

## Methods of assessing biodiversity in rainforest

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### Introduction

Of all the ecosystems, the world's rainforests are the richest and most diverse. The biodiversity provides humankind with an immense wealth of services which include maintenance of soil and water quality, the bases of pharmaceuticals, and raw material for tourism. It has been stated that, in monetary form, these services are estimated to range from US\$16 to 54 trillion a year (Constanza et al. 1998). With the continual destruction of habitats in rainforests, driving thousands of species to extinction each year (Wilson 1989), the aggressive effort to implement methods for assessing and on-going screening of biodiversity is inevitable.

When dealing with species' level of biodiversity, the arthropods dominate life on earth and make up a very large majority of all known and predicted species (Stork 1999). Thus the methods outlined here describe a set of protocols which are used to assess vegetation and associated arthropod diversity. These methods which make use of arthropods and trees as surrogate indicators would provide reliable information on the productivity, stability and sustainability of rainforests and their application for screening the Samoan forest would prove a useful tool for both researches and policy formulation.

### Vegetation survey

Vegetation Survey examines trees profile of the one-hectare plot. For every tree greater than 5cm diameter at breast height (dbh) the position in the 10m x 10m grid is mapped out, its circumference (which is related to the diameter) recorded, its approximate height noted and its botanical identity established. This is a time-consuming process. Ideally, a team of 4 people can work on each 10m x 10m square. One person marks the trees with a biodegradable tag, another person to measure the diameter, another to estimate the height of the trees and another to be a scribe. The botanical identification is often left to the expert field botanist who would later work with a helper who would record information and to some extent be a second-opinion resource personnel.

The results provide the vegetation profile which can be representative of that particular rainforest. These include the taxonomy abundance from Family to Species levels. The heights and widths are also obtained which may reveal the probable growth rates of the trees in the rainforest. Taken together, the results from the vegetation survey can provide baseline information which would be useful as far as environmental and agricultural issues are concerned.

### Arthropod survey

There are a variety of methods used to extract animals that dwell in the forest litter. One of the simplest methods involves the use of the "Tullgren funnel". Basically, the funnel equipment is a box of ten, 40 cm plastic funnels whose stems are inserted through the holes in the base of the box. Above each funnel is a 60 W light bulb connected to a power source. The stem of each funnel is connected to a vial containing 80% ethanol.

In this practice, ten samples of one litre of moist leaf litter are scraped from random points in the one-hectare plot and are emptied into the funnels. Extraction of animals from the sample takes about 4-6 days. The electric bulb over each sample is continually turned on, generating heat to drive the animals to move away from the litter and into the funnel, and subsequently, into the vial (containing 80% ethanol) at the bottom. Litter Extraction catches a variety of animals that crawl on the ground and particularly, *Collembola* and *Acari*.

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Yellow Pan Traps are take-away food containers (1675 x 120 x 400 mm) painted yellow on the inside, and are used as trapping methods. The yellow colour has been shown to attract more insects. Each container is filled two-thirds full with water to which some drops of detergent had been added. The detergent helps sink any insect that might otherwise float.

This is a very simple type of trap to set up and it requires only one person to station them at the coordinates picked beforehand. Ten traps are put out daily for four days in the one-hectare plot on flat location on the ground. The catches are emptied daily, in the morning, with 80% ethanol and concentrated into a vial. Yellow Pan Traps are selective for Collembola and Diptera although some other insects are also caught.

Canopy Knockdown also called Canopy Fogging, Canopy Knockdown has been used for sampling the free-living arthropod fauna of the forest using a cloud of short-lived pyrethrum insecticide. The technique has opened up a new dimension of study in the Tropics. It has been widely used by Kitching and his colleagues in Australia (Kitching et al. 1993).

The Canopy Knockdown is delayed toward the end of the general arthropod survey as to minimise any possible disturbance to the forest fauna caused by the insecticide. A typical catch from one days Canopy Knockdown in a rainforest contains mainly Ants, *Coleoptera* and other *Hymenoptera*.

The Malaise trap was first developed by Malaise (1937) and has undergone modifications. Many workers have adapted Malaise traps for convenience. Here, there are normally six Malaise traps set over the one-hectare plot. Three traps are placed at ground level and three are strategically positioned into the canopy.

For the canopy traps, strong ropes and muscles are also important. Each trap is pulled into the canopy using a rope (which would have been hauled into the canopy by a string-and-arrow method), and maneuvered gently through the lower foliage of the forest using extra two guide-ropes attached to opposite ends of the trap. Damage to the trees is to be avoided.

The traps are emptied daily for four days and the catch is transferred into 80% ethanol before transporting to the laboratory for sorting. Malaise traps target free flying insects. The ground traps tend to be selective for *Coleoptera* and many other insects while canopy traps tend to catch mostly *Diptera* and Ants.

The erection of six Malaise traps is very time consuming. It takes a team of 4 to 6 people to complete the task in one working day. It is relatively easy to empty the ground traps. However it takes about 4 people to help steer the canopy traps to and from the tree tops. Safety procedures are extremely necessary, especially when steering the canopy traps.

Pitfall Traps have been used extensively with many creative modifications. A Samoan version of this type of trap might involve overlaying a big hole with branches and leaves so as to trick a pig into the pitfall! The design described here however, involves the use of glass or plastic tubes as containers placed in the soil to catch fallen arthropods. The tubes are half-filled with 80% ethanol to kill and preserve the animals.

A metal spike is used to drill a hole in the ground for each tube. Nine traps are arranged in a 5 x 5 cross with approximately 50cm between each trap. A plastic roof is fitted over each trap to protect the catch from rain. Eight sets of traps are placed randomly in the one-hectare plot and the traps are emptied every consecutive morning for four days. Catches from each set are pooled together.

Often pitfall traps target Collembola and Ants. It must be stated that at times, soil erosion interferes with the catch and thus renders the pitfall traps ineffective.

Light Traps have been widely used as a result of a simple observation that at night, light attracts insects. Many modified light traps are being developed as to offer convenience and flexibility to researchers. Here, six light traps (3 at ground level and 3 in the canopy.) are set up over a six-day period, within the one-hectare plot. The week around the full moon is avoided as in general; attract fewer moths than at other times (Bowden 1973, Bowden and Church 1973).

The traps would normally run from 5.00pm through the night. The catch is collected in the following morning. The traps target a wide range of insects and particularly, Coleoptera and Lepidoptera. The Coleoptera can be easily picked from the catch and Lepidoptera can be further sorted out putatively into morpho-species in the field.

Bark Spraying has provided interesting evidence that bark surfaces of trees are rich with arthropod fauna. The technique involves the use of a spray can insecticide and a hoop. The hoop is pinned tightly on to the tree bark at the chest height. The segment of the bark above the hoop is sprayed with an insecticide using an aerosol can. About half a square meter of the bark is sprayed for 30 seconds from a distance of one meter, so as not to blow the organisms off the bark surface. Over the next thirty minutes, the bark is gently brushed down on to the hoop with a camel-hair paintbrush, collecting the catch in the vial placed in the hoop.

Kitching and coworkers routinely sample 30 to 40 trees of different species on the one-hectare plot in this fashion. Often, the larger trees as identified already by the Vegetation Survey are sampled. The arthropod taxa commonly identified from samples of bark spraying are Collembola, Diptera, Ants and Acari.

### **Concluding remarks**

Worldwide, scientists and policy makers are working together to develop and adopt ecologically sustainable management. And this type of management depends on scientific data. While not one person has a real understanding of how to carry out the assessment of biodiversity, there is, however, confidence in the effort by International Scientists concerning performance indicators for productivity, stability and sustainability of biological communities.

The methods outlined in this paper are another example of such an effort and the application to the forest of Samoa would benefit both research and corporate plans. These methods are protocols which define a set of international standard techniques for the assessment of the arthropod and associated vegetation diversity. The protocols have been carefully designed and put into practice by many researchers. The data generated as a result would therefore be able to stand up against scientific scrutiny. Moreover, some insights could be gained as to how to improve on methods for assessing biodiversity.

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