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The spatial distribution and plant specificity of Neuropterida in different forest sites in Southern Germany*

(Raphidioptera and Neuroptera)

With 6 Tables

AXEL GRUPPE and HOLGER SCHUBERT

Summary

In Southern Germany the neuropterid fauna of five forest sites was sampled by a set of automatic traps both in the canopy and near the ground. The sites form a gradient regarding the composition of the tree species ranging from a spruce dominated forest, mixed forests with increasing percentages of decidous trees to a stand with oak and beech only.

A total of 1396 Neuropterida were caught between 1995 to 1997 representing 44 species of Raphidiidae, Coniopterygidae, Hemerobiidae and Chrysopidae. Most species and specimens were caught with flight interception traps in the crown stratum. The assemblage of species differed from site to site and between tree species over all sites. Most species were caught on *Quercus petraea* followed by *Larix decidua, Picea abies* and *Fagus sylvatica* in a decreasing order. Eighteen species were seldom encountered. The more frequent species were divided into: **i**) coniferous associated species (10 sp.), **ii**) species of decidous trees (7 sp.), and **iii**) species with no clear preference (9 sp.).

Key words

Neuropterida, Raphidioptera, Coniopterygidae, Hemerobiidae, Chrysopidae, canopy fauna, spatial distribution, plant specificity

Zusammenfassung

In Wäldern unterschiedlicher Struktur wurde die Neuropteriden-Fauna mit Fallen im Kronenraum sowie in Bodennähe erfaßt. Die fünf Wälder bilden einen Gradienten hinsichtlich der Baumartenzusammensetzung, der vom fichtendominierten Wirtschaftswald über Wirtschaftswälder mit zunehmendem Laubholzanteil bis hin zu einem ungenutzten Laubwald reicht.

In den Jahren 1995 bis 1997 wurden insgesamt 1396 Neuropterida aus 44 Arten der Familien Raphidiidae, Coniopterygidae, Hemerobiidae und Chrysopidae gefangen. Die meisten Individuen und Arten traten in Lufteklektoren im Kronenraum auf. Die Artenzusammensetzung unterschied sich sowohl zwischen den Wäldern als auch zwischen den Baumarten. Die meisten Arten wurden auf Eiche (*Quercus petraea*) gefangen, gefolgt von Lärche (*Larix decidua*), Fichte (*Picea abies*) und Buche (*Fagus sylvatica*). 18 Arten traten in den Fängen selten auf. Die häufigeren Arte können in drei Gruppe eingeteilt werden, die **i**) vornehmlich auf Nadelhölzern, **ii**) vornehmlich auf Laubhölzern oder **iii**) auf beiden Gehölzarten gefangen wurden.

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Introduction

The knowledge on the assemblage of neuropterid species varies greatly for regional and national faunas. The fauna of Europe is one of the best-known (NEW, 1998) and many reviews on ecology, systematics and taxonomy exist (ASPÖCK et al., 1980, 1991; CANARD et al., 1984, 1998; NEW, 1986). But even here systematic investigations of regional faunas are lacking. The situation is the same in Germany, where some authors described well investigated faunas of several regions (GÜNTHER, 1991; GÜSTEN, 1993; KRAUSE & OHM, 1970; RÖBER, 1990; TRÖGER, 1986) but between these, undersampled areas remain on the map (PRÖSE, 1992, 1995).

The autecology of most of the European species is known, i.e. the degree of association with specific habitats or plant species. These data are mainly drawn from specimens captured in the lower strata of the habitat (ASPÖCK et al., 1980; GEPP, 1973; MONSERAT & MARÍN, 1992, 1994, 1996). Thus, crown living species are underrepresented.

The current data is one aspect of the comparision of ecosystems of commercial timberland and protected forest areas (AMMER et al., 1995; SCHUBERT, 1998; SCHUBERT et al., 1997; DETSCH, 1999). The assemblages of different insect taxa were determined in this project in the different strata of forest stands. Hereby, we present the data of Neuropterida. Specimens were sampled with a set of automatic traps in the crown stratum and near-ground. This kind of sampling has been rarely used to catch Neuropterida so far (BARSIG & SIMON, 1995). Most investigations of neuropterid faunas were done by sweeping or beating the vegetation (BARNARD et al., 1986; GEPP, 1973; HOLLIER & BELSHAW, 1992; MONSERAT & MARÍN, 1992, 1994, 1996; PAULIAN, 1998; ZELENÝ, 1978), or used light traps (GREVE & KOBRO, 1998; GÜNTHER, 1991; PAULIAN, 1996), coulored pan traps (CZECHOWSKA, 1985, 1994; SAURE & KIELHORN, 1993) or knockdown sprays (BARNARD et al., 1986).

Material and Methods

The arthropods fauna of forest stands was investigated between 1995 and 1997. Samples were taken at five sites within a forest area of about 5,000 ha, the Hienheimer Forst (Kehlheim, Bavaria, Germany) (WGS84, 11°47'33"E, 48°54'46"N). All five sites were situated within approximately six kilometers and, therefore share the same conditions regarding altitude (410 m-465 m above sea level) geology, soil and climate. The geological subsoil consists of malme lime. This is covered by parabraunerde and terra fusca originating from loess deposits. The climate is subcontinental with an average annual temperature of 7.5 - 8.0°C (130 frost days) and an average annual percipitation of 650-730 mm (55 % during the growing period).

The potential natural vegetation is Asperulo-Fagetum with minor differences. The five sites form a gradient of tree species and average of age of the trees. The composition of the tree species ranges from a non-indigenious *Picea abies* (L.) Karst. dominated forest, via mixed forests with an increasing percentage of deciduous trees (*Fagus sylvatica* L., *Quercus petraea* Matt.) to a stand with huge *Q. petraea* and *F. sylvatica* only. *Larix decidua* Mill. occurs in two sites as admixture tree species with up to 13 %. The average age and the composition of the tree species within the stands is shown in table 1.

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Table 1: Average age of trees, composition of the tree species and number of traps at the five forest sites investigated in the Hienheimer Forst (Southern Germany).

	Site I	**Site II**	**Site III**	**Site IV**	**Site V**	**traps per three species**
average age (years)	80	106	103	132	356	
Picea abies	95 %	56 %		8 %		9
Larix decidua		13 %	11 %			6
Fagus sylvatica	5 %	31 %	52 %	66 %	82 %	15
Quercus petraea			35 %	26 %	18 %	9
traps per site	6	9	9	9	6	

Insects were caught with various different traps between April and October in the years 1995, 1996 and 1997. The traps consisted of flight interception traps, emergence traps and branch traps which catch walking specimens on a branch. The traps are described in detail by SCHUBERT (1998). The vessels of all traps contained formaldehyde solution (5 %) and were checked once a month. At each site three different trees per species were chosen for traps in the canopy layer. One flight interception trap and one branch trap were placed into the crown of the same tree. The height of the traps was 25-35 m above the ground depending on the crown architrcture. This design resulted in a different total amount of traps per tree species and site (Table 1). In addition to the traps in the crowns of the trees, there were one flight interception trap, one emergence trap and two branch traps (*F. sylvatica*) close to the soil surface at each site. Additionally, we sampled insects by beating 25 branches of *F. sylvatica* at all stands in August 1997.

Since the number of traps per site, tree species and stratum is inconsistant an overall statistical analysis is impossible. Thus, we used the catches of selected trap types for the different aspects. Regarding the abundance of the neuropterid species in the different forest sites, the numbers of specimens of all catches were summarized. The suitability of the different trap types to catch Neuropterida and their association to tree species was analysed on the basis of the crown traps only. The occurrence of species in the two strata, canopy layer or near-ground, was calculated with data of flight interception traps. We used Chi^2-test to check for significance.

The nomenclature used is according to ASPÖCK et al. (1980) and BROOKS & BARNARD (1990) for Neuroptera (exception: *Anisochrysa* syn. *Dichochrysa*; *Coniopteryx pygmaea* ENDERLEIN 1906 according to GÜNTHER, 1993) and according to ASPÖCK et al. (1991) for Raphidioptera. Females of the genus *Coniopteryx* were identified to the genus.

Results

During the three years of investigation 1396 adult Neuropterida were caught which represent 44 species. Four species, *Coniopteryx haematica*, *C. lentiae*, *Parasemidalis fuscipennis* and *Nineta principiae* were recorded for the first time in Bavaria (PRÖSE, 1995). The number of species and specimens at each particular site is given in table 2. No site included all 44 species. The highest number of species and specimens (39 sp./421 ind.) occurred at site III. The particular faunas (number of species) of the five forest sites did not

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Table 2: List of the species which were caught during the investigation at the five sites in Hienheimer Forst (Southern Germany).

	Site I	Site II	Site III	Site IV	Site V	total
Raphidiidae (ind./spec.)	**5 / 3**	**27 / 4**	**34 / 6**	**25 / 5**	**16 / 4**	**107 / 6**
Dichrostigma flavipes (STEIN 1863)		9	1	1		11
Phaeostigma notata (FABRICIUS 1781)	1	8	6	6	4	25
Puncha ratzeburgi (BRAUER 1876)	1	4	6	2		13
Subilla confinis (STEPHENS 1836)			5		2	7
Venustoraphidia nigricollis (ALBARDA 1891)			8	6	8	22
Xanthostigma xanthostigma (SCHUMMEL 1832)	3	6	8	10	2	29
Coniopterygidae (ind./spec.)	**28 / 5**	**127 / 6**	**61 / 7**	**130 / 8**	**21 / 4**	**367 / 10**
Coniopteryx females	11	50	16	51	10	138
Coniopteryx borealis TJEDER 1930		5	14	12	5	36
Coniopteryx haematica MCLACHLAN 1868			1			1
Coniopteryx lentiae H. ASPÖCK & U. ASPÖCK 1964				2		2
Coniopteryx pygmaea ENDERLEIN 1906	4	38	9	48		99
Coniopteryx tineiformis CURTIS 1834			8	3	1	12
Conwentzia pineticola ENDERLEIN 1905	1	3	3			7
Conwentzia psociformis (CURTIS 1834)				1		1
Helicoconis lutea (WALLENGREN 1871)	5	2		4		11
Parasemidalis fuscipennis (REUTER 1894)	3	25	2	3	2	35
Semidalis aleyrodiformis (STEPHENS 1836)	4	4	8	6	3	25
Hemerobiidae (ind./spec.)	**45 / 5**	**111 / 11**	**164 / 13**	**84 / 9**	**54 / 7**	**458 / 14**
Drepanepteryx algida (ERICHSON 1851)		11	29			40
Drepanepteryx phalaenoides (LINNAEUS 1758)	4	7	12	4	5	32
Hemerobius atrifrons MCLACHLAN1868		4	27	1		32
Hemerobius fenestratus TJEDER 1932	1	1				2
Hemerobius humulinus LINNAEUS 1758		5	5	1		11
Hemerobius marginatus STEPHENS 1836			2		1	3
Hemerobius micans OLIVIER 1792	31	51	49	58	37	226
Hemerobius pini STEPHENS 1836	7	12	5	1		25
Sympherobius elegans (STEPHENS 1836)		1	3	5	1	10
Sympherobius klapaleki ZELENY 1963			3	2	1	6
Sympherobius pellucidus (WALKER 1853)	2	11	22	12	9	56
Wesmaelius concinnus (STEPHENS 1836)			1			1
Wesmaelius quadrifasciatus (REUTER 1894)		8	6			14
Chrysopidae (ind./spec.)	**66 / 7**	**88 / 9**	**162 / 14**	**77 / 12**	**71 / 10**	**464 / 15**
Chrysopa perla (LINNAEUS 1758)		1		1		2
Chrysopa pallens (RAMBUR 1838)			1	1		2
Chrysoperla carnea s.l. (STEPHENS 1836)	17	14	95	54	41	221
Chrysopidia ciliata (WESMAEL 1841)	1	2	5	2	5	15
Cunctochrysa albolineata (KILLINGTON 1935)			2	2		4
Hypochrysa elegans (BURMEISTER 1839)	1	6	14	6	13	40
Dichochrysa flavifrons (BRAUER 1850)		1	1	1		3
Dichochrysa prasina (BURMEISTER 1839)	2	5	17	3	2	29
Dichochrysa ventralis (CURTIS 1834)			1		1	2
Nineta flava (SCOPOLI 1763)			2	1	1	4
Nineta principiae MONSERRAT 1980			1			1
Nineta pallida (SCHNEIDER 1851)	2	3	2	1	1	9
Notochrysa capitata (FABRICIUS 1793)	2	12	1		1	16
Notochrysa fulviceps (STEPHENS 1836)			7	2	5	14
Peyerimhoffina gracilis (SCHNEIDER 1851)	41	44	13	3	1	102
total specimens	**144**	**353**	**421**	**316**	**162**	**1396**
species	**20**	**29**	**39**	**33**	**24**	**44**

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Table 3: Species which were caught with more than 75 % on conifers or decidous trees or without preference. Only species with more than 5 specimens in the crown traps are regarded.

Coniferous trees	Decidous trees	Indifferent
Phaeostigma notata *Puncha ratzeburgi*	*Venustoraphidia nigricollis*	*Xanthostigma xanthostigma*
Coniopteryx pygmaea *Helicoconis lutea* *Parasemidalis fuscipennis*	*Semidalis aleyrodiformis*	*Coniopteryx borealis* *Coniopteryx tineiformis*
Drepanepteryx algida *Hemerobius atrifrons* *Hemerobius pini* *Wesmaelius quadrifasciatus*	*Drepanepteryx phalaenoides* *Hemerobius micans*	*Hemerobius humulinus* *Sympherobius elegans* *Sympherobius pellucidus*
Notochrysa capitata	*Chrysoperla carnea* s.l. *Hypochrysa elegans* *Nineta fulviceps*	*Chrysopidia ciliata* *Dichochrysa prasina* *Peyerimhoffina gracilis*

differ significantly (Chi^2=8.08, df=4, p=0.0887) but the numbers of specimens did (Chi^2=211.04, df=4, p=0.0000).

Regarding the occurrence of Neuropterida associated with the different tree species three groups can be defined, i.e. species of which more than 75 % of all specimens were caught on **i** coniferous trees or **ii** decidous trees or **iii** species which were caught frequently on both (Table 3). No species was found on one tree species only. The closest association with one tree species was found for *D. algida* and *H. atrifrons* which were caught on *L. decidua* with 89.7 % and 87.5 % respectively and for *V. nigricollis* with 85.7 % on *Q. petraea*.

The number of species and specimens caught on different tree species varies from 27 to 33 species and from 263 to 359 specimens. Since different numbers of traps were used, one has to focus on the number of species or specimens per trap. On *L. decidua* an average of 5.0 species per trap were recorded, followed by *Q. petraea*, *P. abies* and *F. sylvatica* in a descending order (Table 4). The distribution of specimens confirms the attractiveness of *L. decidua* for Neuropterida.

The majority of specimens and species were caught with flight interception traps (90.0 %). Nevertheless, there were six species frequent (>=20 %) in branch traps (Table 5). The other species did not reach 12 % of the total in the branch traps. Due to the equal number of the two types of traps in the canopy layer it is possible to compare their suitability to catch Neuropterida. The catches differed significantly between flight interception traps and branch traps at the level of species (Chi^2 = 10.56, df =1, p = 0.0012) and specimens (Chi^2 = 746.80, df =1 , p = 0.0000).

All 44 species were found in the canopy stratum with a total of 1168 specimens, compared to only 19 species with 206 specimens in the near-ground traps (Table 6). A statistical analysis of this distribution is not possible due to the different mumbers and types of traps. Calculating the total numbers to the average number per trap 1.1 and 3.8 species were caught near-ground and in the canopy layer respectively. The only species which was more abundant in the 'near-ground' traps was *D. flavipes* (72.7 % near-ground).

In the second year of the investigation, in August 1997, we sampled insects also by beating branches of *F. sylvatica*. At all sites the most abundant species (about 95 % of all Neuropterida) were adults of *H. micans* and larvae of *C. ciliata*.

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Table 4: Occurrence of neuropterid species and specimens on the four different tree species.

	Fagus sylvatica	*Quercus petraea*	*Picea abies*	*Larix decidua*
Raphidiidae (ind./spec.)	**1 / 1**	**27 / 5**	**21 / 3**	**20 / 5**
Dichrostigma flavipes (STEIN 1863)		2		1
Phaeostigma notata (FABRICIUS 1781)		7	11	4
Puncha ratzeburgi (BRAUER 1876)			5	6
Subilla confinis (STEPHENS 1836)		3		
Venustoraphidia nigricollis (ALBARDA 1891)		6		1
Xanthostigma xanthostigma (SCHUMMEL 1832)	1	9	5	8
Coniopterygidae (ind./spec.)	**58 / 6**	**53 / 8**	**173 / 6**	**83 / 6**
Coniopteryx females	22	23	71	22
Coniopteryx borealis TJEDER 1930	12	9	5	10
Coniopteryx haematica MCLACHLAN 1868		1		
Coniopteryx lentiae H. ASPÖCK & U. ASPÖCK 1964		2		
Coniopteryx pygmaea ENDERLEIN 1906	4	1	74	20
Coniopteryx tineiformis CURTIS 1834	5	2		5
Conwentzia pineticola ENDERLEIN 1905			4	3
Conwentzia psociformis (CURTIS 1834)		1		
Helicoconis lutea (WALLENGREN 1871)	2		9	
Parasemidalis fuscipennis (REUTER 1894)	2	3	9	21
Semidalis aleyrodiformis (STEPHENS 1836)	11	11	1	2
Hemerobiidae (ind./spec.)	**189 / 9**	**78 / 9**	**45 / 9**	**115 / 9**
Drepanepteryx algida (ERICHSON 1851)	3	1		35
Drepanepteryx phalaenoides (LINNAEUS 1758)	9	6	4	1
Hemerobius atrifrons MCLACHLAN 1868		3	1	28
Hemerobius fenestratus TJEDER 1932			2	
Hemerobius humulinus LINNAEUS 1758	3	5	3	
Hemerobius marginatus STEPHENS 1836	2	1		
Hemerobius micans OLIVIER 1792	147	46	10	15
Hemerobius pini STEPHENS 1836	4		11	5
Sympherobius elegans (STEPHENS 1836)	3	4	2	1
Sympherobius klapaleki (ZELENY 1963)	1	4		
Sympherobius pellucidus (WALKER 1853)	17	8	9	19
Wesmaelius concinnus (STEPHENS 1836)				1
Wesmaelius quadrifasciatus (REUTER 1894)			3	10
Chrysopidae (ind./spec.)	**111 / 12**	**105 / 11**	**40 / 9**	**49 / 10**
Chrysopa perla (LINNAEUS 1758)	1			
Chrysopa pallens (RAMBUR 1838)			1	1
Chrysoperla carnea s.l. (STEPHENS 1836)	51	63	13	7
Chrysopidia ciliata (WESMAEL 1841)	1	8	4	1
Cunctochrysa albolineata (KILLINGTON 1935)	3	1		
Hypochrysa elegans (BURMEISTER 1839)	21	6	2	8
Dichochrysa flavifrons (BRAUER 1850)	1			2
Dichochrysa prasina (BURMEISTER 1839)	8	9	3	7
Dichochrysa ventralis (CURTIS 1834)	1			
Nineta flava (SCOPOLI 1763)		4		
Nineta principiae MONSERRAT 1980		1		
Nineta pallida (SCHNEIDER 1851)	3	1	3	2
Notochrysa capitata (FABRICIUS 1793)	2	1	2	10
Notochrysa fulviceps (STEPHENS 1836)	5	6	1	2
Peyerimhoffina gracilis (SCHNEIDER 1851)	14	5	11	9
total specimens	**359**	**263**	**279**	**267**
specimens / trap	**23.9**	**29.2**	**31.0**	**44.5**
total species	**28**	**33**	**27**	**30**
species / trap	**1.9**	**3.7**	**3.0**	**5.0**

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Table 5: Species which occurred frequently (>=20 %) in the branch traps in the canopy.

Species	Specimens total	% specimens in branch traps
Drepanepteryx algida (ERICHSON 1851)	39	51.3 %
Hemerobius pini STEPHENS 1836	20	20.0 %
Chrysoperla carnea s.l. (STEPHENS 1836)	134	32.1 %
Dichochrysa prasina (BURMEISTER 1839)	27	33.3 %
Hypochrysa elegans (BURMEISTER 1839)	37	27.0 %
Peyerimhoffina gracilis (SCHNEIDER 1851)	39	30.8 %

Table 6: Number of species and specimens which were caught in the canopy and ‚near-ground' with different typs of traps. Letters indicate significant differences between groups (see text).

Number of		canopy	near-ground
Species	in branch trap	18 a	12
	in flight interception trap	44 b	12
	total number	44	19
	number / trap	3.8	1.1
Specimens	in branch trap	117 a	170
	in flight interception trap	1054 b	36
	total number	1168	206

Discussion

In the present article we describe the neuropterid fauna of five forest sites representing closed forest stands. Only site V and IV to a smaller amount were opened up by wind-breakage in the early 1990's. Stands of this closed structure are suitable habitates for a relative low number of species whereas open woodlands are inhabited by much more species and bear a higher individual density (ASPÖCK et al., 1980). On the other hand there are some neuropterid species which are known to live in close coniferous stands or which prefere the canopy layer of forest stands. Some of these species were able to enlarge the area of their distribution in dependance on non-indigenious spruce affore-stations in northern parts of Germany (OHM, 1973). In the literature there are only few investigations of the species assemblage of the canopy layer but no comparision of the canopy and the near-ground stratum. The canopy fauna of pine or mixed stands in Poland (CZECHOWSKA, 1985, 1994) yielded 22-28 species. In northern Germany SAURE & KIELHORN (1993) caught 22 and 24 species on pine and oak trees respectively and BARSIG & SIMON (1995) caught 13 species in the crowns of pine trees. GEPP (1973) yielded 35 species from a very diverse forest area in Austria over a period of eight years. The faunistical data cited above can not be compared directly with each other since the methods and duration of investigation differ highly (FRONTIER & PICHOD-VIALE, 1995). However, we found a rich and diverse fauna of 44 species (20-39 species per site) within three years of investigation. This represents about half of the species known in Bavaria.

A significant difference between the particular faunas within the sites was not expected because the greatest distance between two sites was about 6 km. The sites with two tree species (site I and V) contained fewer species (20 and 24 sp.) than the others (29, 39, 33 sp.). This effect might be due to the different numbers of traps as indicated by the lower

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numbers of specimens and of rare species (<10 specimens in all years) in the catches of sites I and V (Table 2). Moreover, not only the number of tree species is important but also the species themselves. The most diverse fauna lives on *Q. petraea* and on *L. decidua* (33 and 30 species respectively) compared to *P. abies* (27 sp.) and *F. sylvatica* (28 sp.). It is surprising that such a low number of Neuropterida originates from *F. sylvatica*, the tree species which is indigenous in that region and plant association and which had the most traps in the crowns (Table 1). The high number of traps is clearly indicated by nearly 360 caught specimens. It is evident that even close forest stands are suitable habitats for many Neuropterida and that more diverse stands, i.e. higher number of tree species, are inhabited by more neuropterid species.

Seventeen species were rarely caught (i.e. <= 10 specimens). *C. psociformis, C. pallens* and *D. ventralis* are eurytopic and show a clear preference to decidous trees like *Quercus* species. *S. confinis, C. haematica, C. lentiae, S. klapaleki, D. flavifrons,* and *N. principiae* are elements of the Mediterranean fauna which seem to be rare due to their temperature requirements. Two specimens of *N. principiae* have been recorded from Germany so far (SAURE, 1997, cited as *Nineta guadarramensis principiae*). The present individual shifts the distribution of this species to 48°54'46" northern latitude. *H. marginatus, C. perla, C. albolineata, N. flava* as well as *C. pineticola, H. fenestratus, W. concinnus* and *N. pallida,* the later group with a preference to coniferous trees, originate from the Siberian or European Extra-Mediterranean fauna. *W. concinnus* is mostly reported from *Pinus* (ASPÖCK et al., 1980) but the only specimen in this investigation was caught on *L. decidua.* The other species seem to need a denser vegetation and shrub layer. The rare occurrence of *H. fenestratus* even at site I and II is surprising. GRUPPE (1997) recorded it as an abundant species in closed forests of similar structure and tree composition (*P. abies, Abies alba, Q. petraea*) in Southern Germany. All these rare species in addition to *D. flavipes,* are excluded from the following discussion of the host tree specificity, since the low number collected does not permit definite conclusion about plant specificity.

Species which prefered coniferous trees (Tab. 3) are mainly elements of the Siberian fauna (*C. pygmaea, D. algida, H. atrifrons, H. pini, W. quadrifasciatus*) or have a holarctic distribution (*H. lutea, P. fuscipennis*). Only *N. capitata, P. notata* and *P. ratzeburgi* are Extra-Mediterran European elements. *D. algida, H. atrifrons,* and *W. quadrifasciatus* are clearly associated with *L. decidua* with a decreasing order of association. Four specimens of *D. algida* were caught on *F. sylvatica* and *Q. petraea,* but all these trees were close enough to *L. decidua* for their crowns to touch.

Seven species were caught with more than 75 % of their specimens on decidous trees (Table 3). Only *V. nigricollis* and *H. elegans* represent Mediterranean elements with high temperature requirements, as is the case with the Extra-Mediterranean-European elements *S. aleyrodiformis* and *N. fulviceps.* The two Hemerobiidae, *D. phalaenoides* and *H. micans,* actually come from Siberian regions and are usually associated with *F. sylvatica.*

Species with no clear preference for coniferous or decidous trees (Table 3) are mainly holarctic or of the Siberian fauna (*X. xanthostigma, C. tineiformis, H. humulinus, C. ciliata*). *C. borealis, S. elegans*, and *S. pellucidus* are Mediterranean species. The number of *C. ciliata* specimens does not represent the real abundance in these sites. Many larvae were beaten from the branches of *F. sylvatica* in all stands in August 1997. This species is a poor flyer and the set of traps is not adequate to catch this species in representative numbers.

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All species in our investigations were present in the catches of the crown traps, but only 19 species could be found in the near-ground traps. This obvious preference of the crown stratum indicates the thermophily of many Neuropterida at least in temperate climate zones (ASPÖCK et al., 1980). The close canopy of a forest can be seen as the upper surface of the stand similar to the forest edge. Here we find very diverse microclimatic conditions and high structural complexity close together. The radiation is high resulting in high temperatures in the sunny parts of the crown. Due to the roughness of the canopy wind is decelerated which results in higher humidity and weak gradients of humidity in the shadded areas, too (PARKER, 1995). Beside this abiotic factors we find different biological structures, for example leaves, small smooth-barked twigs, coarze-barked branches, limbs and dead wood of manifold dimensions. Although the suitability of edges varies with the insect taxon (OZANNE et al., 1997) this habitat seems to be suitable for many Neuropterida as well as for other arthropods which are used directly as prey or indirecly (honey dew) as food resource (ASPÖCK et al., 1980, 1991; ZELENÝ, 1984).

A close host tree association of some Neuropterida is well known (ASPÖCK et al., 1980, 1991). For many species this association is indirect since larvae and adults are predators and the suitability of a host tree or even a certain habitat is determined by their feeding requirements (ZELENÝ, 1984). We have shown that most species seem to prefer the crown stratum of light-demanding trees as *L. decidua* and *Q. petraea*. The sparse crown of these tree species is characterized by warm and sunny microclimatic conditions especially if they occur sporadic in the closed canopy of a forest stand. Thus, it forms a kind of light tunnel which attracts many insects, prey and predators. The relative high number of species of Mediterranean origin which are assumed to have high temperature requirements indicates the favourable microclimate in the crowns of this group of tree species.

The assemblage of Neuropterida in the higher strata of forest stands is poorly known. The most pragmatic way to get an idea of the fauna in this habitat is the use of automatic traps which can also be handled from the ground. Their efficiency depends on the behaviour of any particular species as explained for *C. ciliata*. Moreover, traps might also attract some species which hibernate as adults in protected niches like bark splits (HONEK, 1977; THIERRY et al., 1994). The use of flight interception traps and branch traps has at least three main advantages compared to the other techniques: (1) the environment is not disturbed or affected and the catches are continuously over a period of time at the same place, (2) the specimens are caught in the area of their main activity and (3) the specimens are not attracted. Thus, this technique gives an overview of the insect community of the area nearby the trap.

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Authors adresses:

Dr. AXEL GRUPPE
Institute of Applied Zoology
Technische Universität München
Am Hochanger 13
85354 Freising, Germany
gruppe@zoo.forst.tu-muenchen.de

HOLGER SCHUBERT
Institute of Land Use Planing and Nature Conservation
Technische Universität München
Am Hochanger 13
85354 Freising, Germany

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