LITTER AND MICROBIAL BIOMASS DYNAMICS IN AN UPPER MONTANE RAIN FOREST IN SRI LANKA

by

W. J. S. K. WEERAKKODY

(B. Sc.)

A THESIS SUBMITTED TO THE THE FACULTY OF SCIENCE
IN PARTIAL FULFILMENT OF THE REQUIRMENTS
FOR THE DEGREE OF **DOCTOR OF PHILOSOPHY**

FEBRUARY, 1994
DEPARTMENT OF BOTANY
UNIVERSITY OF KELANIYA
KELANIYA, SRI LANKA

ABSTRACT

Litterfall, litter standing crop, decomposition rates of some common litter, and bacterial and fungal biomass in the litter layer and total microbial biomass in the top mineral soil horizon were monitored in an Upper montane rain forest at Hakgala, Sri Lanka. The main aim of the study was to provide baseline information on some ecological and microbiological parameters of litter and soil which are important in understanding aspects of organic matter and nutrient dynamics of the forest ecosystem at Hakgala, and which allow comparisons with the other forest (particularly tropical) ecosystems in the world.

The mass of litterfall measured by litter traps were at the upper end of the published data for tropical montane forests. The marked similarity of the pattern of litterfall over three years was correlated with periods of high wind. Litterfall consisted mainly of non-woody materials (80%) and the major leaf contributing species were not always the floristically dominant species in the forest.

The fractional mass loss in the forest floor was 0.87 and the residence time for woody and non-woody materials were predicted to be 4 years and 4.5 months respectively.

Comparatively, very high amounts of N and P were cycled through the litterfall and they reside only 12 months and 8 months in the litter layer respectively.

The decay rates of leaves, small wood and large wood of some common species in the litterfall were studied. The decay constants of leaves were varied from 0.19 (*Actinodaphnae*) to 9.6 (*Cestrum*). The decay constants of wood did not show high variation between species. Decay rate variations with time was described by the negative exponential

model (Olson 1963). Neither the chemical data nor the physical data studied were useful in predicting decay rates of individual species of leaves or wood.

Biomass of fungi and bacteria was studied by direct observation methods (Jones and mollison 1948 method for fungi and plate counts for bacteria). Biomass of mushrooms and rhizomorphs were also studied but very large variations were found among replicates, which suggested the need for larger numbers of replicates for such assessments. Bacterial and fungal biomass values were very low compared to the temperate forests. No data were available to make comparisons with tropical forest.

The use of S.I.R. method as a convenient and fast method for assessing microbial biomass was considered and it was calibrated by the F.I. method for use at 28^0C. The preliminary tests on fumigation efficiency, the best control for F.I. method and the glucose concentration which gives the maximum initial respiratory response in S.I.R method were also performed to provide a better accuracy for the conversion factor. The k_C factor used here was 0.45, fumigation time length was 72 hours, the control for F.I method was 10-20 days fumigated soil and the glucose concentration amended for soil was 11000 ppm in S.I.R. method. Then the conversion factor was found to be 41.47 at 28^0C.

The soil microbial biomass did not show significant variation through the year. The basal respiration was very low, suggesting a high proportion of unavailable organic C held in soil. The metabolic quotient was ranged from $3\text{-}5.9\text{x}10^{-3}$. The % C_{micro}/C_{org} was ranged from 1.7-1.95. This was at the middle of the range of data published by various other workers for tropical forests. The value of C_{micro}/C_{org} obtained provide a valuable baseline value for an undisturbed montane rain forest.