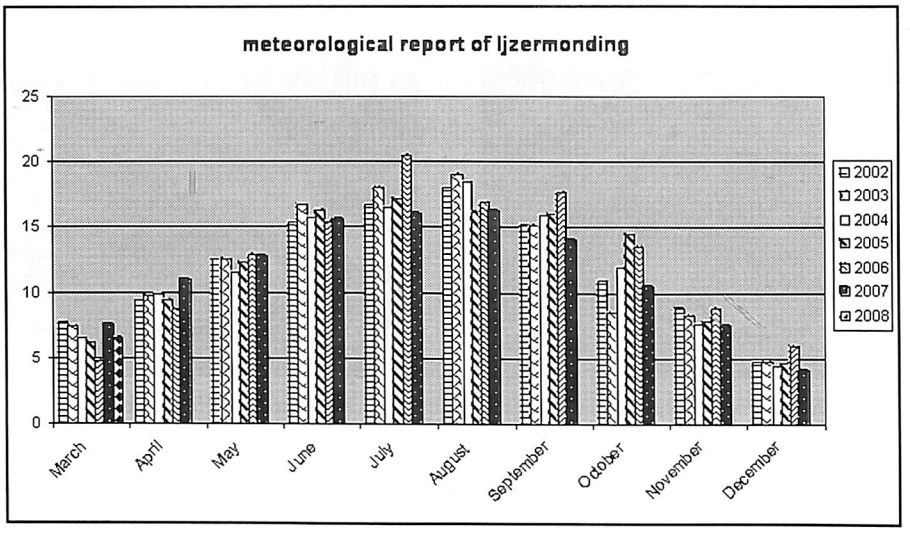

Fig. 3: Monthly mean temperatures of the river IJzer estuary.

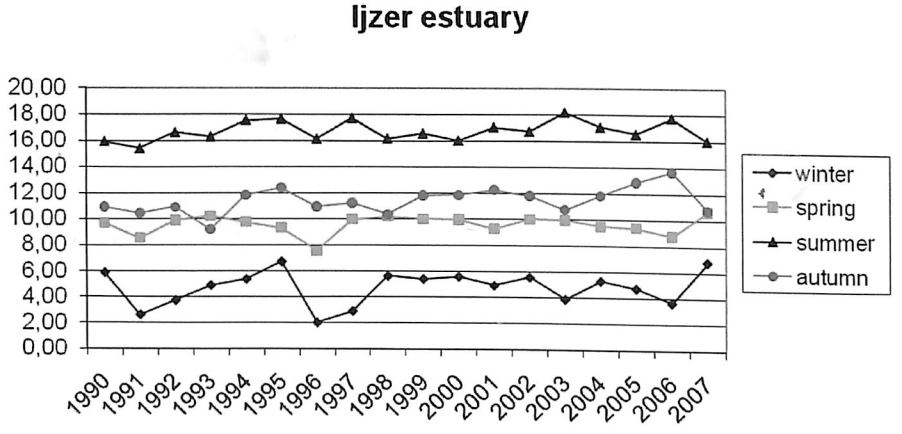

Fig. 4: Seasonal mean temperatures of the river IJzer estuary.

The seasonal observations show that springs are colder than autumns. From 2000 onwards, there is a tendency that years with low summer temperatures are associated with high winter temperatures. Probably the hard winters had their effects on the densities of several species.

Spider fauna

Table 1 shows that the typical dune species *Alopecosa barbipes* and *Haplodrassus dalmatensis* were found in the whole study area. Besides, three aeronautic species (*Bathyphantes gracilis, Tenuiphantes tenuis* and *Parapelecopsis nemoralis*) are also abundant in this area. The populations of *Alopecosa barbipes* increased since 2004 (Fig. 5) in all three Stations. This can be explained by the stabilization of the areas. The small shrinking of the population in the last year for site F can be the result of the warmer winter and colder summer than usual.

Figure 9 shows clearly which species are typical for the first dune ridge (site A) and which ones are common to sites E and F. Moreover it is obvious that some species from site E had colonized the new build dike F.

Agroeca cuprea (Fig. 6) is a typical dune species which increases gradually every year on site A and which seems to colonize also the site E. Maybe the warmer winter-spring and in the other hand the colder summer-autumn may have a positive influence on its abundance.

The site E has an intermediate position between dune grassland and white dune with isolated patches where mosses and lichens dominate the vegetation. The dune grassland has the highest number of typical dune species (all species cited in Table 1 except the salt marsh species *Erigone arctica*). This is a more stable vegetation type with a soil with a deeper organic layer. The vegetation is usually short grazed by rabbits and by sheep since their introduction in

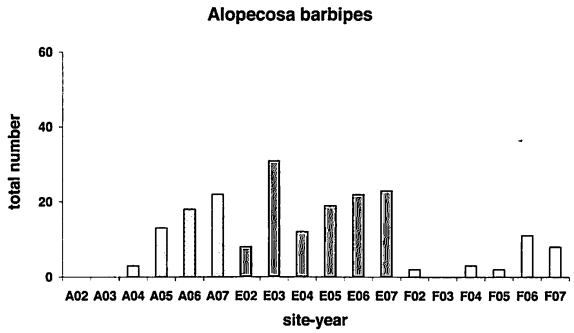

Fig. 5: Activity densities of *Alopecosa barbipes* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling).

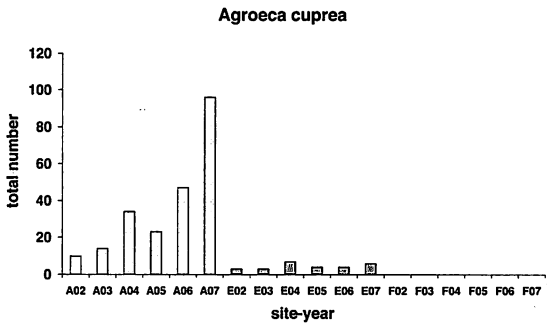

Fig. 6: Activity densities of *Agroeca cuprea* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling).

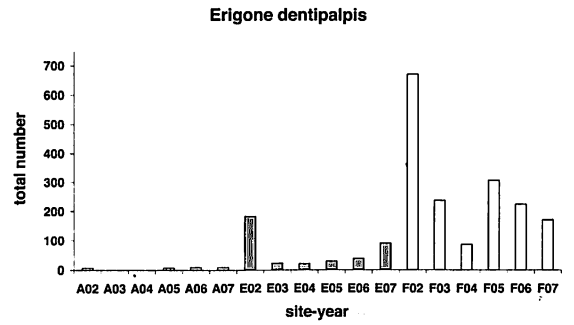

Fig. 7: Activity densities of *Erigone dentipalpis* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling).

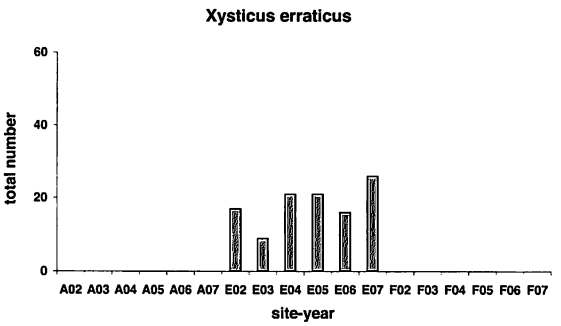

Fig. 8: Activity densities of *Xysticus erraticus* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling).

the area. There is locally an overgrowth of bramble (*Rubus* sp.) or Sea buckthorn bushes (*Hippophaea rhamnoides* L.).

The graph depicting the densities of *Erigone dentipalpis* (Fig. 7) suggests that this species came from site F and colonized sites E and A (since it was not present in both sites before 2002). Because of the harsh winter condition in 2003 the species had some fluctuation in all three sites but continued to be present in the sites E and F after this year.

Xysticus erraticus (Fig. 8) was only found at site E. During seven years, no obvious changes in the densities were visible; the presence of this species suggests that this site became more stable since the restoration.

The site F is situated on a newly created dike, created during the nature restoration works, along the former tidal dock. It is covered with a top-layer of clay enriched soil to protect it against wind erosion. The vegetation type of this area is a dune grassland with *Agrostis stolonifera* L.. Other plants present are: *Crepis capillaries* (L.) WALLR., *Sedum acre* L., *Senecio jacobaea* L., *Arenaria serpyllifolia* L., *Cirsium arvense* (L.) SCOP. and *Carex arenaria* L.. In Table 1 we can observe some abundant spiders typical to highly disturbed habitats like: *Oedothorax apicatus, Oedothorax retusus, Pelecopsis parallela, Centromerita concinna.* One of the examples of species adapted to a highly disturbed habitat is *Oedothorax apicatus*, which was very abundant in 2002 in both sites A and F immediately after the works (not present before in A), became then sporadic the following years and disappeared again from 2005 on (see Table 1). Moreover this table shows that some dune grassland species had also colonised this area in 2004 and 2005 (e.g. *Stemonyphantes lineatus, Haplodrassus dalmatensis, Ozyptila sanctuaria, Pardosa monticola*).

From the DCA ordination diagram (Fig. 9) and Table 1 it is apparent that site F is still changing every year. Some species adapted to highly disturbed habitats are still abundant, but continue to be replaced by more typical dune species.

One typical species for this site is *Centromerita concinna* (Fig. 10). The species colonised and increased in number in the site F during the six years of study. It was very abundant in the period 2007-2008.

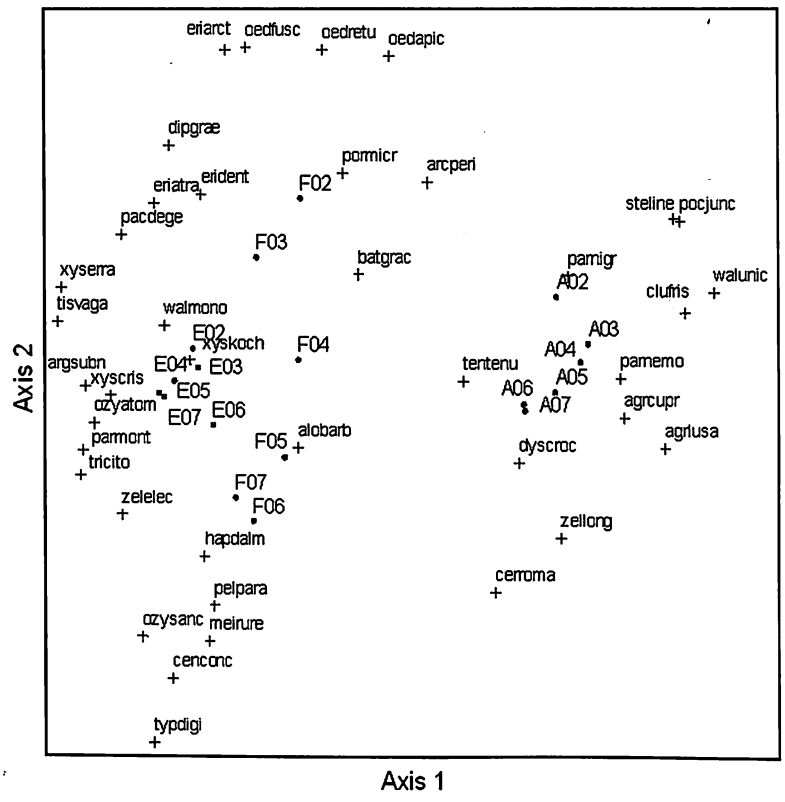

Fig. 9: DCA-ordination of the three sites A, E and F based on spider data 2002-2008, F02-F08, E02-E08 and F02-F08 are pooled data of 3 pitfalls during 12 months of sampling, codes of the speices are listed in Table 1.

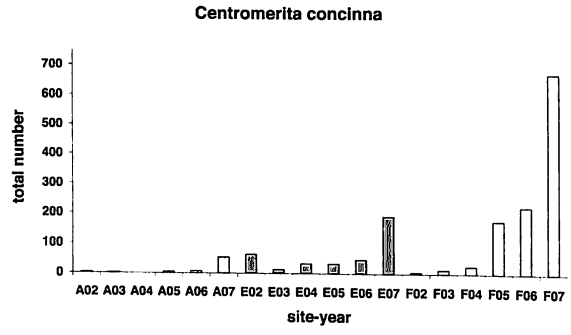

Fig. 10: Activity densities of *Centromerita concinna* (2002-2008) (pooled data of a 3 pitfalls during 12 months of sampling).

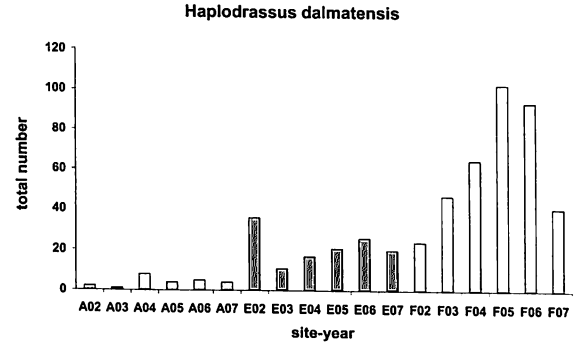

Fig. 11: Activity densities of *Haplodrassus dalmatensis* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling).

Haplodrassus dalmatensis (Fig. 11) is also a typical species for the dune. The species has easily and rapidly colonised the newly created habitat and increased in numbers during the years. The difference with *Centromerita concinna* was the little decrease in its abundance in site F for the last two years. To explain this, we analysed the activity of the females of both *Haplodrassus dalmatensis* (Fig. 12) and *Centromerita concinna* (Fig. 13).

Haplodrassus dalmatensis is active from April till September (summer active) with its highest peak in June. Few females colonised the new dike (F), once build, from the first year on. Their activity density then increased steadily to reach its highest level in 2005, to decrease more and more the following years. This can be explained by the temperature fluctuation having an effect on the food supply while their activity density remained more or less stable in site E.

Centromerita concinna is active from October

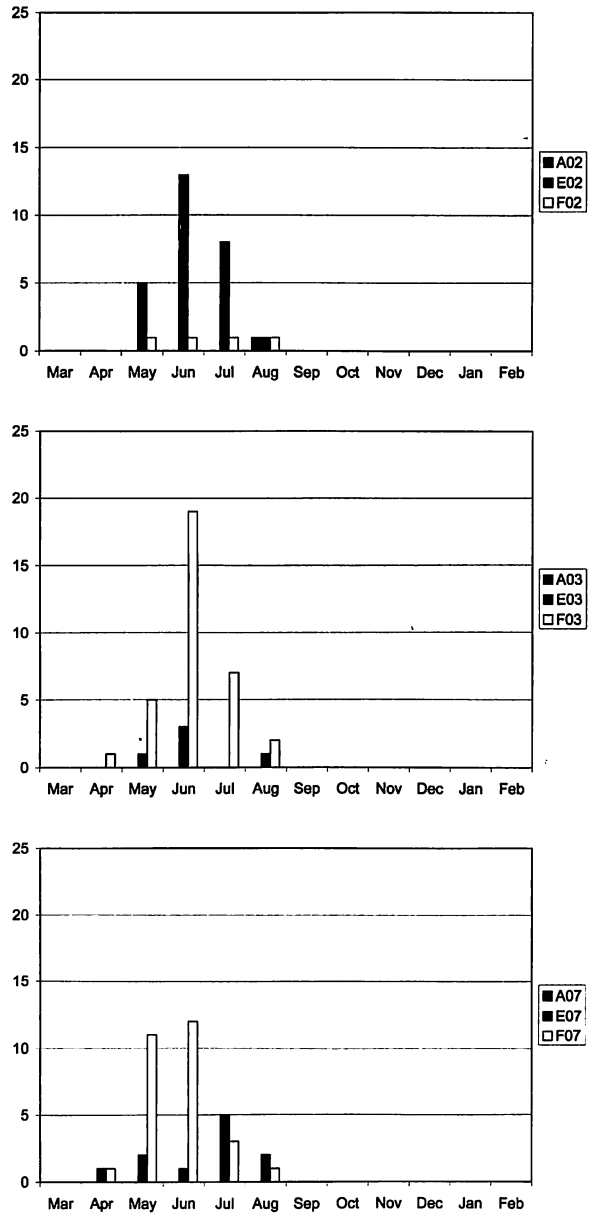

Fig. 12: Activity densities of *Haplodrassus dalmatensis* females.

till April (winter active) with its highest peak in January. As in the former species, a few females colonised the new dike the first three years. A sudden strong increase in activity density occurred from 2005 on. This increase in activity density coincide with the decrease in activity density of *Haplodrassus dalmatensis* and this phenomena might be correlated.

Another example in site F (Fig. 14) showing the effect of the nature restoration on the species interaction is the one between the spring active *Pelecopsis parallela* (from Februari till May) and the winter active *Typhochrestus digitatus* (from December till March). *Pelecopsis parallela* has

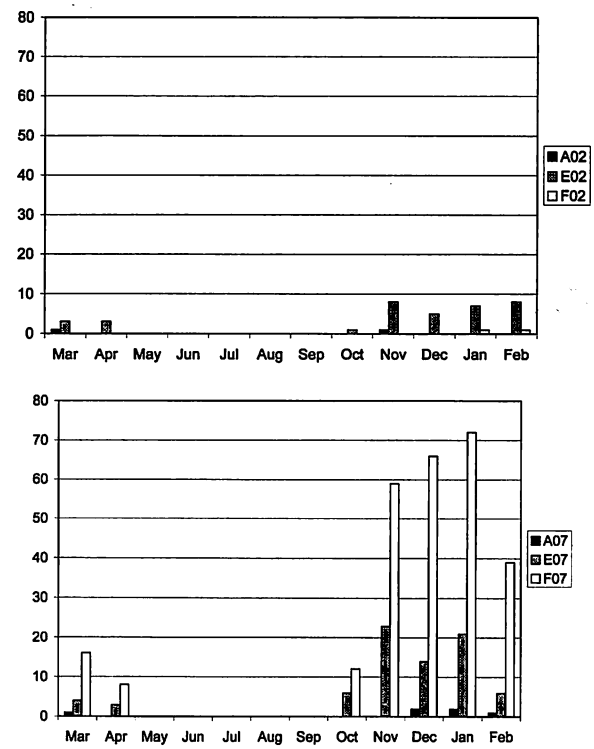

Fig. 13: Activity densities of *Centromerita concinna* females.

been abundant in the first years of its colonisation of the site, while the abundances of *Typhochrestus digitatus* were very low. Since 2005 (cf. former species pair) there is a strong increase of the activity density of *Typhochrestus digitatus* while there is a strong decrease of the

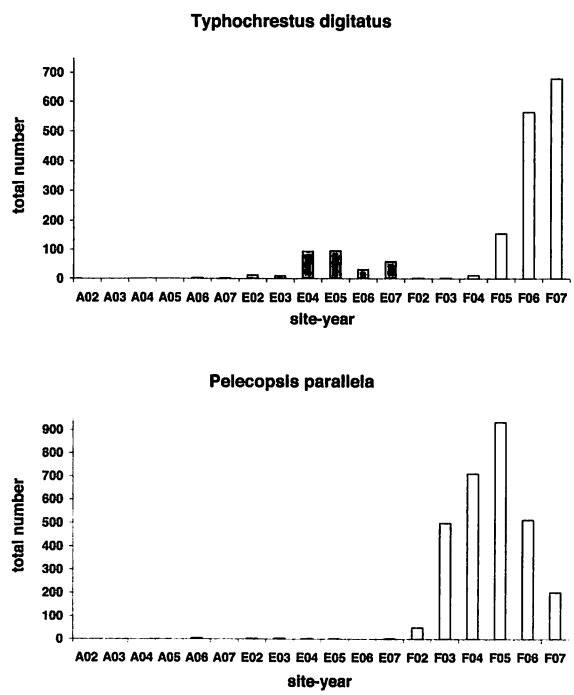

Fig. 14: Activity densities of *Typhocrestes digitatus* and *Pelecopsis parallela* (2002-2008) (pooled data of 3 pitfalls during 12 months of sampling)

Table 1. Spider species caught with more than 40 individuals and used for the analyses.

Code	Spider species	A02	A03	A04	A05	A06	A07	E02	E03	E04	E05	E06	E07	F02	F03	F04	F05	F06	F07
agrcupr	*Agroeca cuprea* Menge, 1873	10	14	34	23	47	96	3	3	7	4	4	6						
agrlusa	*Agroeca lusatica* (L. Koch,1875)	6	5	22	35	27	16			1	1						2		
alobarb	*Alopecosa barbipes* (Sundevall, 1833)			3	13	18	22	8	31	12	19	22	23	2		3	2	11	8
arcperi	*Arctosa perita* (latreille, 1799)	3	2	3	1	1	1				1			9	9	8	6		
argsubn	*Argenna subnigra* (O.P.-Cambridge, 1861)	1	1					20	37	41	58	22	26		5		3	14	17
batgrac	*Bathyphantes gracilis* (Blackwall, 1841)	54	13	14	34	20	12	40	7	11	26	24	15	109	25	32	60	43	79
cenconc	*Centromerita concinna* (Thorell, 1875)	3	1		5	7	53	63	13	32	32	46	189	5	13	25	174	220	668
cerroma	*Ceratinopsis romana* (O.-P. Cambridge, 1872)	5	2	1	3	8	7		3				1	1	1	1	9	12	3
clufris	*Clubiona frisia* Wunderlich & Schuett, 1995	21	22	15	18	14	10	1									1		
dipgrae	*Diplocephalus graecus* (O.P.-Cambridge, 1872)							1	10	13	3			18	25	9	4		
dyscroc	*Dysdera crocata* C.L.Koch, 1838		5	5	4	4	6		1	1	2	10	3					1	1
eriarct	*Erigone arctica* (White, 1852)	51	1											3049	2315				
eriatra	*Erigone atra* Blackwall, 1833	14	5	3	6	12	12	460	78	86	90	62	271	397	138	43	78	130	173
erident	*Erigone dentipalpis* (Wider, 1834)	7			7	9	9	184	23	21	29	38	91	673	238	87	307	224	171
hapdalm	*Haplodrassus dalmatensis* (L. Koch, 1866)	2	1	8	4	5	4	36	11	17	21	26	20	24	47	65	103	94	41
meirure	*Meioneta rurestris* (C.L. Koch, 1836)							1		1			1	41	10	24	70	111	24
oedapic	*Oedothorax apicatus* (Blackwall, 1850)	118	1	7				2	1	1	1	2		569	16	1	1		
oedfusc	*Oedothorax fuscus* (Blackwall, 1834)	5		1	1		1	17	6	2			3	344	39		2		
oedretu	*Oedothorax retusus* (Westring, 1851)	8		1			1				1			74	7				
ozyatom	*Ozyptila atomaria* (panzer, 1810)					1		2	6	7	9	18	9					1	4
ozysanc	*Ozyptila sanctuaria* (O.P.-Cambridge, 1871)					1		5	3	6	16	14	26	3	2	10	19	43	35
pacdege	*Pachygnatha degeeri* Sundevall, 1830					1		3	13	2	11	2	2	3	3	2	2	2	
parmont	*Pardosa monticola* (Clerck, 1757)	1		1				85	89	191	263	56	141	3	12	19	28	77	80
parnemo	*Parapelecopsis nemoralis* (Blackwall, 1841)	57	13	43	15	62	43	3	3	6	2		3	1	1	6	12	6	3
parnigr	*Pardosa nigriceps* (Thorell, 1856)	1		4	5	11	11	3	5		1			3					
pelpara	*Pelecopsis parallela* (Wider, 1834)					4		2	3	2	1		2	49	499	710	932	513	201
pocjunc	*Pocadicnemis juncea* Locket & Millidge, 1953	41	14	17	5	3	7	2		1	1								
pormicr	*Porrhomma microphthalmum* (O.-P. Cambridge, 1871)	4	1	1			1			2	1			10	7	12	3		
steline	*Stemonyphantes lineatus* (Linnaeus, 1758)	258	95	51	58	17	14	7	3	5	2	2	3	2	2	5	1	2	2
tentenu	*Tenuiphantes tenuis* (Blackwall, 1852)	135	27	97	94	119	81	59	7	49	53	38	35	171	20	115	104	91	177
tisvaga	*Tiso vagans* (Blackwall, 1834)							14	7	14	12	14	46						1
tricito	*Trichopterna cito* (O.P.-Cambridge, 1872)							21	32	53	84	16	18			1	8	29	18
typdigi	*Typhochrestus digitatus* (O.P.-Cambridge, 1872)					2	1	12	10	94	96	32	60	2	2	11	155	566	681
walmono	*Walckenaeria monoceros* (Wider, 1834)	8	8	2	2	3	3	28	29	27	24	24	51		2	1		4	11
walunic	*Walckenaeria unicornis* O.-P. Cambridge, 1861	7	13	17	6														
xyscris	*Xysticus cristatus* (Clerck, 1757)	1	1	1			1	15	26	23	27	30	17		6	2	4	12	8
xyserra	*Xysticus erraticus* (Blackwall, 1834)							17	9	21	21	16	26						
xyskoch	*Xysticus kochi* (Thorell, 1872)	7	4	9	4	24	17	49	56	67	26	36	94	11	2	18	12	16	17
zelelec	*Zelotes electus* (C.L. Koch, 1839)				4	1	1	16	12	11	25	52	30		0		13	13	13
zellong	Zelotes longipes (C.L. Koch, 1866)		3	6	6	6	8		1	2		4					1	5	2

activity density of *Pelecopsis parallela*. The reason for this situation may be the temperature fluctuation but also the higher food consumption of winter active spiders like *Centromerita concinna* and *Typhochrestus digitatus* might be an explanation.

Conclusion

The general aim of this restoration was to restore or create beach-dune-salt marsh ecotones with salt-fresh, dynamic-stable, wet-dry and mud-sand ecotones. In order to evaluate the recent nature restoration, spiders are studied along the river IJzer estuary. In this nature reserve, we have analysed three different sites which are: the first dune ridge in seaside (site A), the grey dune and dune grassland (site E) and the new dike (site F). In total, we collected and identified more than 25,862 spiders during this sampling, belonging to 135 species.

This nature reserve has been studied without interruption, by members of the Department of Entomology (RBINS, Brussels) since 1990 (DE WAELE, 2005). In this paper, we have only analysed the spiders captured between 2002 and 2008. Our study showed the remarkable increase of several target species with high conservation interest (MAELFAIT & BAERT, 1988a; MAELFAIT & BAERT, 1988b; MAELFAIT *et al.*, 1989; MAELFAIT, 1996; MAELFAIT *et al.*, 1998) which colonised the new or restored habitats. The sites A and E became more stable and this had an effect on the new dike area (site F). Species like *Pardosa monticola, Haplodrassus dalmatensis* or *Centromerita concinna*, typical for site E colonised easily site F. Moreover the activity graphs of several species seem to prove there is an interaction between the existing (sites A & E) and the new created site (site F). Some species like *Agroeca cuprea, Xysticus erraticus* and *Pocadicnemis juncea* did not colonise site F. One species, *Tiso vagans* did this only the last year of sampling. This might mean that the new restored area is apparently not yet sufficiently well developed. It can however also be a result of the temperature fluctuation at that time. The effect of temperature has clearly been observed in the fluctuation of many spider-populations (see figures).

However, the monitoring in the river IJzer estuary has to be continued in order to evaluate the real changes occurring in this area as a result of the made restorations. The management programme seems to be successful, but some disturbance like a global warming may have a negative effect in general.

Acknowledgements

We wish to thank Rudiger CLAUS for his technical assistance. This study has been financially supported by the 'MONAIJ'-project (financed by the Nature Department of AMINAL, Ministry of the Flemish Community) and RBINS (Dept. Entomology). The European Community gave financial support through LIFE, enabling the realization of the nature restoration project.

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Bulletin S.R.B.E./K.B.V.E., 147 (2011) : 38-45

Melanogaster parumplicata (LOEW, 1840), syrphe nouveau pour la faune de Belgique (Diptera: Syrphidae)

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Abstract

Melanogaster parumplicata (LOEW, 1840) is reported for the first time from the Belgian fauna in two localities distant of 90 km. The first record is a male specimen that was found visiting flowers of Rowan (*Sorbus aucuparia* L.) on 16 May 2005 in the military camp Lagland, at Arlon (province of Luxembourg). The biotope is a sandy heathland near a marsh complex, at an altitude of 390 m a.s.l. The second observation also concerns a male caught on 10 May 2010 in valley of the river Lesse at Villers-sur-Lesse (province of Namur). Here the site consists of a mesophilic meadow edged by a cut-off meander and an alluvial wetland fed by a small stream water, at an altitude of 140 m a.s.l. Data on the distribution, status and ecology of this rare hoverfly are summarized.

Keywords: Syrphidae, *Melanogaster parumplicata*, Belgium, Faunistic, Marshland.

Résumé

Melanogaster parumplicata (LOEW, 1840) est signalé pour la première de la faune belge dans deux localités distantes de 90 km environ. La première capture se rapporte à un mâle butinant *Sorbus aucuparia* L. le 16 mai 2005 dans le camp militaire de Lagland, à Arlon (province de Luxembourg). Le biotope est une lande sur sable proche d'un complexe de marais, à une altitude de 390 m. La seconde observation concerne également un mâle capturé le 10 mai 2010 dans la vallée de la Lesse à Villers-sur-Lesse (province de Namur). Le site est ici constitué d'un pré mésophile en bordure d'une zone humide alluviale alimentée par un petit ruisselet et d'un bras-mort, à une altitude d'environ 140 m. Les données sur la distribution, le statut et l'écologie de cette espèce rare sont résumées.