

AN ESTIMATE OF TOTAL SURFACE AREA OF VEGETATION FOR PUKEITI CATCHMENT, NORTHLAND, NEW ZEALAND

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ABSTRACT

An estimate of the total plant surface area of a catchment dominated by *Leptospermum scoparium* J. R. et G. Forst. (manuka) scrub is given. For a catchment area of 1.44 ha the total surface area of the manuka including twigs, branches, stems and leaves (the latter one side only) is 1.04 ha. The ratio of vegetation surface area to ground area occupied, called the surface area index, is 0.72 with a standard error of 0.06. The method used to obtain the estimate is described.

INTRODUCTION

The Pukeiti catchment is situated 32 km northwest of Whangarei, New Zealand. It occupies the southwestern corner of Puketurua Experimental Basin, and is the smallest of the three catchments making up the basin (Fig. 1). It slopes gently from south to north and is drained by a branch of the Puketurua Stream.

The catchment probably originally supported kauri forest which was destroyed, possibly in pre-European times (Burke, 1973). The present cover is *Leptospermum scoparium* J. R. et G. Forst. (manuka) scrub of about 1.5 m mean height which is seral to the re-establishment of forest.

At the climate station in Puketurua catchment (Fig. 1) the average annual rainfall is 1453 mm (1964-72), of which 60 percent falls in winter - there is usually a dry period of two to three months in summer. Mean annual temperature is 14.7° C, mean annual humidity is 80 percent, and mean annual open-water evaporation is 797 mm. The average number of ground frosts is 18 per annum.

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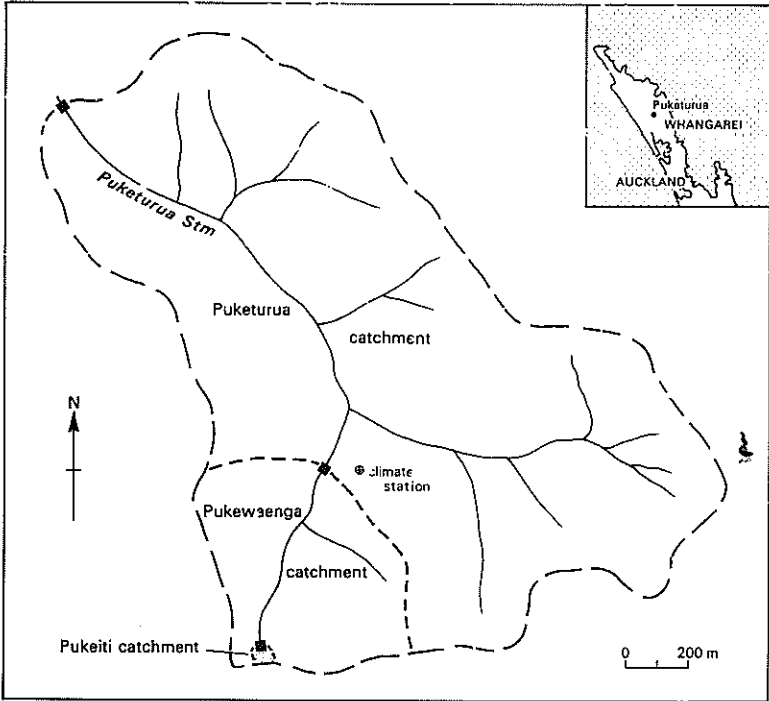


FIG. 1 — Locality map of Puketurua Experimental Basin, showing the three catchments.

The object of this investigation was to derive an estimate of the total surface area (twigs, branches, stems and leaves) of the manuka cover of Pukeiti catchment. Studies of the interception process by Ibbitt (1971) in a stand of manuka in Puketurua catchment have implied a value of the order of 1.2 for the ratio of total vegetation surface area to ground surface area, and the present study was intended to provide a direct estimate for comparison.

THE STUDY AREA

The manuka canopy covered 80–90 percent of the area of the catchment. Three small areas of the adventive *Hakea acicularis* growing as almost pure stands accounted for much of the remaining ground surface but were not considered sufficiently distinctive to require separate treatment. Sub-canopy elements appeared only as scattered individuals, with the exception of two clubmosses (*Lyc-*

podium spp.) which covered 10–30 percent of the surface, and unidentified lichens and mosses which formed a continuous mat on the soil surface.

METHOD OF ANALYSIS

The information available for the determination of the total surface area of the manuka on the catchment was:

1. A map (Fig. 2) showing patches of manuka with the mean height of the plants. The map was made by walking over the catchment and delineating areas by eye.
2. A linear regression which gave the equation $y = -149.7 + 6.9x$ where y is total surface area in cm^2 and x is height in cm. The correlation coefficient $r = 0.93$ was significant at the 1-percent probability level. The regression was calculated from a sample of 10 shrubs taken from a 1 m^2 plot of pure manuka in Puketurua catchment. The height of the 10 sample shrubs ranged from 21 cm to 53 cm with a mean height of 35.6 cm. The sample was selected subjectively to cover the range of heights found in the shrubs on the plot. The surface area was found by the methods of Blake and Burke (1972), which consist of stripping the shrub into its components – leaves, twigs, branches and stem. To find the surface area of leaves on a shrub, they were weighed, a subsample was measured on graph paper and weighed, and simple proportion was used to find the total

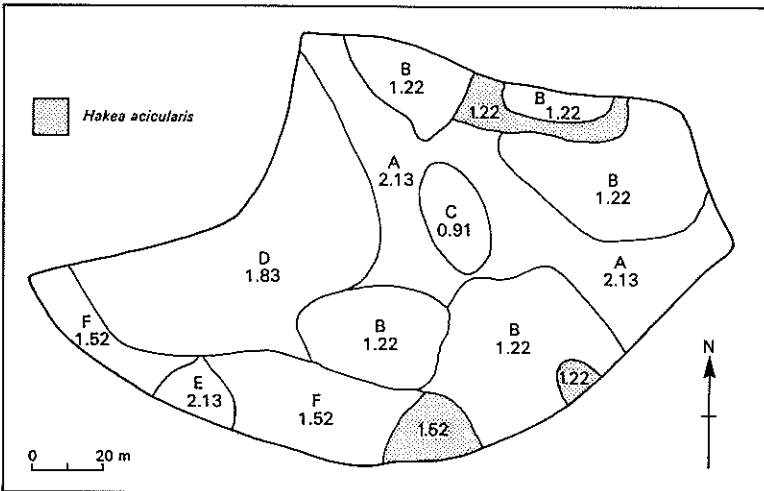


FIG. 2 — Map of Pukeiti catchment showing patches of manuka and *Hakea acicularis*. Heights are shown in metres.

The variance and standard error were found for each patch by a derivation of the formula of Kendall and Stuart (1969), para. 10.6.

RESULTS AND DISCUSSIONS

The total surface area of the catchment cover was 1.04 ha, and the ratio of vegetation surface area to ground surface was 0.72, with a standard error of 0.06 (Table 1). Calculation of the total surface area of vegetation gives an estimate of the surface active in rainfall interception and evaporation. It is, however, inexact since differences in the waxiness of leaves or the roughness or smoothness of barks must affect the behaviour of the interposed surface.

The total surface area of vegetation can be expressed as an index of the ratio of total surface area to ground area occupied, and this allows different stands of vegetation to be compared. It is proposed to call the index 'surface area index' (SAI) similar to the 'leaf area index' (LAI) of Watson (1947).

There appear to be few other estimates of SAI of stands of vegetation. Whittaker and Woodwell (1967) report an SAI of 4.5–8.8 for temperate deciduous forest in the United States, and Swank and Schreuder (unpublished) found an SAI for a catchment of *Pinus strobus* in the Southern Appalachians which was 6.36 for a 10-year-old stand, 11.49 for a 12-year-old stand and 12.53 for a 15-year-old stand. The value of SAI obtained by the present author is roughly half that obtained by Ibbitt (1971), but both estimates suggest that SAI in stands of manuka is very much lower than in the North American examples cited above, and that a ratio of about equal vegetation surface area to ground area can be used in studies of hydrological processes in manuka scrub.

TABLE 1—Results of surface area calculations for each patch of manuka in Pukeiti catchment. Total surface area of all manuka patches 1.04 ha. Surface area index 0.72 ± 0.06 .

Patch	Ground area (m ²)	Height of manuka (m)	Surface area of one shrub* (m ²)	Surface area of manuka patch (m ²)	Standard error (m ²)
A	2745	2.13	0.1333	2771	±469
B	5352	1.22	0.0696	2822	±461
C	515	0.91	0.0485	189	±30
D	3374	1.83	0.1120	2860	±480
E	322	2.13	0.1333	325	±55
F	2100	1.52	0.0908	1444	±240

Total: 10411

* According to the regression equation.

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