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An exercise in characterizing a habitat on the basis of its dolichopodid community (Diptera Dolichopodidae)

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Summary

A habitat characterization was made by the first author on the basis of samples of Dolichopodidae (Diptera) from an unknown habitat within "De Oude Landen" Nature Reserve (Ekeren, Belgium) delivered by the second author. This was subsequently matched to a habitat description also provided by the second author. When considering only the most abundant species, it was suggested that the habitat consisted of open as well as covered sites with a very wet soil or pools in the latter. Taking into account the less abundant but more stenotopic species as well, the sampling habitat could be described as a mosaic of humid marshlands or reed marshes and canopied habitats with open water showing muddy banks. The final comparison between both descriptions revealed a considerable correspondence. Some aspects of trapping methodology and entomological inventories are discussed.

Keywords : Dolichopodidae, Diptera, habitat characterization, communities, bio-indicators.

Introduction

Most of the ecological research on the habitat preference in Diptera is conducted as sampling campaigns in particular habitat types in order to find a relationship between the collected Diptera species and the features of the habitats themselves. And indeed, these inventories can provide clues to establish these affinities. After a sufficient number of these basic ecological studies, it is possible to determine whether a species is stenotopic (occurring in a single or limited number of habitat types) or eurytopic (occurring in many and different habitat types). Of course, these are just the two extreme states of this ecological character. During years of ecological investigations, the ecologists build an experience which is fine-tuned with the outcome of every new sampling campaign. However, as so many environmental features seem to influence the occurrence of Diptera (e.g. POLLET *et al.*, 1986; POLLET, 1992a; POLLET & GROOTAERT, 1987, 1996; MEYER *et al.*, 1995), it is not very likely that all possible habitat types can and will be sampled. It is therefore quite possible that the most preferred habitats of some species will never be located and/or sampled. Moreover, suitable habitats for Diptera are not always appreciated as such by man: in this context, POLLET & GROOTAERT (1996) proved that e.g. *Dolichopus migrans* favoured scrubby edges of dune slacks of only a few meters wide, whereas dense reedbeds proved to be among the most species-rich habitats for dolichopodids in Belgium (POLLET, 1992b).

The establishment of the former ecological relationships is essential when the organisms under consideration are to be used in site quality assessment studies or, more generally, as bio-indicators. The kind of investigations described above always starts with the selection of a habitat and tries to determine its dipteran community by sampling. Long-legged flies or Dolichopodidae

is a dipteran family which is strongly believed to be of great value for site quality assessment studies (POLLET & GROOTAERT, 1999). If these flies are, indeed, potential bio-indicators, then it must be possible to work the other way around, namely by trying to characterize an unknown habitat on the basis of its dolichopodid community.

In the present paper, samples from "De Oude Landen" Nature Reserve (Ekeren, Belgium) were obtained by the second author and identified by the first one, the latter without any knowledge of the particular site. Upon the basis of the species list from the Oude Landen NR and with background information on the ecology and distribution of these flies in Belgium built up during the last 15 years, the first author tried to reconstruct the habitat investigated. This reconstruction was then subsequently compared with the habitat description given by the second author.

Material and Methods

Samples were obtained by means of a Malaise trap which was installed in "De Oude Landen" NR (Ekeren, Belgium) (Fig. 1) on 2.V.1988 and removed on 16.X.1988 with weekly to fortnightly servicing. All dolichopodid flies were preserved in a 70% alcohol solution and deposited at the Museum of the Royal Belgian Institute of Natural Sciences (Brussels, Belgium). Flies were identified by means of PARENT (1938), ASSIS FONSECA (1978), MEUFFELS & GROOTAERT (1990), POLLET (1990, 1996) and some unpublished keys by MEUFFELS (NL). Nomenclature follows the recently updated British Checklist (CHANDLER, 1998).

Fig. 1. Location of "De Oude Landen" Nature Reserve in Belgium.

Results

Table 1 gives a complete species list with total numbers indicated. A total of 439 specimens was collected, belonging to 49 named species. Some females of *Medetera* (n=5), *Rhaphium* (n=1) and *Teuchophorus* (n=60) could not be identified upon species level, although it is very likely that most *Teuchophorus* females belong to *T. calcaratus* as most males in the samples did. The overall yield is remarkably low compared to results of other Malaise traps: 922 (garden at Schoten, POLLET & DE BRUYN, 1987), 2,168 (garden at Ottignies, MEUFFELS *et al.*, 1989), 2,602 (Wijnendalebos, POLLET & GROOTAERT, 1987) and even 9,866 at Chimay (Lake of Virelles NR, GROOTAERT *et al.*, 1988) (all localities in Belgium).

The most abundant species in the samples demonstrate the following habitat affinities (ordered by decreasing yields; preferred habitats for the other species are given in Table 1):

- *Chrysotus gramineus*: eurytopic species (group) with main distribution in grasslands and marshlands; occurs in both wet and dry habitats and can be found mostly higher up in the vegetation;
- *Teuchophorus calcaratus* (and *T. nigricosta*): hygrophilous species from muddy banks of mesotrophic to eutrophic ponds and pools, preferably with tree canopy;
- *Dolichopus wahlbergi*: stenotopic species from cool mature woodlands with a moderately wet to wet soil surface (POLLET *et al.*, 1986);
- *Argyra leucocephala*: rather eurytopic woodland species, mainly occurring along small ditches and paths providing open stagnant or running water;
- *Syntormon bicolorellum*: stenotopic species which seems to have a bimodal distribution (like *Hercostomus plagiatus*) as it occurs in both reed marshes and humid woodlands (POLLET *et al.*, 1989a; POLLET, 1992a,b);
- *Rhaphium caliginosum*: eurytopic species from habitats with well developed vegetations such as woodlands and reed marshes; highest numbers reported from woodland habitats though.

From the ecological information on these species, it could, however preliminary, be concluded that the sampling site was probably composed of open as well as covered habitats and especially in the latter ones, a very wet soil is present, perhaps

Table 1. Overview of species collected by Malaise trap in "De Oude Landen" Nature Reserve (Ekeren, Belgium) during May - October 1988.

Species	*Red Data Book category **	*habitat preference ***	*males*	*females*	*total*
Achalcus cinereus (Haliday in Walker, 1851)	vZ	M	-	4	4
A. flavicollis (Meigen, 1824)	vZ	RM	2	1	3
Argyra elongata (Zetterstedt, 1843)	Z	M	1	-	1
A. leucocephala (Meigen, 1824)	N	E	21	27	48
A. vestita (Wiedemann, 1817)	vZ	RM	3	1	4
Asyndetus latifrons (Loew, 1857)	Z	O	-	1	1
Campsicnemus curvipes (Fallén, 1823)	N	E	3	4	7
C. picticornis (Zetterstedt, 1843)	N	E	-	2	2
C. scambus (Fallén, 1824)	N	E	3	-	3
Chrysotimus molliculus (Fallén, 1823)	N	E	4	5	9
Chrysotus blepharosceles Kowarz, 1874	N	G	-	4	4
C. cilipes Meigen, 1824	N	G	-	3	3
C. gramineus (Fallén, 1823)	N	E	14	66	80
C. neglectus (Wiedemann, 1817)	N	E	1	1	2
Diaphorus oculatus (Fallén, 1823)	3	W	-	2	2
Dolichopus excisus Loew, 1859	vZ	M	-	1	1
D. festivus Haliday, 1832	N	W/M	1	1	2
D. latilimbatus Macquart, 1827	N	O	2	2	4
D. longitarsis Stannius, 1831	3	M	1	-	1
D. nubilus Meigen, 1824	N	O	2	2	4
D. pennatus Meigen, 1824	N	W	1	2	3
D. plumipes (Scopoli, 1763)	N	E	3	2	5
D. popularis Wiedemann, 1817	N	W	-	1	1
D. simplex Meigen, 1824	N	H	-	1	1
D. subpennatus d'Assis Fonseca, 1976	N	M	2	1	3
D. ungulatus (Linnaeus, 1758)	N	E	1	1	2
D. wahlbergi Zetterstedt, 1843	N	W	23	28	51
Hercostomus (G.) aerosus (Fallén, 1823)	N	H/W	1	1	2
H. (G.) assimilis (Staeger, 1842)	N	RM	-	2	2
H. (G.) chalybeus (Wiedemann, 1817)	N	RM	-	7	7
Hercostomus nanus (Macquart, 1827)	N	M	1	1	2
H. praeceps Loew, 1869	vZ	M	1	-	1
Medetera abstrusa Thuneberg, 1955	vZ	T	1	-	1
M. jacula (Fallén, 1823)	N	E	2	-	2
M. truncorum Meigen, 1824	N	E	2	4	6
Medetera spec.			2	3	5
Nodicornis nodicornis (Meigen, 1824)	N	O	1	-	1
Rhaphium caliginosum Meigen, 1824	N	E	13	18	31
R. commune (Meigen, 1824)	3	W	-	2	2
R. crassipes (Meigen, 1824)	N	W	2	-	2
R. fasciatum Meigen, 1824	vZ	RM	-	4	4
R. laticorne (Fallén, 1823)	N	O	3	-	3
Rhaphium spec.			-	1	1
Sciapus laetus (Meigen, 1838)	2	CD	-	1	1
S. platypterus (Fabricius, 1805)	N	W	1	-	1
S. wiedemanni (Fallén, 1823)	N	E	3	2	5
Syntormon bicolorellum (Zetterstedt, 1843)	N	W/M	18	23	41
S. pallipes (Fabricius, 1794)	N	O	1	1	2

Table 1 (continued).

Species	*Red Data Book category* *	*habitat preference* **	*males*	*females*	*total*
Teuchophorus calcaratus (Macquart, 1827)	vZ	W	4	-	4
T. nigricosta (von Roser, 1840)	vZ	W	1	-	1
Teuchophorus spec.			-	60	60
Xanthochlorus tenellus (Wiedemann, 1817)	N	E	-	1	1
Number of species					**49**
Number of specimens			**145**	**294**	**439**

* 2: Endangered; 3: Vulnerable; Z: Rare; vZ: Fairly Rare; N: At low risk/Safe (see Pollet, in press).
** CD: coastal dunes; E: eurytopic; G: grassland; H: heathland; M: marshland; O: riparian habitats; RM: reedmarsh; T: tree trunks; W: woodland.

even with pools or any kind of open water. This description might fit a large number of habitats and in order to get a more precise characterization, information on the less abundant species is added. Besides a large number of rather eurytopic species, roughly three groups with a different ecological status could be distinguished:

- (1) species typical for marshlands and reed marshes in particular (see POLLET, 1992a, b): *Achalcus flavicollis, Argyra elongata, A. vestita, Hercostomus (G.) assimilis, H. (G.) chalybeus, H. praeceps* and *Rhaphium fasciatum*. Only *H. (G.) chalybeus* has been encountered in very high numbers in a willow carr site as well (POLLET *et al.*, 1989b);
- (2) species typical for humid woodland: *Diaphorus oculatus, Rhaphium crassipes* and *Sciapus platypterus* (e.g. EMEIS, 1964). The latter species can be found in both dry and wet woodland types but remains restricted to woodland; *Medetera abstrusa* and the unidentified *Medetera* females are strictly tree trunk-dwellers, but occur on isolated trees too;
- (3) hygrophilous species from muddy banks of pools or ponds within different mesotropic to eutrophic habitat types: *Achalcus cinereus, Campsicnemus curvipes, C. picticornis, C. scambus, Dolichopus latilimbatus, D. nubilus, Rhaphium commune* and *R. laticorne*. The *Campsicnemus* and *Dolichopus* species are mainly soil-dwellers, whereas *Rhaphium* species mostly occur in the vegetation layer. *R. laticorne* and *R. commune* prefer the direct vicinity of open water, stagnant water in the first, running water in the second species. *Nodicornis nodicornis* is typical for borders of pools with a well developed herb layer and tree canopy.

Other species, though collected in very small numbers, reflect very specific information about the geographical location of the site: the rather common *Dolichopus simplex* has its main distribution in the eastern part of the country which is characterized by extensive heathlands on sandy soil, *H. (G.) assimilis* is mainly recorded from the northwestern part of Belgium (POLLET *et al.*, 1989a), whereas *S. laetus* is nearly entirely confined to the coastal dune area (POLLET & GROOTAERT, 1994, 1996).

By integrating all this information, the "virtual" habitat can be described as follows:

- first of all, the sampling site is definitely a humid place as most of the species are hygrophilous; moreover, the number of xerophilous species and specimens (e.g. *Medetera* and *Sciapus* spp.) is negligible;
- trees must be present, if not, real woodland (*Medetera abstrusa* only occurs on trees and several other species can be considered as stenotopic woodland-inhabiting dolichopodids);
- the site must be located in the northern part of the country *(D. simplex, H. (G.) assimilis)* (see POLLET *et al.*, 1992) and presumably near the coast (*S. laetus*);
- the site most probably consists of a mosaic of open habitats such as marshland or reed marshes (*C. gramineus* and the number of stenotopic reed marsh species) and canopied habitats (*S. bicolorellum, D. wahlbergi*) with open water showing muddy banks which are, in part, covered by tree canopy.

Also the amazingly low numbers of two of the most common species in western Europe, *D. plumipes* and *D. ungulatus*, and the complete absence of another common species, *Sympycnus desoutteri*, indicate that the habitat is not eutro-

phic. In fact, the sampling site cannot be a mature humid woodland nor a eutrophic grassland as *D. ungulatus* and *D. plumipes* resp. are among the dominant species in these habitat types.

The crucial step in the present exercise is, of course, the ultimate comparison between the descriptions of the "expected" and the real habitat. In this respect, the second author delivered the following information on the habitat: "De Oude Landen NR is primarily a large reed marsh, although the trap was installed in the gradient zone between the reed marsh and an adjacent humid woodland (with its core at about 100 m); in this zone, occasional *Crataegus* schrubs occur. The reed marsh is dominated by common reed (*Phragmites australis*) and *Carex* spp. are abundant. Less frequent herb species are: *Epilobium hirsutum*, *Rubus* sp., *Urtica dioica*, *Pulicaria dysenterica*, *Cirsium arvense* and *Symphytum officinale*. So apparently, it is ruderalized to some extent. The reed marsh and the gradient zone both show a very humid soil and are usually flooded during winter. The soil is covered with a litter layer of reed plant remnants and crossed by shallow ditches with permanent water. The tree layer of the core woodland mainly consists of *Crataegus* with less frequent *Acer pseudoplatanus, Quercus robur* and *Alnus glutinosa* trees."

Comparing both descriptions, it can be concluded that there is a considerable correspondence between both: the sampled site is, indeed, a humid habitat, a reed marsh in particular, with a woodland in the near vicinity. Even the presence of open water ("shallow ditches") and tree canopy ("occasional *Crataegus*"), essential for *Teuchophorus*, *Campsicnemus* and some *Rhaphium* species, has been confirmed.

Discussion

Malaise traps are among of the most efficient trapping devices for flying insects, but they show some disavantages when it comes to ecological investigations (see POLLET *et al*, 1989b; ANONYMUS, 1994):

- the amount of specimens collected is sometimes too huge to work out in proper time, especially when more than one trap is installed in a single site;
- Malaise traps are large objects that can attract occasional passengers who might cause damage or total destruction;
- perhaps ecologically the most important disadvantage is the fact that it mainly captures frequent or strong flyers among Dolichopodidae (e.g. *Argyra* spp., see POLLET & GROOTAERT, 1987); at the same time, however, species which occur near the soil, including the vast majority of dolichopodid species, are underrepresented (e.g. *Campsicnemus* spp.). In contrast, other dipteran families e.g. Sphaeroceridae seem to be caught more readily with Malaise traps than with water traps installed at soil surface level (VEN & DE BRUYN, 1992).

The action radius of Malaise traps entirely depends on the behaviour of each individual species. Although it has been shown on numerous occasions that *Sciapus* and *Argyra* species are strong and frequent flyers in contrast to the mainly soil-dwelling *Hydrophorus* and *Campsicnemus* species, no real information on the vagility and dispersal powers of dolichopodid flies is available in the literature. Anyhow, for large scale inventories, Malaise traps are the most recommendable collecting methodology and even for a rough habitat characterization, they appear to be useful as proved in the present exercise.

It is evident that an approach as demonstrated here can only be applied if sufficient information is gathered on the ecology and geographical distribution of the taxa under investigation. In this respect, e.g. site quality assessment studies can only properly be carried out when distribution maps and ecological characterizations of the species are available. But, at the other hand, it is equally absurd to wait until all possible sites have been sampled before starting to use invertebrates for this kind of purposes. Therefore, information gathered throughout successive sampling campaigns must be interpreted as quickly as possible and related to environmental features. To state that e.g. *D. wahlbergi* is a stenotopic woodland species is most probably a much too bold expression. POLLET *et al.* (1986) proved that its distribution in woodland habitats was significantly negatively correlated with light intensity. It is possible that this species is not directly affected by the presence of trees itself but by the relatively low insolation or temperatures (unfortunately not recorded by POLLET *et al.*, 1986) which are provided by their canopy or by the litter layer (for e.g. the development of their larvae) and therefore, is able to survive in suitable adjacent habitats too. One might expect this species in a certain, apparently suitable habitat

and it just may be absent there. On the other hand, the unexpected presence of certain species may sometimes be related to human interference. In this respect, the somewhat enigmatic occurrence of *S. laetus* in "De Oude Landen" could be explained by the deposition of massive quantities of sand in certain parts of the nature reserve, which possibly favoured this otherwise coastal dune-inhabiting species. And that brings us to the real body of this kind of ecological research which can only be built upon years of experience in the field: the continuous process of implicit comparison between the new information and the expectations that are made before the sampling even started. During each step of this iterative proces, a more precise ecological characterization of the most abundant species is made. When significant changes in this characterization process are no longer observed, it can be concluded that the species is sufficiently well known from a global ecological point of view. And at that point, the real autecology i.e. which environmental factors are directly affecting the presence and abundance of a species, can take a start.

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