# BIOLOGIE D'UNE CANOPÉE DE FORÊT ÉQUATORIALE - II

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# INSECT SAMPLING IN FOREST CANOPIES : A NEW METHOD

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## ABSTRACT

A new technique for sampling insects in tree canopies is described. "Sled sweeping" provides replicated estimates of relative insect abundance in tree canopies in a homogeneous fashion, and can be replicated over many trees in rapid succession. Its use will enable accurate estimates of insect distribution and abundance in tropical forests, as well as a measure of variability of insect abundance among tree canopies.

The diversity of insects in tropical forest canopies is currently the subject of intense debate and interest (reviewed by WILSON 1989). Estimates of the numbers of organisms on earth, conservatively estimated at 1-3 million during the last decade (SOUTHWOOD 1978a, STRONG et al. 1984), have skyrocketed up to 10 million (WILSON 1989) and even as high as 30 million with ERWIN's fogging studies in neotropical rain forests (ERWIN 1982, 1991). But these high estimates have been critisized, since they are extrapolations from a relatively small number of tree canopies (GASTON 1991). The limitations of most sampling techniques in tree canopies make it difficult - nearly impossible - to quantify accurately the distribution and diversity of invertebrates in rain forests (rev. in SOUTHWOOD 1978b, LOWMAN 1984, ERWIN 1989).

One of the major problems is the obvious logistic difficulty associated with access into tree canopies (reviewed in MITCHELL 1986, WILSON 1991). During the last decade, several new and innovative techniques have been employed :

1) Canopy fogging, whereby a non persistent insecticide mist is sprayed throughout a column of forest from an apparatus hoisted up into the canopy. Insects fall into sheets or other collecting devices on the forest floor (ERWIN 1983, STORK 1991, KITCHING & LOWMAN, unpublished data).

2) Technical climbing hardware and ropes that enable vertical access to different levels of foliage (e.g. PERRY 1978, NADKARNI 1984, LOWMAN 1984).

3) Canopy walkways, offering permanent access to sections of understory canopy (e.g. WINT 1983).

4) Canopy raft or RADEAU DES CIMES, powered by a dirigible, that can be placed temporarily atop the canopy for access to foliage around the edges of the structure (HALLÉ 1989).

All of these methods have obvious limitations for ecological sampling of insects, as summarized in Table 1.

During the 1991 expedition of OPERATION CANOPEES in the equatorial rain forests of the Biafran-Congo basin, Cameroon, a new insect

sampling technique was designed to overcome some of the limitations of other methods. We collected replicated samples of insects from the uppermost foliage of canopy trees, a level virtually inaccessible with fogging or other methods. We used a newly-constructed canopy sled, a portable triangular raft (9m x 9m x 9m) that was capable of "sailing" atop the rain forest canopy, maneuvered by the dirigible. In a fashion similar to fishing-boats trawling with nets in shallow waters, we conducted sweep netting along a transect from the sled at 5-minute intervals over one hour, at 35-45 m in the uppermost foliage. Each sample, collectively comprising 10 full sweeps from one tree canopy, was immediately emptied into a plastic bag. The net was sprayed lightly with a knockdown nonpersistent insecticide (Prentex, active ingredient 3% Resmethrin) to allow easy transfer of insects out of the nets. An improved net, with multiple clip-off nets to allow fast and accurate sampling, is being designed for future sled sweeping.

The new technique of "sled sweeping" offers ecologists an opportunity to conduct statistically valid, repeated samples of foliage insects from the uppermost rain forest canopy, a region not previously accessible, and certainly not within reach of any other mode of rapid, replicable sampling technique. At present, the data from tropical tree canopies have been limited to a few tree canopies in a few sites because fogging is so labor-intensive and samples only one canopy per day. The sleds can be used to undertake comparative studies of insects between many different canopies within one day. The construction of portable sleds is less expensive than the original raft structure.

During the Cameroon expedition, we collected sweep-net samples from 23 tree canopies over a 2-day period. The total number of insects ranged from 2-32 individuals per sample (i.e. per tree canopy), suggesting that insect distribution in tropical forests is more patchy than originally predicted from fogging results. The densities of insects appeared to coincide with phenological events (e.g. flowers, leafing). If this is the case, then ERWIN's extrapolations of biodiversity may be slightly overestimated since trees may not all harbor high insect diversity during one time period. Rather, guilds of insects may shift between tree crowns depending upon phenological events of the foliage and flowers.

Further sampling is planned to examine the hypothesis that insect distribution in tropical forest tree canopies is patchy and to quantify the variability of insect densities in tree crowns. The contents of the African sweeps are awaiting further taxonomic analyses as part of more comprehensive studies on rain forest canopy insects and herbivory in Cameroon (LOWMAN, MOFFETT and RINKER unpublished data).

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| METHOD | ADVANTAGES | DISADVANTAGES |
|---|---|---|
| Single rope techniques | Access to different canopy heights<br>Shifts easily between trees and sites<br>Easy to operate alone or in pairs<br>Easy to replicate between canopies<br>Relatively inexpensive | No access to uppermost canopy<br>Requires time and effort to climb<br>Only 1 researcher can climb at once<br>Requires skill to operate safely |
| Walkways | Permanent structure<br>Permanent access to specific trees<br>Can work at night and in bad weather<br>Can be expanded as time and funds allow<br>Allows collaborative work<br>Moderately inexpensive | Can not be moved to new sites<br>Can not reach more than 5-8 trees (in most cases)<br>No access to uppermost canopy<br>Expansion limited to available strong trees<br>Can result in over-use of adjacent trees |
| Canopy cranes | Permanent access to different trees<br>Easy to replicate between trees<br>Allows collaborative work | Can not reach far beyond length of the boom<br>Access to lower canopy may be impeded (by density of upper crown)<br>Limited number of workers at one time (3)<br>Expensive to own and maintain |
| Raft/Sled inflatables | Allows replicated, quantified sampling<br>Access to uppermost canopy<br>Allows collaborative work<br>Minimal damage to sites<br>Can sample in many crowns over short duration | Not functional in bad weather<br>Good access to lower canopy levels w/ropes<br>Only 3-6 researcher in the canopy at one time<br>Site selection important (to minimize damage to inflatables)<br>Short duration of "flights"<br>Expensive to own and maintain |

**Table 1** - Current techniques of access into rainforest canopies and their respective features for fieldwork