Bulletin S.R.B.E./K.B.V.E., 141 (2005) : 73-80

Pilot study on tree canopy fogging in an ancient oak-beech plot of the Sonian forest (Brussels, Belgium)

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Abstract

During summer of 2003 and 2004 a canopy fogging was performed of an oak tree in an old oak-beech plot in Sonian forest (Brussels, Belgium). About 3,000 arthropods were collected belonging to 149 species. Some rare tree-dwelling/canopy-dwelling species were found that are impossible to collect by other techniques.

Introduction

Studies on the arthropod fauna of forests are generally limited to the occurrence and activity of arthropods near ground level. The fauna of forests is usually sampled with pitfall traps, Malaise traps, emergence traps, window traps and recently also with pheromone traps. However, the fauna of the canopy is poorly known due to sampling difficulties. Canopy fogging gives opportunities to obtain momentary samples of arthropods, active in and on trees.

Until now, no data were available on the technique of canopy fogging of trees in Belgium. We have to refer to studies in the U.K. (STORK & HAMMOND, 1997; STORK *et al.*, 2001; SOUTHWOOD *et al.*, 1982; THUNES *et al.*, 2003) or Germany (FLOREN & SCHMIDL, 1999, 2003; FLOREN & GOGOLA, 2002) to estimate which insects and spiders are living in the canopy of forests in temperate Europe .

The present paper reports the results from a pilot study to get acquainted with the technique and to get a first idea of the faunal composition of arthropods living in tree crowns in Belgian forest. On two occasions an oak tree was fumigated in an ancient plot of the Sonian Forest (planted in 1815). The results of as many invertebrate groups as possible are presented below and comments on remarkable species are given. About 3000 insects and spiders belonging to 149 species were identified.

Material and methods

On two occasions, we performed a canopy fogging of the same old oak tree (*Quercus robur*, Fig. 1; total height 40 m, fogger height during fogging 24 m (measured using a Blume-Leiss dendrometer)) with some younger beech (*Fagus* spec.) nearby (Fig. 2) in an old mixed oak-beech plot in the Sonian forest, Bundersdreef / Drève des Bonniers – Graafdreef / Drève du Comte (UTM ES9925 or ES92). Foggings were performed on 8 July 2003 and on 1 July 2004. On the first date we used a swing fogger, on the second date a London fogger. Pyretrex (Edialux) was used as knockdown insecticide. Foggings were started at 7.45 in the morning and lasted respectively 10 and 20 minutes. Beneath the oak a white plastic sheet was spread that covered about 225 m² (15×15m) (see Fig. 3). The knocked-down arthropods (Fig. 4) were handpicked, up to 2.5 hours after the fogging. The remaining material was later swept together and was stored in 70 % alcohol.

Figs 1-4. 1. Fogging of an oak tree in an old oak-beech plot in Sonian forest (Belgium); 2. Fumigation with London fogger; 3. Sheet spread to collect arthropods; 4. insect sample (photos K. DESENDER).

Observations

It should be noted that there was an understorey of younger beech (2m to 10m high) under the canopy of the old oak tree (Fig. 1, base of crown at 15 m). Therefore, the fauna collected is not purely from oak but also possibly from beech. Table 1 gives the list of the species collected at both dates. The Red Data Book status of the species is indicated in the table when available (CE: Critically endangered; E: Endangered; V: Vulnerable; S: Susceptible; S/LR: Safe/low risk). On the other hand, if something is known about the abundance in Belgium, we mentioned rare or common (C: common; UC: uncommon).

The first fogging in 2003 yielded 746 insects and spiders or a yield of 3.32 arthropods/m². The second year, the fumigation lasted longer and we collected 2,199 arthropods or 9.77 arthropods/ m².

Table 1. Spiders and insects collected by canopy fogging of an old oak tree in an old oak-beech plot in Sonian forest, Brussels, Belgium. The column RDB gives the species with Red Data Book status: CE: Critically endangered; E: Endangered; V: Vulnerable; S: Susceptible; S/LR: Safe/low risk. If something is known about the abundance in Belgium, C: common; UC: uncommon is mentioned.

Order	Family/group	Species	8.VII.2003	1.VII.2004	Total	RDB
Acari	Ixodidae	Ixodes ricinus		3	3	C
Araneae	Araneidae	Araniella cucurbitina	1		1	S/LR
		Cyclosa conica		1	1	S/LR
		Araneus spec. (?diadematus) juv.	5		5	S/LR
		Gibbaeranea spec. Juv.	1		1	S/LR
	Clubionidae	Clubiona comta	3		3	S/LR
		Clubiona terrestris		1	1	S/LR
		Clubiona spec. Juv.	2		2	
	Dictynidae	Nigma flavescens		3	3	S/LR
	Linyphiidae	Hypomma cornutum		5	5	S/LR
		Maso sundevalli		1	1	S/LR
		Meioneta innotabilis		1	1	S/LR
		Nereine emphana		1	1	V
		Nereine peltata	2	5	7	S/LR
		Tenuiphantes zimmermanni		1	1	S/LR
		Walckenaeria atrotibialis		2	2	S/LR
		Drapetisca socialis juv.	2		2	S/LR
		Linyphia triangularis juv.	5		5	S/LR
		Linyphiidae spec. Juv.	4		4	
	Salticidae	Ballus chalybeius		2	2	S/LR
		Neon reticulatus		1	1	S/LR
		Ballus spec. (?depressus) juv.	1		1	
	Tetragnathidae	Metellina mengei	1	1	2	S/LR
		Tetragnatha obtusa		1	1	S/LR
		Metellina spec. Juv.	8		8	
	Theridiidae	Achaearanea lunata		2	2	S/LR
		Anelosimus vittatus		2	2	S/LR
		Enoplognatha ovata	2	9	11	S/LR
		Theridion mystaceum		1	1	S/LR
		Theridion pinastri		4	4	S/LR
		Theridion tinctum		2	2	S/LR
		Enoplognatha spec. Juv.	1		1	
		Achaearanea spec. (?tepidariorum) juv.	1		1	S/LR
	Anyphaenidae	Anyphaena accentuata	1		1	S/LR
		Anyphaena accentuata juv.	2		2	
	Lycosidae	Pardosa spec. Juv.	1		1	
Coleoptera	Buprestidae	Agrilus angustulus		5	5	
	Cantharidae	Cantharis livida		3	3	
		Malthinus balteatus		3	3	
	Carabidae	Agonum assimile	2		2	S/LR
		Carabus problematicus		1	1	S/LR
		Dromius agilis	1	14	15	S
		Dromius quadrimaculatus	1	7	8	S/LR
		Dromius spilotus	1	2	3	S/LR
		Notiophilus biguttatus	3	2	5	S/LR

		Notiophilus quadripunctatus		1	1	S
		Pterostichus oblongopuctatus	1		1	S/LR
	Cerambycidae	Leiopus nebulosus		26	26	
	Cisidae	Cis sp.		1	1	
	Cleridae	Opilo domesticus		1	1	
	Coccinellidae	Calvia 14-guttata	1	2	3	
		Halyzia 16-guttata		13	13	
		Propylea 14-punctata	1		1	
	Curculionidae	Attelabus nitens		2	2	
		Balanobius pyrrhoceras		1	1	
		Balanobius salicivorus		8	8	
		Coeliodes cinctus		1	1	
		Coeliodes dryados		14	14	
		Curculio glandium		20	20	
		Curculio venosus		12	12	
		Depaurus betulae		5	5	
		Dieletus argentatus		55	55	
		Orchestes signifer		2	2	
		Otiorhynchus species		1	1	
		Panus barbicornis		21	21	
		Phyllobius (Ustabvenus) betulae	3		3	
		Polydrosus (Eustolus) undatus	1	31	32	
		Polydrosus (Thomsoneonymus) sericeus	106		106	
		Rhynchaenus avellanae		2	2	
		Rhynchaenus hungaricus		2	2	
		Rhynchaenus jota		1	1	
		Rhynchites cupreus		1	1	
		Stomodes gyrosicollis		1	1	
		Strophosoma capitatum	24	197	221	
		Strophosoma melanogrammum	7	40	47	
		Thomsoneonymus sericeus		355	355	
	Elateridae	Agriotes acumminatus		1	1	
		Agriotes pallidulus		1	1	
		Athous haemorrhoidalis	3	55	58	
		Athous subfuscus		50	50	
		Athous vittatus		53	53	
		Melanotus niger		1	1	
		Selatosomus bipustulatus		7	7	
		Stenagostus villosus	1		1	
	Lagriidae	Lagria hirta	1	2	3	
	Malachiidae	Axinotarsus sp.		2	2	
	Melandryidae	Conopalpus testaceus		5	5	
	Melyridae	Dasytes sp.		1	1	
	Nitidulidae	Epuraea sp.		1	1	
	Omalisidae	Homalisus fontisbellaquei		3	3	
Dermaptera	Forficulidae	Forficula auricularia ad.		1	1	C
		Forficula auricularia juv.	136	72	208	C
Dictyoptera	Dictyoptera	Ectobius sp.	1		1	C
Diptera	Asilidae	Dioctria linearis	2	3	5	C
		Neoitamus cyanurus	1	5	6	C

	Brachycera	Brachycera sp.		226	226	
		Fanniidae	32		32	
		Lauxaniidae	70		70	
		Pallopteridae	1		1	
		Phoridae	4		4	
	Dolichopodidae	Chrysotus gramineus	1		1	S/LR
		Dolichopus wahlbergi	2		2	S/LR
		Gymnopternus brevicornis	3	2	5	S/LR
		Medetera dendrobaena	3		3	S/LR
		Sciapus platypterus	54	254	308	S/LR
		Sybystroma obscurellum	3		3	S/LR
		Dolichopus discifer		1	1	S/LR
		Medetera impigra		2	2	S
		Xanthochlorus tenellus		1	1	S/LR
	Empididae s.l.	Drapetis parilis		1	1	S/LR
		Empis (E.) aestiva	2	4	6	S/LR
		Hilara litorea	1	5	6	E
		Oedalea flavipes		2	2	S/LR
		Oedalea tibialis		1	1	S/LR
		Oedalea zetterstedti		2	2	S
		Phyllodromia melanocephala		2	2	S/LR
		Platypalpus clarandus	1	5	6	S/LR
		Platypalpus exilis		1	1	S
		Platypalpus optivus		1	1	S
		Rhamphomyia (Acl.) longipes		87	87	S/LR
		Rhamphomyia (Amy.) gibba		18	18	S
		Tachypeza nubila		1	1	S/LR
		Trichina elongata		7	7	S/LR
	Rhagionidae	Rhagio lineola	27	10	37	UC
	Sciaridae	Sciaridae	4		4	
	Syrphidae	Baccha elongata	1		1	?
		Episyrphus auricollis		1	1	?
		Episyrphus balteatus	1	3	4	?
		Episyrphus cinctellus		1	1	?
		Sphaerophoria sp,		1	1	?
		Syrphus torvus		2	2	?
		Syrphus vitripennis		1	1	?
	Therevidae	Thereva nobilitata	1	1	2	C
	Tipulidae	Tipulidae sp.	4	5	9	C
Dyctyoptera	Dyctyoptera	Phyllodromica maculata		6	6	C
Heteroptera	Acanthosomatidae	Elasmosthetus interstinctus L.	1		1	
	Microphysidae	Loricula elegantula		4	4	
	Miridae	Cyllecoris histrionicus		2	2	
		Phylus melanocephalus		5	5	
		Phytocoris sp.		23	23	
		Psallus sp.		6	6	
	Nabidae	larvae	15		15	
	Pentatomidae	Pentatoma rufipes	10	12	22	
Homoptera	Cicadellidae	Alebra albostriella		1	1	
		Jassus lanio		41	41	
		Oncopsis cf carpini		1	1	

		Cicadellidae sp.	1		1	
	Issidae	Issus coleoptratus		3	3	
Hymenoptera	Formicidae	Lasius niger		1	1	?
		Myrmica ruginodis	24	6	30	?
	Parasitica	Parasitica sp.	47	80	127	
	Symphyta	Symphyta sp.		2	2	
Isopoda	Isopoda	Oniscus asellus	5	9	14	C
		Porcellio scaber	6	4	10	C
Lepidoptera	Lepidoptera	caterpillars (not ident.)	7		7	
		caterpillars (16 species)		33	33	
		Moths adults	5	40	45	
Mecoptera	Mecoptera	Panorpa communis		2	2	C
Neuroptera	Neuroptera	Chrysoperla sp.	1		1	C
		Neuroptera sp.	1		1	C
Opiliones	Opiliones	Laccinius ephippiatus		1	1	
		Leiobunum rotundum	12		12	
		Mitopus morio	9	18	27	
		Oligolophus spec. juv.	8	1	9	
		Platybunus triangularis		1	1	
Orthoptera	Orthoptera	Meconema thalassinum	27	83	110	S/LR
Psocoptera	Psocoptera	sp.	12		12	
Trichoptera	Trichoptera	Trichoptera sp.		1	1	

Spiders were in the first year mainly represented by juveniles; there were more adults in the second year. Whether this is caused by metereological circumstances, year-to-year fluctuations or the fact that another type of fogger was used is not clear. Most species are rather common with the exception of *Nereine emphana* which is listed as vulnerable (Maelfait *et al.*, 1998). Most captured spiders live in higher strata (shrub layer, e.g. almost all species within the Theridiidae), are typical for living on stems and bark of trees (e.g. *Drapetisca socialils, Hypomma cornutum, Meioneta innotabilis*) and are only rarely caught in sampling techniques which focus on epigaeic arthropods. This means that the fogging was rather effective and that almost no ground-living species were caught (although the sheet was spread down on the forest floor instead of hanging up). This is further illustrated by the presence of *Ballus chalybeius*, a salticid spider typical for oak trees.

Meconema thalassinum (DEGEER, 1773), the Drumming katydid was abundant. This species feeds on insects and has the RDB status of Safe/Low Risk in Belgium (Decleer *et al.*, 2000). Normally the species is difficult to inventory because it doesn't produce any stridulation noise. So far it was mainly found by beating oak branches.

Three ladybirds species were collected. *Propylea 14-punctata* is a very common species that is found in all types of vegetation layers. *Calvia 14-guttata* is also a common ladybird in Belgium that prefers hedges and shrubs (*Crataegus* sp.) (Baugnée *et al.*, 2001). *Halyzia 16-guttata* is an uncommon ladybird found in open forests (preferably on *Acer pseudo-platanus*).

Ground beetles of high faunistic and ecological interest were sampled. The 3 observed *Dromius*-species, found on both occasions, are known as arboricolous and corticolous predators. Only little is known on the biology, ecology and population genetics of these species. All of these *Dromius*-beetles were mentioned before from the Sonian forest, but the most recent observation of *Dromius spilotus* dated as far as 1950 (Desender *et al*, 1995). Canopy fogging therefore is a very innovative technique for studies on such species, a.o. within the context of ecology and nature conservation. In addition, possibly newly appearing pest beetle species can be much more rapidly detected.

The carabid *Notiophilus quadripunctatus* is rare as it is only known in our country from 28 UTM 10×10km squares. In the Sonian forest one individual was very recently obtained in the studies on urbanisation by E. Gaublomme (PhD), whereas the only other observation of the species dated back as far as 1936. The ecology of this ground beetle is also poorly known. The finding of *Carabus problematicus* is somewhat suspect

as there remains a possibility that his beetle was running on the soil surface in the surroundings. Nevertheless it is known that this large carabid likes to climb trees (literature as well as own observations, a.o. from tree-eclectors), even to considerable heights above the surface.

The Elateridae species sampled are mostly phytophagous forest species. They were already found during other studies conducted in the Sonian forest. The most important species caught was *Stenagostus villosus*. This click beetle lives as larvae in the decaying wood of beech and oak trees and hunts the larvae of mainly longhorn beetles. The adult lives hidden and has a nocturnal activity. This species is indicated as very rare in Belgium.

All sampled Curculionidae are, with exception of *Panus (Magdalis) barbicornis*, phytophagous and commonly found. Only the latter species is xylophagous and develops in twigs and branches of different tree species (also in orchards). This xylophagous species is reported for the first time in the Sonian forest during this study. The most abundant species was *Thomsoneonymus sericeus*, a phytophagous weevil that is commonly found on beech and oak.

Only one buprestid and one cerambycid species were found during the fogging: respectively *Agrilus angustulus* and *Leiopus nebulosus*. Both species are interesting because of their xylophagous habit. Especially the capture of many individuals of the first species is interesting. Burprestid species are difficult to sample (especially with window and trunk window traps) and were not found during former sampling campaigns in the same area. This is not only a proof of the presence of Buprestidae in the vicinity but also of a lack of sampling accuracy when studying saproxylic beetles. Care should be taken when drawing conclusions about presence/absence of species. *A. angustulus* develops in small branches of *Quercus* and *Carpinus* species. The life cycle takes one year. In literature other tree species are mentioned as host tree for this species; *Acer*, *Aesculus*, *Alnus*, *Betula*, *Castanea*, *Ceratonia*, *Corylus*, *Fagus*, *Juglans*, *Ostrya*, and *Ulmus*. The species is about 3.5 to 6.5mm in length and metallic green in colour. The latter species (*Leiopus nebulosus*) was found in other studies. This xylophagous species lives in dead branches of various tree species.

Remarkable are the low numbers of moths, especially the larger species, the absence or very low abundance of Tenthredinidae and the large numbers of Lauxaniidae and Fanniidae. We do not understand the meaning of this phenomenon.

As to the dance flies, only *Hilara litorea* has the Red data Book status 'Endangered'. It is actually only known from the Sonian forest. The larvae of *Oedalea* species are xylobionts and do occur also in the mosses growing on bark. The adults swarm in the canopy. *Phyllodromia melanocephala* is a forest species, hunting on the surface of leaves in low vegetation.

Two species of robber flies were observed. *Dioctria linearis*, typical for humid loamy soils with *Salix* sp. and oak -*Carpinius betulus* forest associations. The second species was *Neiotamus cyanurus*, usually occurring in oak-beech forest (van Veen, 1996).

General conclusion

The present investigation is just a preliminary study in order to get a first know-how on the use of the technique of knockdown fumigation. A number of canopy-dwelling arthropod species were found, which are difficult to collect with other techniques. Although this sampling technique has some limitations in its practical use (complexity, labour intensity (at least two people in the field), dependence on weather conditions (dry weather, absence of wind), cost (fogger, knockdown insecticide, plastic sheet)), it is still one of the easiest ways to learn something about arthropods in the canopy of our forests. It would therefore be of great interest to initiate further and more elaborated or designed studies on our indigenous forest canopy arthropods.

Acknowledgements

We would like to thank Mr. E. De Winne (Technical services of the City of Brussels) and Dr. Marc De Meyer (RMCA) for lending us a fogger. We also thank , Dr. Machteld Gryseels (Brussels Institute for Environmental Management) for the authorisation to perform the fogging in Sonian forest. Ir. Stéphane Vanwijnsberghe and the personnel of the Forest Department (Brussels Institute for Environmental Management) are hereby also thanked for their practical help. Mr. Jérôme Constant identified the Hemiptera.

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