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A COMPOSITE INTERCEPTION TRAP FOR SAMPLING ARTHROPODS IN TREE CANOPIES

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Abstract

A new design of interception trap is presented based on a combination of features of window and Malaise traps. The trap has been developed for study of the canopy faunas of rainforest trees, specifically *Argyrodendron actinophyllum*. Five such traps have been operated in SE Queensland for a year with catches being removed weekly. Coleoptera, Nematocera, Homoptera and Hymenoptera were the most abundant groups in these samples with the families Sciaridae, Cicadellidae, Scolytidae and Chrysomelidae dominating the collections. The trap appears to sample the arboreal fauna selectively and was used to identify the peak of arthropod abundance during the year.

Introduction

Arboreal arthropods are usually sampled in rainforests using light traps (Ricklefs 1975; Sutton and Hudson 1980) or canopy fogging (Erwin 1983; Stork 1987). However the limitations of light traps are well known (Bowden 1982): information is gained on night-flyers only; the attractiveness of the trap varies from one taxon to another; correction factors must be computed for the effect of temperature, moonlight and cloud cover; the catches are directly related to the trap illumination and to the background illumination. This last point is particularly important when the sampling program is concerned with the host specificity of the specimens collected. Light traps operated in the rainforest canopy under different background illuminations are indeed likely to attract insects from a wide range of host trees and vines. The comparison and the interpretation of the qualitative and quantitative data would be difficult in such conditions.

This paper describes a simple and inexpensive interception trap which overcomes most of the problems cited above. The temporal distribution of canopy arthropods associated with the rainforest tree, *Argyrodendron actinophyllum*, was appraised during a first year of continuous trapping with 5 such traps.

Materials and methods

The study site was situated in a region of subtropical rainforest (complex notophyll vine forest) near Mt Glorious (27°19′S, 152°45′E, 700 m), some 30 kms NW of Brisbane, Qld. *Argyrodendron actinophyllum* Edlin (Sterculiaceae) is a canopy tree which is common on the site and often reaches 40 m in height in subtropical rainforests. Young (1985: group 9) provides a detailed description of the floristic data in the study area.

Five traps were placed in 5 different *A. actinophyllum* trees free of vines and several hundreds of metres distant from each other. The traps were positioned at mid-level in the heart of the crowns, at about 25 m above the forest floor, in February 1986. Each trap was surveyed weekly, on the same day, using the single rope technique described by Perry (1978). The fixed position of the trap minimised problems related to changes in trap orientation (and the consequent differences in catches) during this long-term study.

The interception trap developed in this project is a composite trap which consists of 2 sub-units (Fig. 1). The top sub-unit is a small Malaise trap similar to the model of Townes (1972), previously tested in a survey of the arboreal fauna associated with *Pinus mugo* in Europe (Basset 1985 a and b). The profile area is 0.35 m^2. A recent review of the use of Malaise traps in entomology is given by Haenni and Matthey (1984). The bottom sub-unit is a window trap derived from the design of Wilkening *et al.* (1981), with a collecting surface of 0.14 m^2. Arthropods either fly or crawl up into the collector of the Malaise trap or impact against the plexiglass panels, falling into the collector of the window trap. Both collectors were filled with a collecting fluid (ethylene glycol 20%), which is neither an attractant nor a repellant and has a low evaporation coefficient. A commercial killing agent ("Shelltox Ministrip") in the collectors was replaced at 3-week intervals. The collected material was stored in 70% alcohol and sorted into families or Recognisable Taxonomic Units (RTU's). Sorting is still in progress.

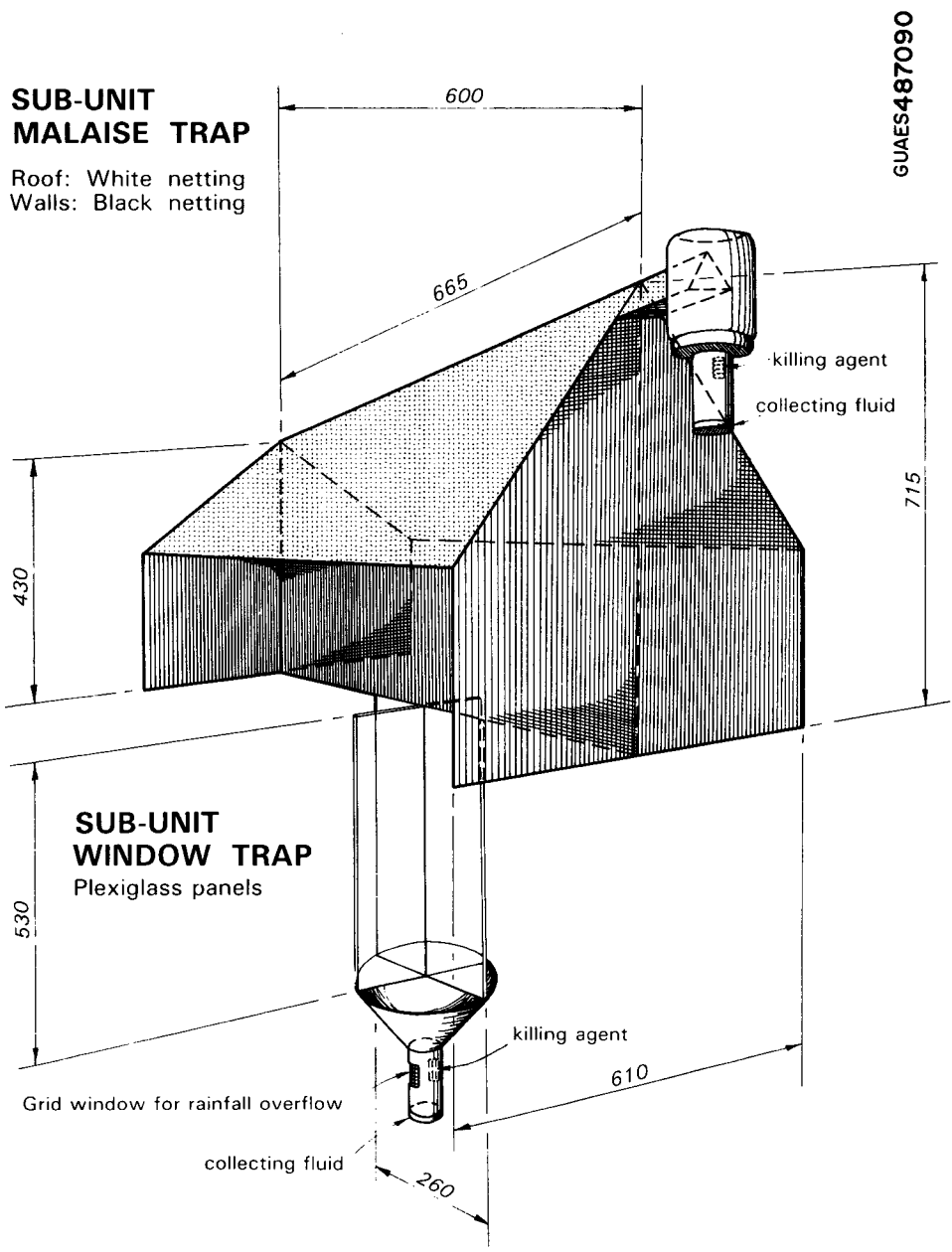
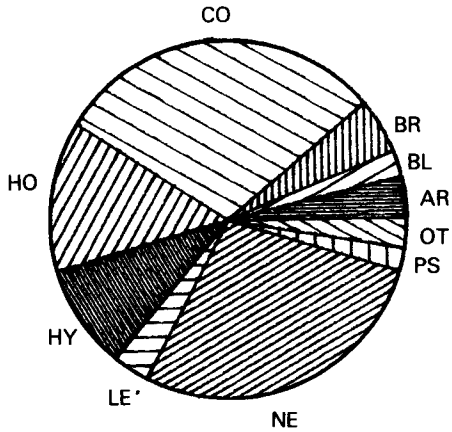


FIG. 1—Diagram of the interception trap. Dimensions in mm.

Results

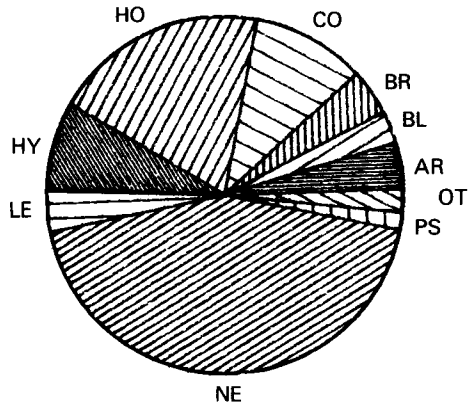
Qualitative results

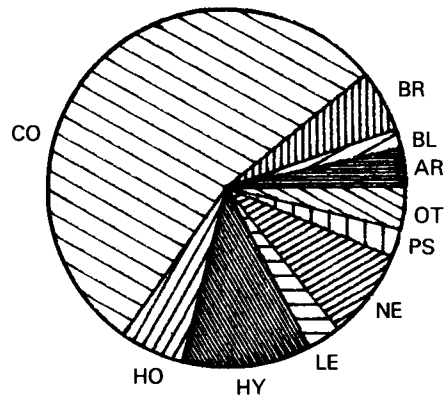
Some 24,758 specimens were collected by the 5 traps during this first year of continuous trapping. When swarming conditions occurred (alate ants, bark beetles, etc.) a maximum score of 100 individuals per trap was allocated to the RTU concerned, in order to standardise the data for subsequent statistical analysis. Nineteen different arthropod orders of 120 families were identified. Mites and springtails were disregarded. The distribution of the most common orders and families is shown in Figs 2 and 3.



AR	ARANEAE	3.67 ± 0.388%
BL	BLATTODEA	2.32 ± 0.488
BR	BRACHYCERA	4.96 ± 0.911
CO	COLEOPTERA	29.82 ± 3.620
HO	HOMOPTERA	13.50 ± 1.738
HY	HYMENOPTERA	9.58 ± 1.260
LE	LEPIDOPTERA	3.36 ± 0.351
NE	NEMATOCERA	28.06 ± 2.107
PS	PSOCOPTERA	2.03 ± 0.449
OT	OTHERS	2.70
	HETEROPTERA	1.11 ± 0.191
	ORTHOPTERA	0.56 ± 0.086
	NEUROPTERA	0.45 ± 0.094
	THYSANOPTERA	0.27 ± 0.088
	ISOPTERA	0.23 ± 0.080
	DIPLOPODA	
	MANTODEA	
	DERMAPTERA	
	PSEUDOSCORPIONES	

INTERCEPTION TRAPS (n = 5)
24,758 specimens collected





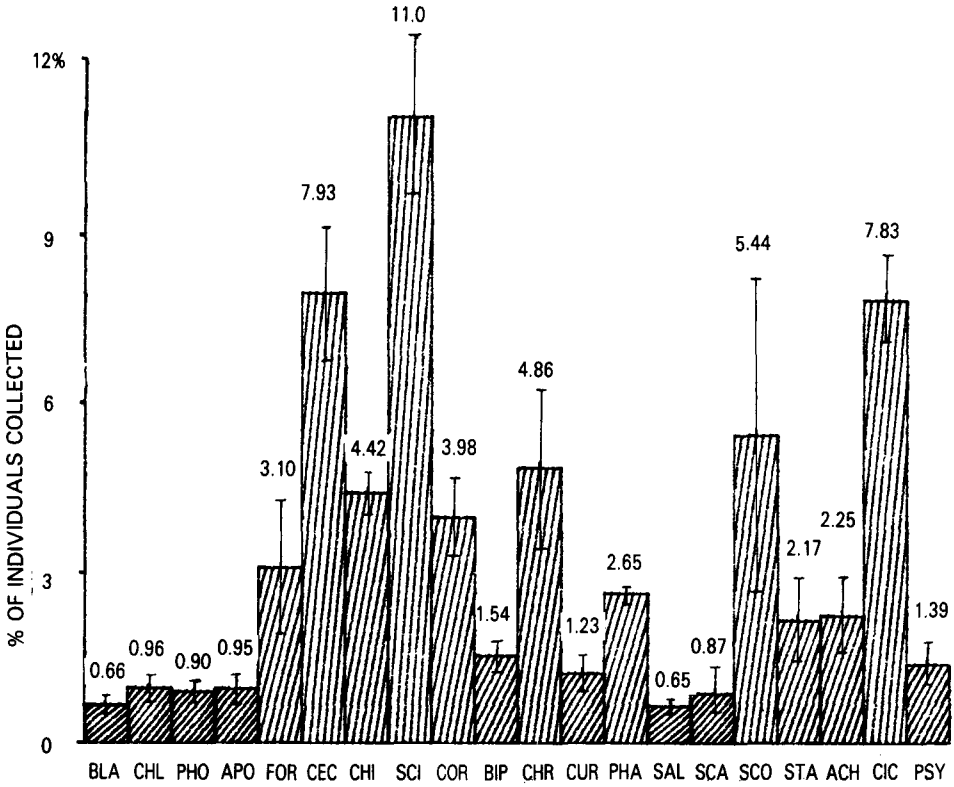
SUB-UNITS MALAISE TRAP (n = 5)
14,597 specimens collected

AR	4.15 ± 0.708%
BL	2.90 ± 0.700
BR	4.18 ± 0.274
CO	10.26 ± 2.040
HO	19.49 ± 1.602
HY	8.08 ± 1.100
LE	3.69 ± 0.400
NE	43.63 ± 2.420
PS	1.56 ± 0.441
OT	2.06

SUB-UNITS WINDOW TRAP (n = 5)
10,161 specimens collected

AR	3.44 ± 0.418%
BL	1.70 ± 0.313
BR	5.59 ± 0.960
CO	54.36 ± 4.330
HO	5.86 ± 1.265
HY	11.66 ± 1.296
LE	3.01 ± 0.428
NE	8.06 ± 1.081
PS	2.53 ± 0.500
OT	3.79

FIG. 2—Distribution of individuals by order in five interception traps and their Malaise and window sub-units. From one year of continuous trapping in the crowns of *Argyrodendron actinophyllum* (means and s.e.).



BLA	BLA.	BLATTELLIDAE	CHR	COL.	CHRYSOMELIDAE
CHL	BRA.	CHLOROPIDAE	CUR	COL.	CURCULIONIDAE
PHO	BRA.	PHORIDAE	PHA	COL.	PHALACRIDAE
APO	HYM.	APOIDEA	SAL	COL.	SALPINGIDAE
FOR	HYM.	FORMICIDAE	SCA	COL.	SCARABAEIDAE
CEC	NEM.	CECIDOMYIIDAE	SCO	COL.	SCOLYTIDAE
CHI	NEM.	CHIRONOMIDAE	STA	COL.	STAPHYLINIDAE
SCI	NEM.	SCIARIDAE	ACH	HOM.	ACHILIDAE
COR	COL.	CORYLOPHIDAE	CIC	HOM.	CICADELLIDAE
BIP	COL.	BIPHYLLIDAE	PSY	HOM.	PSYLLIDAE

FIG. 3—The 20 most common insect families as collected with interception traps in the crowns of *Argyrodendron actinophyllum* during a year of continuous trapping (means and s.e.).

Malaise traps have often been used in rainforest at ground level, where they usually sampled a lower proportion of beetles than in this study (e.g. 4.6%: Geijskes 1968; 2.1%: Frith and Frith 1985). The value of 10% recorded here (Fig. 2) may suggest a notably higher density of beetle activity in the canopy, particularly for families Scolytidae and Chrysomelidae. Sutton and Hudson (1980) reported a marked concentration of flying beetles, especially Staphylinidae and Scolytidae, in the upper levels of a rainforest in Zaire.

The qualitative differences in the trap effectiveness (*sensu* Bowden 1982) between the 2 sub-units of the trap are shown in Fig. 4. Most insect families were not captured equally by the 2 sub-units. Each taxon reacts differently to the 2 collecting devices. These results emphasise again the need for different sampling techniques when surveying the arboreal community (Basset 1985a). The bias introduced by sampling techniques (Frith and Frith 1985) can be reduced by using composite methods such as the interception traps described in this study.

Occurrence of wingless species

Eleven percent of the collected material in the traps consisted of wingless species. The catches included juveniles of 10 different orders plus adults of spiders and ants. All traps were set in a situation where the surrounding foliage was sparse, in order to allow a better comparison among the data from each trap. However the ropes employed to secure the traps may have been used as bridges, particularly to the Malaise unit, by nomadic crawling species. Herbivores such as caterpillars spend considerable energy in movement in order to locate the most suitable leaves for feeding (Schultz 1983) and therefore may be captured in the interception traps (0.4% of the total catches in this study).

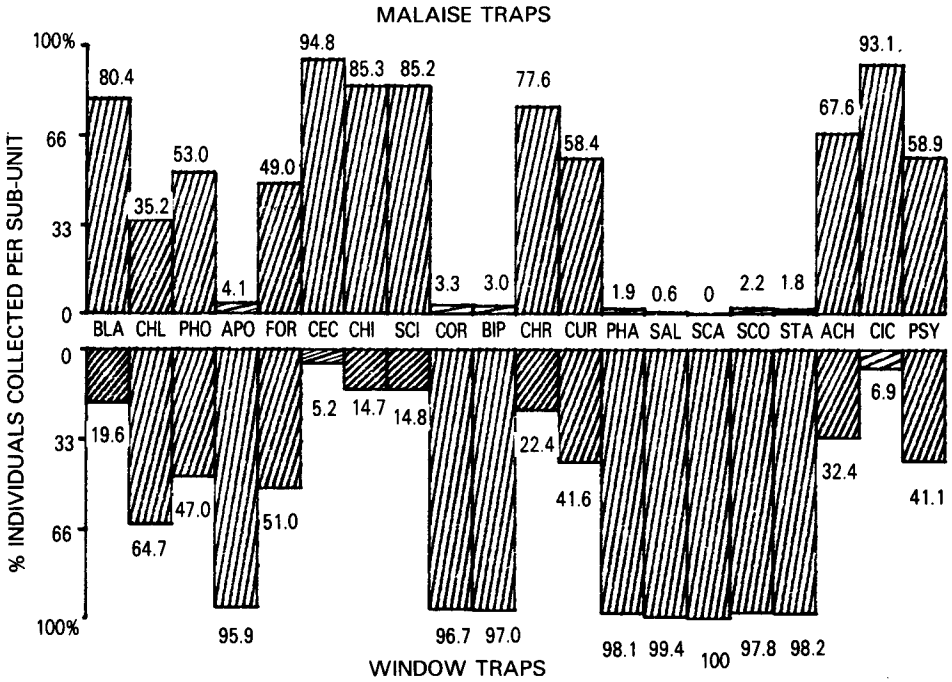


FIG. 4—Qualitative differences in the trap effectiveness between the 2 sub-units of the interception trap. Data from the 5 traps have been pooled over a year of continuous trapping in the crowns of *Argyrodendron actinophyllum*. Codes as in Fig. 3.

Trap selectivity

The collection of "incidental" species (*sensu* Nielsen 1975) flying among the tree crowns is unavoidable. However the interception traps appear to sample selectively the fauna which lives upon this rainforest tree or exploits some of its habitats. The high selectivity of the traps during the sampling year is supported by the following observations.

Firstly, incidental psyllid species on *A. actinophyllum* (K. L. Taylor, pers. comm.) accounted for less than 3.5% of all the psyllids collected by the traps (341 specimens caught). Psyllids are usually highly host specific within rainforest trees (Hodkinson 1984).

Secondly, with few exceptions, the most common RTU's collected upon the foliage of this tree by restricted canopy fogging were also collected by the interception traps (unpub. data). An estimation of the trap efficiency (*sensu* Bowden 1982) was provided by cross-checking the data from both collecting methods. Agreement was found to be particularly good for chewers and sap suckers. In these groups the dominant RTU's as collected by fogging were well represented—if not dominant—in the trap collections. However spiders, thrips and the immature stages of several groups were largely under-represented in the trap catches, as compared with the collections obtained by fogging (unpub. data).

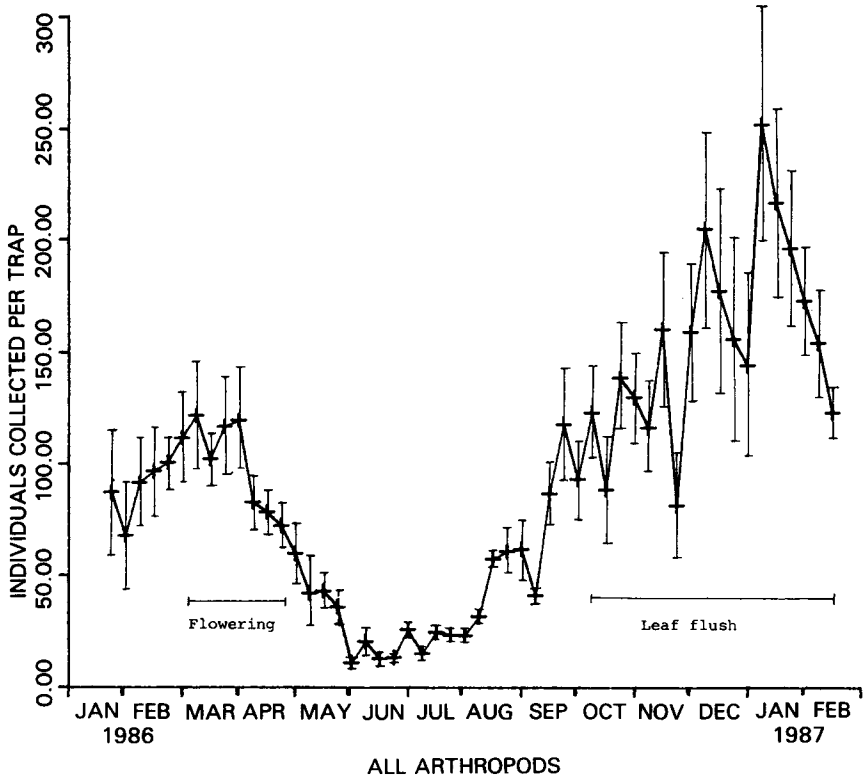


FIG. 5—Overall distribution of the arthropods collected in the crowns of *Argyrodendron actinophyllum* with 5 interception traps (means and s.e.) over a year of continuous trapping, with the number of individuals caught per trap and per week.

Temporal distributions

The composite make-up of the trap enables collection of a wide range of arthropods of different life habits and behaviours. Therefore the study of the temporal distribution of these arthropods is likely to be more realistic than if the collections were made using conventional methods. For the sampled year a marked seasonality of arthropod abundance was recorded in the crowns of *A. actinophyllum* (Fig. 5), with a minimum at the end of June 1986 (55 specimens collected by the 5 traps within a week) and a maximum in January 1987 (1,293 individuals collected in a week). Apparently 2 peaks of arthropod abundance existed. The main peak coincided with the active growth period of leaves of the host tree and a smaller peak occurred at the beginning of the flowering period. Phenologies of the arboreal guilds and species concerned will be presented elsewhere.

Discussion

The advantages of this form of interception trap include: continuous trapping, day and night; localised interception of the arthropods, whether flying or crawling within the tree crown or flying across the crown; a wide range of arthropods is trapped; the traps are inexpensive (costing less than A$50.00 each) and, once in place, they require little attention. On the other hand long-term studies expose the traps to mechanical damage by wind. Another limitation is the low trap effectiveness, related to the small collecting area, and hence, sometimes, low numbers of arthropods collected with concomitant problems in statistical analysis. A solution may be to increase the collecting area or the number of traps. However, the low figures provided by the interception traps are counterbalanced by their selectivity. Species collected by such traps are likely to be the most common among active species present. Rare active species or sedentary species are likely to be poorly represented.

Although interception traps provide a measure of relative abundance, primarily they provide a measure of flight or crawling activity. When the phenology of the species is of concern, it must be emphasised that flight activity could be very different across taxa if their minimal temperature threshold for flight is different. Thus the data must be interpreted cautiously, although this effect is probably reduced when considering large numbers of many species over long term periods of time.

Interception traps such as those used in this study can be used profitably in conjunction with canopy fogging to gain information about the taxonomy, life history, temporal distribution and host specificity of some rainforest arboreal arthropods.

Acknowledgments

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