INTERCEPTION AND PHYTOMORPHOLOGY

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ABSTRACT

A research programme consisting of type sampling, development sampling, and data extension has been instigated to discover more about the process of interception. This paper gives a brief outline of the method used in type sampling and the extension of site data to larger areas by using phytomorphological characteristics.

INTRODUCTION

Interception loss — the difference between gross and net precipitation — has been analysed since at least 1850 from records of gross precipitation, throughfall and, to a lesser extent, stem flow in coniferous, hardwood, and herbaceous associations. Recent presentations by Molchanov (1963) and Zinke (1967) summarize the data coverage for forest associations, with the implication that enough basic work has been completed, particularly in the United States, to assess interception loss for a wide variety of conditions.

Sampling methods are well founded but, despite the apparent desire for work in this field, several aspects have generally been neglected. Results have seldom been more than records from isolated sites which are usually inadequate for description of interception beyond the confines of the site. Moreover, further study of the process of interception is required. The standard method of sampling vegetation by type or species is still necessary, but a change in emphasis would clarify relationships between the interception parameters and other features such as radiation, wind, humidity, transpiration, evaporation, soil moisture and phytomorphology (the external form of the vegetation).

To apply site data to larger areas they must be related to some easily measured basin characteristics. These could be characteristics of climate, soils or vegetation. All three may be measured, but vegetation characteristics (phytomorphology) probably afford the best basis for extension of data. Early examination of leaf form has shown that these characteristics are not as irregular as they may appear from casual observation.

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Geomorphology, which has a very important influence on the distribution of gross precipitation, is of little value in extending interception data because of the very complex relationship between relief and interception.

METHOD OF STUDY

To meet New Zealand requirements the Hydrological Survey of the Ministry of Works has undertaken a threefold research programme consisting of species or type sampling, development sampling, and data extension.

Type Sampling

The variety of vegetation types throughout New Zealand makes it impossible to sample every type; a series of 20 sites has therefore been selected to represent a range in phytomorphology. Initially, basic data on interception processes and phytomorphological characteristics will be collected from seven important vegetation associations:

native forest — kauri (*Agathis australis*) — Trounson Kauri Park, Northland;
exotic forest — pine (*Pinus radiata*) — Rotorua, Bay of Plenty;
regenerating hardwoods — *Coprosma australis, Neopanax arboreum, Pittosporum tenuifolium* — Otutira Experimental Basin, central North Island;
native scrub — manuka (*Leptospermum scoparium*) — Puketurua Experimental Basin, Northland;
exotic scrub — gorse (*Ulex europaeus*) — Moutere Experimental Basin, Nelson;
native grass — *Chionchloa* spp. — McKenzie Basin, Canterbury;
exotic pasture grass — perennial rye (*Lolium perenne*) — Dairy Flat, Auckland.

Kauri forest, although restricted in its distribution, is relatively open, and this facilitates measurement. *Pinus radiata* in plantation forms a pure stand which makes instrumentation and measurement straightforward. Regenerating hardwoods and native and exotic scrub cover large areas of the country, as do the native and exotic grasses.

Additional interception studies have been or are being carried out in *Pinus radiata* (Fahey, 1964), in manuka (*Leptospermum scoparium*) by Blake (1965), in manuka and hard beech (*Nothofagus truncata*) by the D.S.I.R. Soil Bureau, and in mountain beech (*Nothofagus solandri* var. *cliffortioides*) by the New Zealand Forest Service.

All forest and scrub sites are selected in mature stands and away from the edges of stands in order to reduce boundary effects.

Site details given below refer only to sites in woody vegetation; for herbaceous sampling see UNESCO (in press). Sites vary in size from 0.002 acre for low scrub to 0.2 acre for forest. They may be rectangular or circular, preferably on a slope of 25–30° to aid the installation of throughfall troughs, which must have a slope of at least 25° (Helvey and Patric, 1965) to avoid splash. Gross precipitation is measured above the canopy. Throughfall is collected in PVC troughs, and stem flow by PVC collars attached to the stems. Data are recorded by a modified daily Kent water-level recorder which records four variables, operating on a set of four $\frac{1}{4}$ (90°) V-notches fitted into small tanks.

Development Sampling

The purpose of development sampling is to extend the knowledge of the interception process. By this means it will be possible to measure the micro-climate, phytomorphology and soil conditions to a degree economically impossible in a type-sampling programme. Initial work will be carried out on one or two plots using multi-channel recorders.

DATA EXTENSION USING PHYTOMORPHOLOGY

The need for a method of extending sample data is urgent. The current equation used in New Zealand for calculating interception loss was developed by Horton (1919). In comparison with sample data from the Puketurua Experimental Basin it overestimates the measured interception loss by at least 10%. This is not surprising, as much of Horton's research was carried out on individual trees and was therefore influenced by boundary effects.

Phytomorphology is the study of the external form of the vegetation and has, until now, been neglected by most workers. The criteria of measurement for herbaceous vegetation have not yet been considered, but they will differ from those for woody vegetation because of the structural difference between the two types. To decide which features of the woody vegetation should be measured, the four interception parameters (gross precipitation, throughfall, stem flow and interception loss) are considered separately and the vegetation characteristics affecting each of them enumerated.

Gross precipitation is measured above the canopy and thus phytomorphological characteristics will have no effect on it. Throughfall, stem flow and interception loss are, however, influenced by most of the characteristics — which include tree height; crown depth, spread, and volume; branching angle; positions of branches, twigs, and leaves; leaf shape ,size, and surface features.

In addition, there are several characteristics which are not concerned with throughfall, but which have an effect on stem flow and interception loss. These include external surface area of stem, cross-sectional area of stem, bark texture, and the nature of leaf and branch axils.

When data from field measurements have been studied it may be found desirable to exclude some characteristics and perhaps introduce others. Statistical analyses are being used to establish significant characteristics which will be related to interception variables, with the ultimate aim of incorporating the results in a physical or conceptual model. This model will be constructed from data collected on a development-sampling site. Data from type-sampling sites can then be placed in the model.

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