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Diptera and Coleoptera collected in the forest reserve Sihlwald ZH

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We analysed an extensive data set of Diptera (953 species) and Coleoptera (699 species) collected by trunk-window traps and eclectors in the forest reserve Sihlwald (Canton Zurich, Switzerland) in 1996 and 1997. The samples contained 186 species of Diptera new to the Swiss fauna and approximately 20 species of the same group new to science. Temporal variability among the samples was larger than spatial variability. Despite the unusually large collecting effort, several methods applied for estimating total species richness revealed undersampling of > 30%. We therefore underline the necessity for using standardized sampling techniques which make different studies comparable and reduce sampling effort without considerable loss of information.

Keywords: Diptera, Coleoptera, trunk-window traps, eclectors, sampling strategy

INTRODUCTION

Ecological studies of insects usually require extensive samples which frequently are analysed and published only partly. As a result, valuable background information about faunistically interesting species, phenological data or the efficiency of the traps used gets lost. Furthermore, it remains often unclear, which proportion of the focal community has been sampled. However, the latter aspect is important for further studies, as such data may be used as a guideline for choosing the adequate sampling strategy. Here we present a dataset from an ecological investigation into saproxylic Diptera and Coleoptera based on two year sampling with eclectors and trunk-window traps. We first describe a new eclector type and discuss the efficiency of the traps we used for this investigation. Second, we estimate total species richness using rarefaction curves (SIMBERLOFF, 1972) and other parametric and nonparametric techniques (MAGURRAN, 1988; COLWELL & CODINGTON, 1994). We then explore the effects of spatial and temporal variability on our collections. Finally, we give a list of 106 species of Diptera new to Switzerland and not yet included in the Swiss Checklist (MERZ *et al.*, 1998).

METHODS

Study area

The study was carried out in the forest reserve Sihlwald (47° 15' N; 8° 33' E) at a NE-orientated slope 10 km south of Zurich, Switzerland. The entire forest covers 10 km^2 and is dominated by beech (*Fagus sylvatica*) and spruce (*Picea abies*), fol-

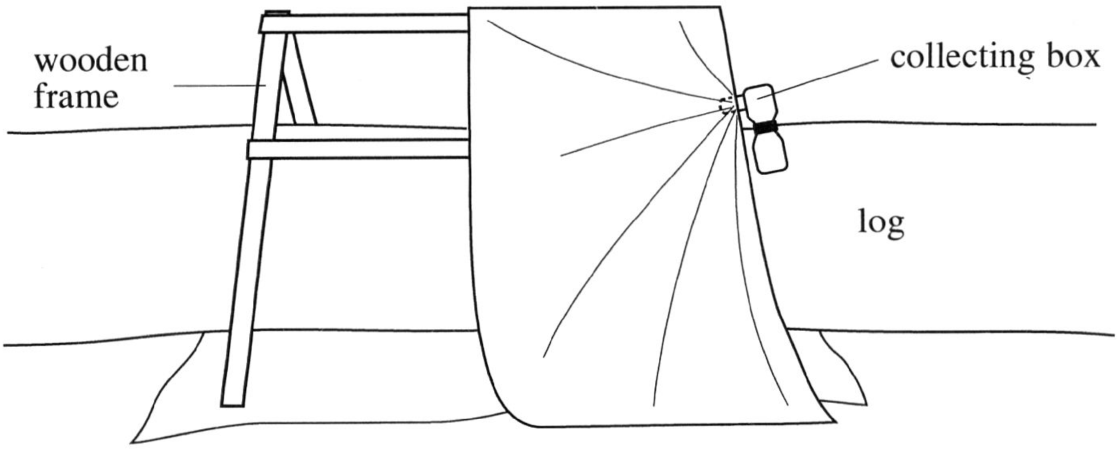


Fig. 1. A log eclector during installation.

lowed by ash (*Fraxinus excelsior*) and fir (*Abies alba*). Rainfall averages out at 1400 mm per year. We selected 14 study plots between 500–800 m a.s.l. that were similar to each other with respect to exposition, stand structure and age as well as tree species composition.

Insect sampling

Insects were collected using eclectors ('extraction cylinders', ØKLAND, 1996; 'emergence traps' IRMLER *et al.*, 1996) and trunk-window traps (KAILA, 1993). Due to the tent-like construction of eclectors, pieces of dead wood can be enclosed to rear saproxylic insects. Emerging insects are attracted by the attached collecting boxes which are the only source of light in the trap. The senior author developed an improved eclector type, which can be used on fallen dead wood in contact with the forest floor (Fig. 1).

Its construction is simple and it can be installed within one hour in the field. Material costs are low and the trap is suited for repeated use. A major advantage are the simplified collecting boxes which can be exchanged within a few minutes. Four eclectors were installed in each of the 14 sites, two containing a part of a log (diameter at the smaller end > 20 cm, L = 1.5 m, log eclectors) and two containing branches (diameter at both ends 5–10 cm, L = 1.0–1.5 m, branch eclectors), giving 28 traps of each type, 56 in total. The collecting boxes were filled with a 2% formaldehyde solution and emptied monthly from May–November 1996 and 1997. The branch eclectors were only operated in 1996. Additionally, four trunk-window traps (KAILA, 1993) were installed in each plot (Fig. 2).

All traps were placed in the plot centre within a range of 10 m. Trunk-window traps consisted of a transparent plastic plate (30 x 45 cm) attached above a 30 cm wide plastic funnel. A 0.3 l collecting box with 4% formaldehyde solution and some drops of a detergent to lower surface tension was mounted below the funnel. The trap was fixed on a piece of wood with the lower end about 1 m above ground. This method has been successfully used in various studies (KAILA, 1993; SIITONEN, 1994; ØKLAND *et al.*, 1996; HAMMOND, 1997; KAILA *et al.*, 1997) and yields high numbers of saproxylic species. The small diameter of the collecting box prevents animals from drinking the formaldehyde solution and reduces evaporation. The only restriction is that falling leaves may clog up the opening of the collecting box in autumn. The trunk-window traps were active from April–September both in 1996

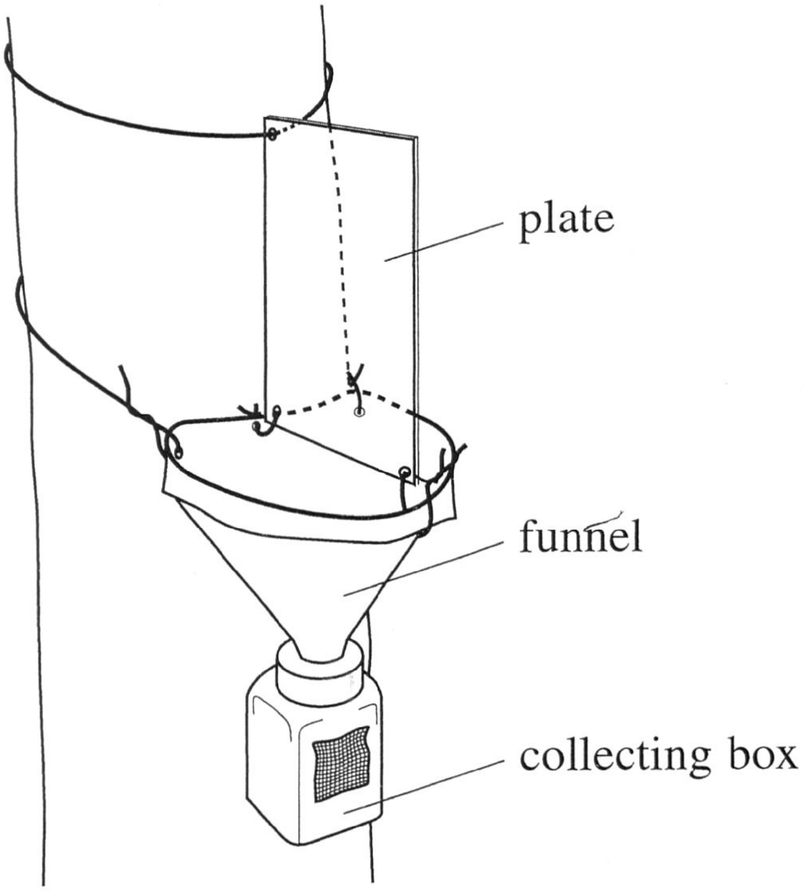


Fig. 2. A trunk-window trap.

and 1997 and were emptied biweekly. All specimens of Diptera and Coleoptera were sorted out and identified to species level by various specialists except for Cecidomyiidae, Chironomidae, Phoridae, Psychodidae, and Sphaeroceridae which could be identified only partly due to identification problems. Additionally, we had to omit all samples of Diptera collected by trunk-window traps in August and September 1997 because of restrictions in time and money.

Estimating species richness

As no community can be sampled fully, one might be interested in how many species it actually contains. We applied the following three methods for estimating total species richness:

a) S/i functions (increasing number of species with increasing number of individuals)

Rarefaction curves (SIMBERLOFF, 1972) usually are applied to reach a standardized estimate of the number of species collected with any given sampling effort, e. g., number of individuals (COLWELL & CODDINGTON, 1994). However, these methods can also be used to extrapolate the number of species for a given, large number of individuals (DUELLI, 1997). We found empirically the following equation to describe the asymptotic function of the number of species per number of individuals:

$$N_s = \frac{\underline{N}_s * (1-\exp(-p1 * N_i^{p2}))}{(1-\exp(-p1 * \underline{N}_i^{p2}))}$$

where

N_s = number of species caught with a given number of traps

N_i = number of individuals caught with a given number of traps

$\underline{N}_s$ ($\underline{N}_i$) = total number of species (individuals) caught with all traps

p1 and p2 = function parameters

Applying this function to a sufficiently large dataset allows to estimate the number of species that would have been obtained if more individuals had been collected (e. g. 1 Mio individuals, for a more detailed description see DUELLI, 1997).

b) Parametric models for estimating species richness

A community can be characterized by the abundance distribution of its species. These distributions usually are described in relation to four main models (MAGURRAN, 1988): the log normal distribution, the geometric series, the logarithmic series and MacArthur's broken stick model. We fitted our data to a truncated lognormal distribution following the maximum likelihood method devised by COHEN (1961) and described by MAGURRAN (1988). Goodness of fit was tested by a χ^2-test (MAGURRAN, 1988). We used the truncated lognormal model to calculate an estimate of total species richness.

c) Abundance-based estimators of species richness

Non-parametric models provide an alternative way to estimate total species richness (reviews in COLWELL & CODDINGTON, 1994; CHADZON *et al.*, 1998). We decided upon the abundance-based coverage estimator (ACE) developed by CHAO *et al.* (1993) and LEE & CHAO (1994). This estimator is based on those species with less than 11 individuals per sample, as it is suspected that undersampling occurs mostly in low abundance classes. All calculations were done using EstimateS Version 5.0 (COLWELL, 1997).

Reducing sampling effort?

Trunk-window traps are frequently used in investigations into saproxylic beetles, but the number of traps involved usually is smaller than in our study (KAILA, 1993; SIITONEN, 1994; KAILA *et al.*, 1997). The question arises, therefore, what consequences reduced sampling effort has. Based on our extensive data set obtained from 56 traps, we compared the number of beetle species we obtained in 1997 with the species numbers in subsamples of that year. The subsamples were formed by simulating reduced sampling effort: a) considering only two out of four traps per site, resulting in 14 sites and 28 traps, and b) considering only seven sites, resulting also in 28 traps. With this procedure, our subsamples differed only in the number of sites involved. The traps and sites to be included in the subsamples were selected randomly and this was repeated until the mean number of species stabilized (10 times).

RESULTS

Number of species collected

Totally, 699 (29'690 individuals) species of beetles and 953 (61'866 individuals) species of Diptera were collected. Of the latter, 186 species were new to Switzerland (Haenni, 1997; Merz, 1997; Delécolle & Schiegg, 1998; Dempewolf & Schiegg, 1998; Otto & Schiegg, 1999) and some of them have already been included in the Swiss Diptera Checklist (Merz *et al.*, 1998). About 20 species were new to science (e.g., Delécolle & Schiegg, 1999), most of them belonging to Sciaridae (Heller, pers. com.). The species new to Switzerland which have not yet been published, are given in the Appendix and a complete list of species is available from M. Obrist upon request. No beetle species new to the Swiss fauna was found (C. Besuchet, unpubl.). As only a part of the specimens of the families Psychodidae, Chironomidae, Phoridae, and Sphaeroceridae were identified, we excluded these families in all tables and analyses, except for estimation of species numbers.

In Coleoptera, the eclectors yielded a total of 399 species, 116 (29.1 %) of which did not occur in the trunk-window traps. Alternatively, 298 of 581 species (51.3 %) were found exclusively in the trunk-window traps. In Diptera, 566 species were collected by eclectors and 322 (56.9 %) were not present in the trunk-window traps, which in turn contained 351 of 595 species (59.0 %) not occurring in eclectors (Tab. 1).

Trunk-window traps

In Coleoptera, 55.7 % of all species collected by trunk-window traps were sampled in both years (Fig. 3). Most species were present with only few individuals, only two species exceeded 5 % of relative abundance, namely *Xyleborus dispar*, (Fabricius, 1792), (39.2 % in 1996; 12.1 % in 1997) and *Atomaria diluta* Erichson, 1846, (5.0 % in 1997). Hence, the larger number of individuals in the coleopteran samples was mainly due to these two species.

Tab. 1. Number of species collected by the three trap types. Diptera, trunk-window traps, 1997: data only April–July 31. Not included are the species of Cecidomyiidae, Chironomidae, Phoridae, Psychodidae, and Sphaeroceridae.

	log eclectors			**branch eclectors**	**trunk-window traps**			**all traps**
	1996	**1997**	**total**	**1996**	**1996**	**1997**	**total**	**total**
Coleoptera								
families	32	30	**40**	**38**	54	50	**58**	**61**
species	232	237	**328**	**265**	443	404	**581**	**699**
individuals	3'215	2'604	**5'819**	**2'901**	14'348	6'622	**20'970**	**29'690**
Diptera								
families	37	35	**41**	**45**	53	35	**55**	**59**
species	348	280	**441**	**415**	481	297	**595**	**879**
individuals	14'927	23'891	**38'818**	**17'000**	2'514	2'615	**5'129**	**60'947**

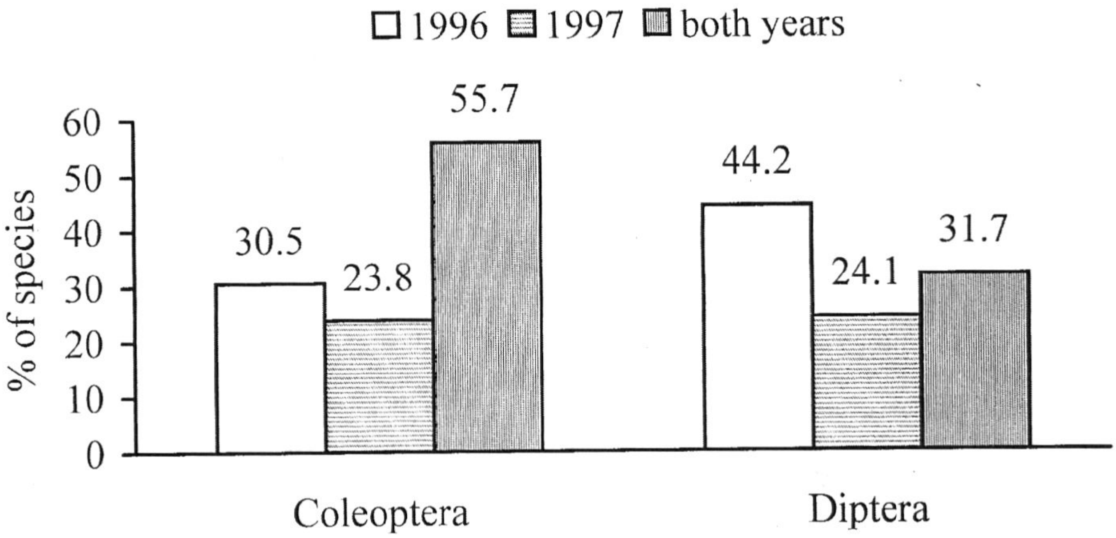


Fig. 3. Percentages of species collected by trunk-window traps exclusively in 1996, 1997, and in both years.

Tab. 2. Number of beetle species (observed and estimated) obtained in all samples of the trunk-window traps of 1997 and in subsamples, where only half of the traps per site (traps) or half of the sites (sites) were considered. Given are mean numbers ± SD (10 randomisations). S/i = species/individuals function; lognormal = estimate based on truncated lognormal distribution of species abundances.

method	**all samples**	**subsamples**	
observed		**traps**	**sites**
	404	312 ± 13.8	305 ±8.9
estimated			
S/i	658	527 ± 41.9	526 ± 39.0
lognormal	605	465 ± 11.2	467 ± 11.8

As dipteran data from trunk-window traps in 1997 are only available from 7 May–31 July, we only considered the data of this time span in 1996 for between year comparisons. There was a marked species turnover between 1996 and 1997, as just 31.7 % of the species were collected in both years (Fig. 3). Only Sciarids were present with relative abundances > 5 %: *Bradysia hilariformis* TUOMIKOSKI, 1960 with 7.5 % in 1996 and 7.2 % in 1997, as well as *Scatopsciara calamophila* FREY, 1948 with 5.9 % in 1997 and *Bradysia fungicola* (WINNERTZ, 1867) with 6.1 % in 1997.

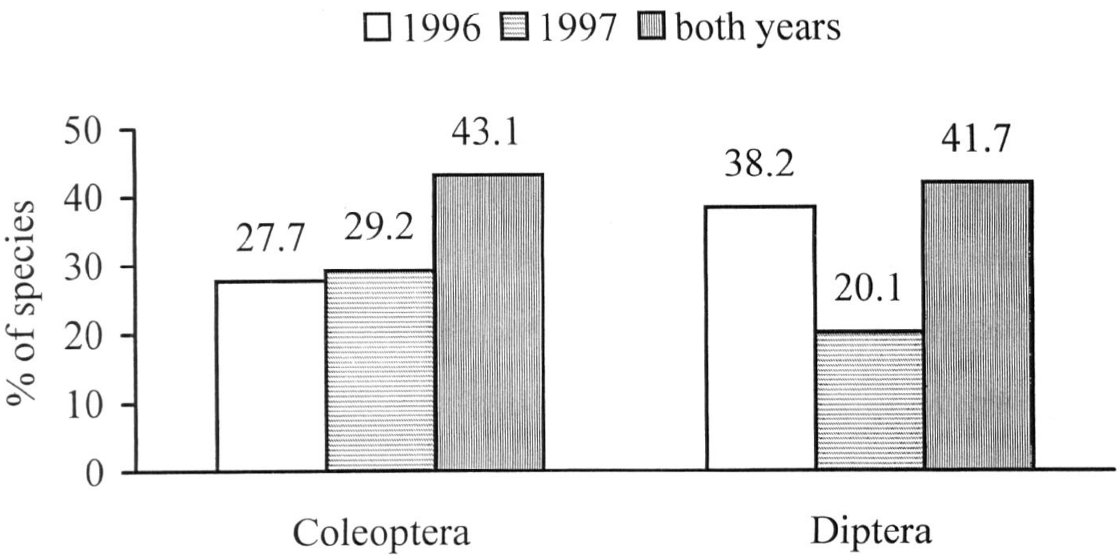


Fig. 4. Percentages of species collected by log eclectors exclusively in 1996, 1997, and in both years.

Spatial variability

When only the samples of half of the trunk-window traps active in 1997 were considered, still > 75 % of all beetle species were recorded (Tab. 2). It was of no relevance whether the number of traps per site or the number of sites was reduced, neither the observed nor the estimated species numbers differed significantly from each other (Mann-Whitney U-test, df =1, p > 0.1 in all cases). We did not use the ACE estimator here, as the collector's curve (cumulative number of species plotted against sampling effort, see below) did not reach an asymptote, making reliable estimation by a nonparametric procedure impossible.

Log eclectors

As the branch eclectors were operated only in 1996, we had to rely on log eclectors for between year comparisons. The collections with interception traps in two consecutive years are temporally independent. In contrast, eclector samples of the second year can only contain species which have already been present in the first year, provided that the trap has not been displaced. Hence, the samples reflect the situation at the time when the trap was installed. Despite this potential limitation, over 20% of the species sampled with log eclectors appeared only in the second sampling year, both in Diptera and in Coleoptera (Fig. 4).

In Coleoptera, 57 (17.4%) and in Diptera 78 (17.7%) species were more abundant in the second than in the first year. Regarding the samples of 1996 and 1997, the relative frequency of three species in Coleoptera and of four species in Diptera was > 5 %.

Estimated species numbers

Given the unusually large collecting effort of this study, one might suspect that further samples would not add a considerable number of species. However, Fig. 5 shows still increasing numbers of species both in Diptera and in Coleoptera when plotting them against sampling effort (collector's curve). The abundance-based

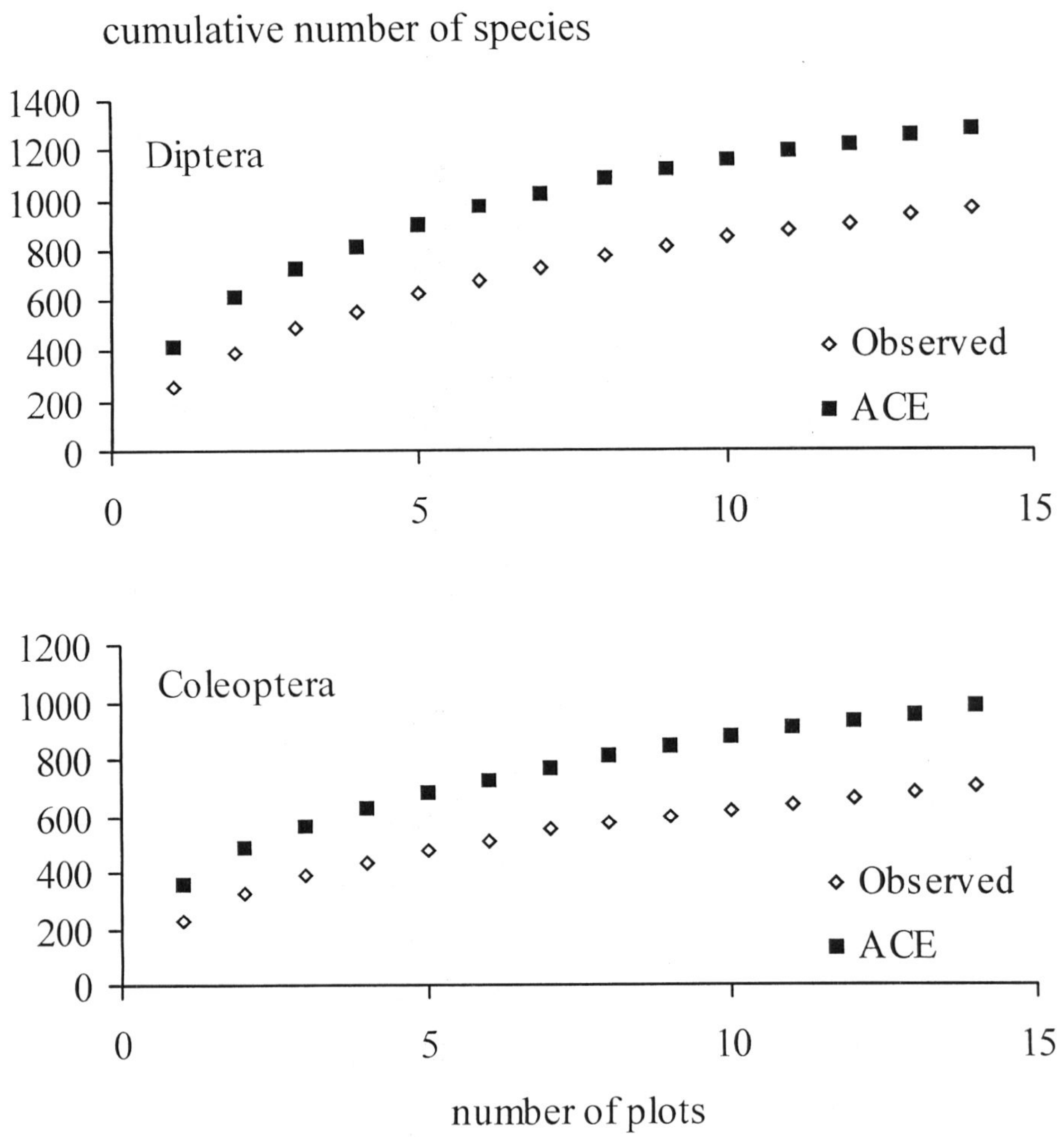
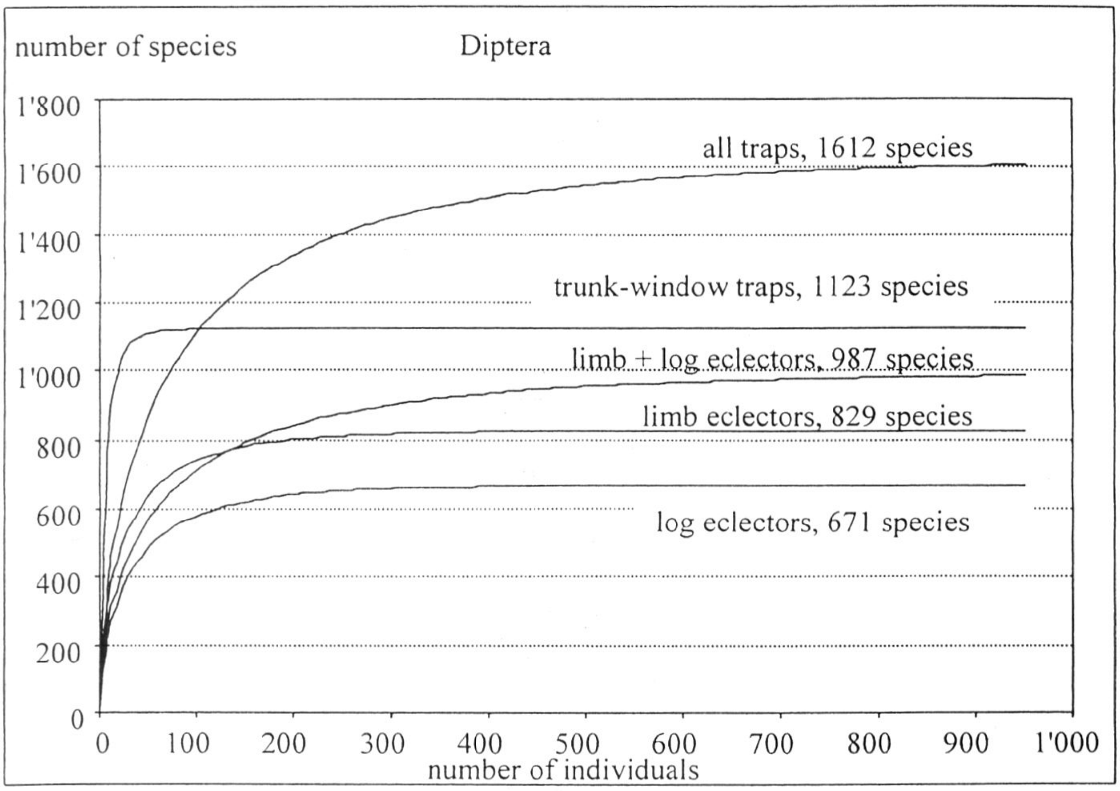


Fig. 5. Cumulative number of species against sampling effort. Data from all traps; both years pooled.

Tab. 3. Observed and estimated numbers of species. All traps pooled, data from 1996 and 1997. S/i = species/individuals function; lognormal = estimate based on truncated lognormal distribution of species abundances; ACE = abundance-based coverage estimator of species richness.

method	**Coleoptera**	**Diptera**
observed	699	953
estimated		
S/i	1370	1612
lognormal	1145	1679
ACE	>983	>1278



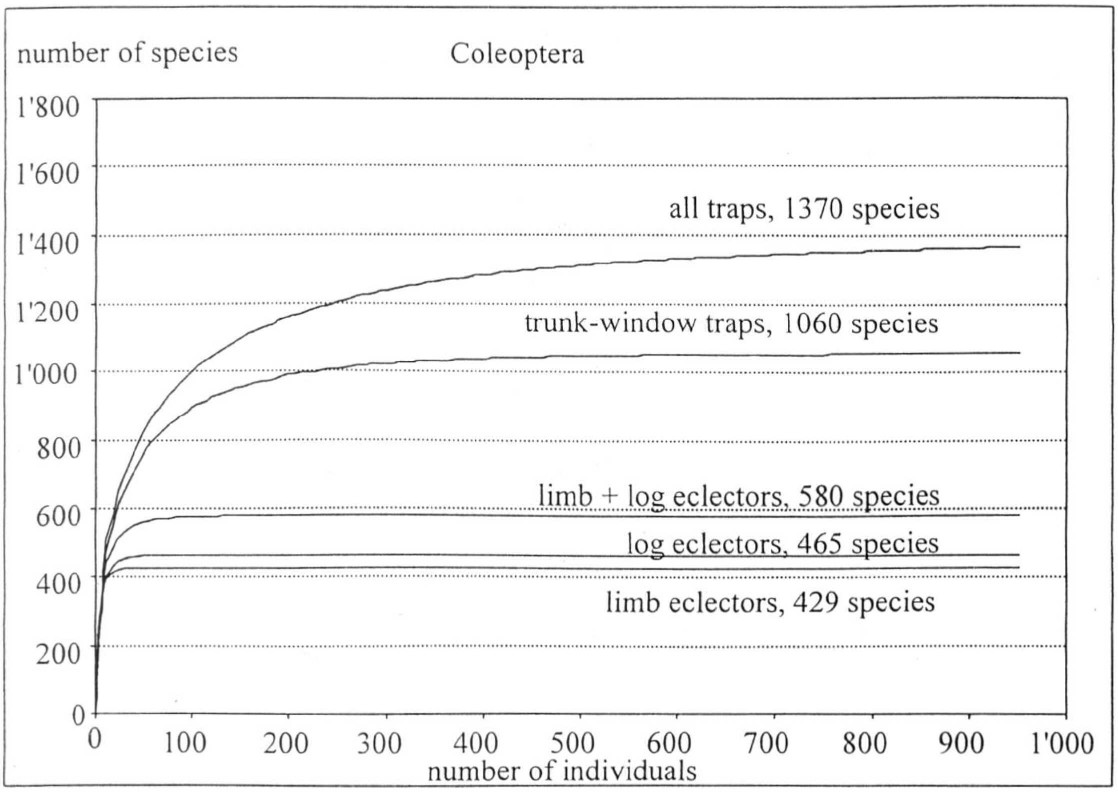


Fig. 6. Extrapolated number of species per number of individuals (x1000) for each trap type. Above: Diptera; below: Coleoptera.

coverage estimator of species richness (ACE) does also not reach an asymptote, indicating that considerably more plots should be sampled to obtain a flattened curve. The species-abundance distribution did not deviate significantly from a truncated lognormal distribution, neither in Coleoptera ($\chi^2 = 9.97$; $p > 0.10$, $df = 7$) nor in Diptera ($\chi^2 = 7.23$; $p > 0.30$; $df = 7$). All three methods for estimating species richness revealed a clear undersampling of at least 39% in Coleoptera and 30% in Diptera (Tab. 3).

Fig. 6 shows the contribution of each trap type to the total estimated species richness. The slope of the curve representing the trunk-window trap samples was steeper than of the curve originating from the eclector samples. This illustrates that more species were collected in low abundances by trunk-window traps. Furthermore, the curve of the trunk-window traps flattens earlier in the dipteran than in the coleopteran data, reflecting the higher species:individuals ratio of the dipteran samples stated earlier.

DISCUSSION

Species new to Switzerland

Most species new to Switzerland belong either to Ceratopogonidae or Sciaridae. Both groups have received little attention in Switzerland and are therefore only poorly known (MENZEL, 1998; SZADZIEWSKI, 1998). Some species of other families are common in neighbouring countries and could be expected to occur also in Switzerland (*Oedalea holmgreni* ZETTERSTEDT, 1852; *Hemerodromia unilineata* ZETTERSTEDT, 1842; *Phaonia mystica* (MEIGEN, 1826)). Others are rare and only known from other parts of Europe (*Euthyneura halidayi* COLLIN, 1926; *Oedalea oriunda* COLLIN, 1961; *Rhamphomyia obscuripennis* MEIGEN, 1830). The large number of dipteran species new to the Swiss fauna illustrates the sparse knowledge of this group, particularly of species associated with forested habitats.

Trapping efficiency

Trunk-window traps yielded more species both in Diptera and in Coleoptera than eclectors. Beetles were present in much larger numbers in the trunk-window traps than Diptera (20'970 versus 5'129), which was mainly due to the frequent occurrence of *Xyleborus dispar* (FABRICIUS, 1792) and *Atomaria diluta* ERICHSON, 1846. Just the opposite relation was found in the eclectors, where Diptera were more abundant than Coleoptera (8'720 versus 55'818). As all interception traps, trunk-window traps measure flight activities of the species present in the area (HAMMOND, 1997). Hence, the collections are biased towards active flyers and also contain species which accidentally cross the area. The species-abundance distributions in samples gathered by eclectors in the first year are more likely to reflect the real patterns, but the species collected originate solely from the substrates enclosed. Thus, eclectors provide specific samples of high information quality, but interception traps give a better impression about the species present in an area. Further advantages and limitations of both trap types are discussed in ALBRECHT (1990), SCHMITT (1992), KAILA (1993), RAUH (1993), ØKLAND (1996), and HAMMOND (1997).

Interpretation of eclector samples

The collecting strategy of eclectors is based on the assumption that emerging insects are attracted by the light originating from the collecting boxes. Our data provide evidence that some species behave differently: First, we found > 20 % of all species only in the second year, both in Diptera and in Coleoptera, and for at least some of these species we know that their larval phase lasts less than one year (e.g., most Diptera). Second, 17 % of all species were more abundant in the second year than in the first, indicating that they may have been reproducing in the trap. We cannot exclude that some species may have entered the trap through openings created by mice, but we consider their quantity as negligible. It is possible that the attractivity of the light source within the trap is lowered for species which do not intend to disperse. Whether insects undertake migrational or trivial flights depends on intrinsic, as well as external factors such as photoperiod, ambient temperature and humidity, and varies between species and even within populations (RANKIN & BURCHSTED, 1992). Some saproxylic species of Ptilidae, for instance, produce wingless generations after successful colonisation of dead wood forming an inbreeding 'multiplication phase'. Winged adults appear only when the dead wood deteriorates forcing the population to find a new substrate (HAMILTON, 1978). Additionally, the microclimate within the trap is warmer and dryer than outside, so some species may adapt their dispersal strategy to the altered conditions. Another confounding factor is the postponed dispersal of species, where only a part of a population emerges in a particular year. This strategy helps to minimise the risk that entire populations are wiped out in case of harsh weather conditions (JOHNSON, 1969). The composition of the communities and phenological aspects must therefore be interpreted carefully when samples originate from eclectors. But despite these limitations, the following conclusions can be drawn here: first, species that were collected only in the first year must be predominantly those that intended to migrate before oviposition, and their larval phase lasts one year or less; second, species that occurred only in the second year must have passed a larval phase lasting at least two years, and they also tended to migrate before reproduction; finally, the larval phase of the species that were markedly more abundant in the second year than in the first, must be one year or less, and they tended to reproduce without or before migration.

How many species are there?

Our study demonstrates that even with our unusually large collecting effort, only a portion of the spectrum of species has been sampled. Ecological investigations implicitly assume that a representative sample of the community in focus has been obtained. Especially when the species are grouped into guilds, they should be represented in frequencies reflecting the conditions in the study area. Unfortunately, this basic assumption has never been tested, as this would require a nearly fully sampled community, which is almost impossible to achieve. Optimising the collecting strategies and developing statistical models to scale up the relations found in the samples are the only ways to gain an adequate insight into the communities of interest. Several authors elaborated methods for standardized sampling (e. g., ALBRECHT, 1990; DUELLI, 1997) providing a basis for comparing the results of different investigations, as well as reducing sampling effort without considerable loss of information. However, it depends on the habitat, which sampling strategy must be considered as optimal. Often, a trade-off has to be made whether to force spatial (= number of collecting sites) or temporal (= length of collecting periods) aspects of the study to obtain a maximum number of species. In our study, we observed high species turnover between the two sampling years, as for instance 44.2 % of all dipteran species collected by trunk-window traps were found only in 1996. On the other hand, a reduction in the number of traps of 50 % in one year resulted in the loss of about 25 % of the species, irrespective of whether the number of traps per site or the number of sites was reduced. The same held true for estimations of total species richness, whether being done by applying the truncated lognormal distribution model or the extrapolation by rarefaction curves. Thus, the effect of between year variability was larger than of spatial heterogeneity. As we selected our study plots to be as similar to each other with regard to exposition, as well as stand structure and age, this result could be expected. Up to 66 % of the species were collected exclusively by one trap type, underlining that it is indispensable to combine several collecting methods to obtain a sample of the community appropriate to answer the questions of a study. We suspect that the use of additional trap types such as yellow water pans or malaise tents would still lead to a considerable increase of the species recorded.

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ZUSAMMENFASSUNG

Wir analysierten einen umfassenden Datensatz von 953 Dipteren- und 699 Käferarten, die mit Eklektoren und Fensterfallen im Naturwaldreservat Sihlwald (Kt. Zürich, Schweiz) in den Jahren 1996 und 1997 gefangen wurden. In den Proben fanden sich 186 Dipterenarten, die zum ersten Mal in der Schweiz nachgewiesen wurden, sowie zusätzlich rund 20 Dipterenarten, die neu für die Wissenschaft sind. Die Fangresultate waren mehr von zeitlicher als von räumlicher Variabilität beeinflusst. Trotz des ungewöhnlich hohen Fangaufwandes lassen verschiedene Methoden zur Schätzung der totalen Artenzahl über 30 % mehr Arten im Sihlwald erwarten.

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APPENDIX: SPECIES OF DIPTERA NEW TO SWITZERLAND

Limoniidae
Ormosia rostrifera SAVCHENKO, 1973
Psychodidae
Feuerborniella obscura (TONNOIR, 1919)
Mormia nigripennis KREK, 1971
Psychoda brevicornis TONNOIR, 1940
Psychoda crassipennis TONNOIR, 1940
Psychoda lobata TONNOIR, 1940
Satchelliella palustris (MEIGEN,1818)
Sycorax feuerborni JUNG, 1954
Ceratopogonidae
Atrichopogon fuscus (MEIGEN, 1804)
Atrichopogon setosipennis (KIEFFER, 1911)
Bezzia fuliginata CLASTRIER, 1962
Brachypogon babiogorensis SZADZIESKI, 1994
Brachypogon fagicola (DELÉCOLLE, 1999)
Brachypogon hudjakovi (REMM, 1974)
Brachypogon nitidulus (EDWARDS, 1921)
Ceratoculicoides havelkai WIRTH & GROGAN, 1988
Ceratoculicoides tontoeguri (HAVELKA, 1980)
Ceratopogon grandiforceps (KIEFFER, 1913)
Culicoides achrayi Kettle & LAWSON, 1955
Culicoides cameroni CAMPELL & PELHAM-CLINTON, 1960
Culicoides dewulfi GOETGHEBUER, 1936
Culicoides pseudoheliophilus CALLOT & KREMER 1961
Dasyhelea flaviventris (GOETGHEBUER, 1910)
Dasyhelea malleola REMM, 1962
Dasyhelea pallidiventris (GOETGHEBUER, 1931)
Dasyhelea paludicola KIEFFER, 1925
Dasyhelea saxicola (EDWARDS, 1929)
Forcipomyia acanthophora REMM, 1976
Forcipomyia borealis REMM, 1966
Forcipomyia ciliata (WINNERTZ, 1852)
Forcipomyia eques (JOHANNSEN, 1908)
Forcipomyia picea (WINNERTZ, 1852)
Forcipomyia tenuisquama KIEFFER, 1924
Forcipomyia tibialis REMM, 1961
Forcipomyia titillans (WINNERTZ, 1852)
Kolenohelea calcarata (GOETGHEBUER, 1920)
Palpomyia brachialis (HALIDAY, 1833)
Palpomyia distincta (HALIDAY, 1833)
Palpomyia lineata (MEIGEN, 1804)
Mycetophilidae
Allodia pyxidiiformis ZAITZEV, 1983
Allodia retracta PLASSMANN, 1977
Coelosia silvatica LANDROCK, 1918
Mycomyopsis trilineata (ZETTERSTEDT, 1838)
Neomycomya fimbriata (MEIGEN, 1818)
Sciaridae
Bradysia affinis (ZETTERSTEDT, 1838)
Bradysia fenestralis (ZETTERSTEDT, 1838)
Bradysia giraudii (SCHINER, 1864)
Bradysia hilaris (WINNERTZ, 1867)
Bradysia lobulifera FREY, 1948
Bradysia longicauda MOHRIG & MENZEL, 1990
Bradysia lucida MOHRIG & MAMAEV, 1989
Bradysia nervosa(MEIGEN, 1818)
Bradysia quadrispina MOHRIG & KRIVOSHEINA, 1982
Sciaridae (continued)
Bradysia subaprica MOHRIG & KRIVOSHEINA, 1989
Caenosciara alnicola TUOMIKOSKI, 1957
Caenosciara lucifuga MOHRIG, 1970
Camptochaeta dentata (BUKOWSKI & LENGERSDORF, 1936)
Camptochaeta minutula (MOHRIG & KRIVOSHEINA, 1978)
Camptochaeta praedentata (MOHRIG & MAMAEV, 1987)
Corynoptera brevichaeta MOHRIG & ANTONOVA, 1978
Corynoptera heteroclausa RUDZINSKI, 1991
Corynoptera saetistyla MOHRIG & KRIVOSHEINA, 1985
Corynoptera sphenoptera TUOMIKOSKI, 1960
Corynoptera tetrachaeta TUOMIKOSKI, 1960
Corynoptera trispina TUOMIKOSKI, 1960
Cratyna egertoni (EDWARDS, 1922)
Cratyna pernitida (EDWARDS, 1915)
Cratyna perplexa (WINNERTZ, 1867)
Dolichosciara flavipes (MEIGEN, 1804)
Dolichosciara ornata (EDWARDS, 1915)
Dolichosciara subflavipes (MOHRIG & MENZEL, 1994)
Epidapus schillei (BÖRNER, 1903)
Leptosciarella confusa MENZEL & MOHRIG, 1997
Leptosciarella fuscipalpa (MOHRIG & MAMAEV, 1979)
Leptosciarella melanoma MOHRIG & MENZEL, 1990
Leptosciarella viatica (WINNERTZ, 1867)
Leptosciarella yerburyi FREEMAN, 1983
Lycoriella brevipila TUOMIKOSKI, 1960
Lycoriella eflagellata TUOMIKOSKI, 1960
Lycoriella mali (FITCH, 1856)
Lycoriella micria MOHRIG & MENZEL, 1990
Lycoriella minutula (BUKOWSKI & LENGERSDORF, 1936)
Scatopsciara fluviatiliformis MOHRIG & MAMAEV, 1987
Scatopsciara longispina MOHRIG & KRIVOSHEINA, 1989
Trichodapus rhenanus (FRITZ, 1983)
Trichosia flavicoxa TUOMIKOSKI, 1960
Trichosia pulchricornis (EDWARDS, 1925)
Trichosia trochanterata (ZETTERSTEDT, 1851)
Xylosciara heptacantha TUOMIKOSKI, 1957
Hybotidae
Anthalia schoenherri ZETTERSTEDT, 1838
Euthyneura halidayi COLLIN, 1926
Oedalea holmgreni ZETTERSTEDT, 1852
Oedalea oriunda COLLIN, 1961
Empididae
Hemerodromia unilineata ZETTERSTEDT, 1842
Hilara abominalis ZETTERSTEDT, 1838
Hilara hirtipes COLLIN, 1927
Hilara implicata COLLIN, 1927
Rhamphomyia obscuripennis MEIGEN, 1830
Dolichopodidae
Rhaphium ensicorne MEIGEN, 1824
Rhaphium xiphias MEIGEN, 1824
Teuchophorus nigricosta (VON ROSER, 1840)
Anthomyiidae
Eutrichota frigida (ZETTERSTEDT, 1845)
Mycophaga testacea GIMMERTHAL, 1834)
Muscidae
Phaonia apicalis STEIN, 1914
Phaonia mystica (MEIGEN, 1826)