

PROTECTION FOREST RESEARCH IN THE NORTH ISLAND  
IN RELATION TO HYDROLOGY

A. Cunningham

Forest and Range Experiment Station, Napier

---

ABSTRACT

The New Zealand Forest Service is responsible for the management of large tracts of protection forest in the North Island. In recent years the Forest Research Institute has extended its field of enquiry to include protection forest areas. Field surveys have been completed for most of the main axial ranges south of the Napier-Taupo highway, and techniques have been evolved for the study of vegetation condition and trend. On Kaweka Range a field station has been established for study of reforestation techniques, mountain climates, and rates and patterns of erosion. The relationship of this work to hydrology is briefly discussed.

---

INTRODUCTION

The North Island contains 7,750 square miles of non-merchantable indigenous forest land (Yska, 1961), a considerable portion of which is protection forest under the control of the New Zealand Forest Service.

Since its inception in 1920 this Service has been aware of the need to protect the vegetative cover on such land, and has vigorously pursued a policy of fire prevention with a success that deserves greater recognition. It would seem that many of these protection forests have for centuries been subjected to partial destruction by periodic floods and earthquakes, but during the past 50 years the various vegetation types, be they forest, subalpine scrubland, or alpine grassland, have been modified by the introduction of a variety of browsing and grazing animals. The policy and action of the Service in control of these animals is more widely known. An increasing number of inspections and reports on the protection forest areas indicated the need for a greatly improved knowledge of these regions. Although there were some outstanding individual investigations on record, it was not until 1956 that the Forest Research Institute was able to apply its resources to this work in systematic fashion.

After the completion in that year of the National Forest Survey, this group, which had been assessing the country's indigenous production forest resources, turned its skill and experience to the classification and mapping of other indigenous forests in the North Island. In the main these were protection forests. Each forest type was delineated and mapped, and field parties made detailed records of its structure. Maps and descriptions of the various forest types are now in process of compilation and publication.

The year 1956 also saw the formation, in the South Island, of a Forest and Range Experiment Station, the objectives of which were "to examine the condition of alpine and subalpine catchments and, where these are unsatisfactory, or appear likely to become so, to determine the remedy." A subsidiary station was established in the North Island, at Napier, in 1959, and it is with the work of this station that this paper is mainly concerned.

### GENERAL FIELD PROCEDURES

The obvious first step towards a deeper understanding of the mountain regions is their close examination, and this is undertaken each summer with the assistance of selected teams of university and forestry students. Each region is examined catchment by catchment, with respect to the condition of its forests, subalpine scrublands, and alpine grasslands. Field notes are made on vegetation condition, geology, river condition, animals, degree of erosion etc. Permanent plots are established in each vegetation type and a detailed record is made of the plants and ground cover within these plots. The objective is remeasurement of the plots at five - or 10 -yearly intervals to determine trends in vegetation conditions.

### PROGRESS TO DATE

During the past five years the following regions have been examined with a view to greater understanding of the relationships between vegetation and water flow:

1958-59:	Tararua Range	1961-62:	Ruahine Range
1959-60:	Upper Tutaekuri Catchment	1962:	Rimutuka Range
1960-61:	Upper Ngaruroro Catchment	1963:	Aorangi Range

Initial surveys of this nature help to shed some light on the situation, and assist towards defining the problems involved; but it is not until repeated surveys have been undertaken that the rate and nature of changes, and their significance, can be clearly established. The first North Island re-survey, that of the Tararua Range, is proposed for 1963-64.

Field work is well in advance of publication of these surveys, and apart from a report on the Tararua Range (Holloway, et alia, 1963) only a few miscellaneous papers arising from these surveys have been published. Technical data, however, are steadily accumulating, while at the same time reference sources, such as library, herbarium, and photo library, which are necessary aids for this research, have been considerably developed.

#### OTHER INVESTIGATIONS

On the eastern slopes of Kaweka Range a field station has been established at Makahu Saddle, 3,250ft, some four hours' travel from Napier. Here the processes of erosion are being followed in greater detail. A meteorological station has been maintained for three years and now includes screen and grass thermometers, cup and gust anemometers, and (by courtesy of the N.Z. Meteorological Service and the Hawke's Bay Catchment Board) an automatic raingauge. An octapent raingauge has been in operation for five years. Simple devices have been installed to record the rate of certain types of erosion.

Makahu Saddle also gives access to a wide assortment of erosion-subject sites between 3,000ft and 5,000ft altitude, and a major project is the testing of various plant species over a range of altitudes and erosion types: for it is conceivable that erosion control by artificial means may become necessary in some North Island mountain lands in the not-too-distant future. Nurseries have been established for the raising and propagation of tree stocks, and trials have been undertaken with many plants, indigenous and exotic, ranging in form from grasses to trees. At present some 84 species in 32 genera are being tested.

#### THE RELATIONSHIP BETWEEN HYDROLOGY AND PROTECTION-FOREST RESEARCH

The relationship between this work and hydrology is not easy to define. It can be accepted as a fact that most of the North Island protection forests, including the subalpine scrublands and alpine grasslands, have been modified to some degree by introduced animals. In some cases a new vegetation has developed containing a greater proportion of unpalatable species. In such cases the effect on the water regime is difficult to determine. More commonly, however, the vegetation has been seriously depleted and the soils compacted, leading, chain-reaction fashion, to further deterioration of the vegetation, which then shows greater susceptibility to damage by snow, wind, insects, and fungi; the soils becoming progressively more exposed to rainwash, frost heave, and desiccation. In saturated conditions one may expect, because of the reduced density of the cover, a greater incidence of soil movement and landslides, particularly in steep earthquake-prone

country such as parts of the Ruahine, Aorangi and Rimutaka Ranges. At the present time the number of landslides which are healing is generally very low in comparison with the number recently formed. Each new slip adds to the area of bare surface, leading in turn to increased runoff, increased sediment yield, increased aggradation in and below the foothills, and increased irregularity of surface water flow.

Thus, of the 48,000 acres which comprise the headwaters of the Tutaekuri River catchment in Hawke's Bay, over 5,000 acres are virtually bare of vegetation: the effects must be significant but have not yet been subjected to measurement or careful assessment. To the east of the Rimutaka Range, most of the main streams carry no surface water for long periods during the summer - a fact stemming from damage to the vegetation. While, on the south-west slopes of the Aorangi Range the absence of surface water and the alleged drying up of traditional springs in summer pose problems of watering and droving for stock owners. This also appears to stem from damage to the vegetation.

It is obvious, therefore, that the fields of work of foresters and hydrologists overlap. The hydrologist is concerned with the measurement of stream flow and sediment; the research forester is concerned with vegetation as it affects sedimentation and stream flow; both are concerned with river control. Vegetation is a significant factor in relation to certain aspects of the water-flow regime and sediment yield. Ultimately, then, the status or condition of vegetation must be related to water and sediment yields.

#### REFERENCES

- Holloway, J.T., et alia 1963: Report on the Condition of the Forests, Subalpine Scrublands and Alpine Grasslands of the Tararua Range. N.Z. Forest Service Tech. Paper 41.
- Yska, G.J. 1961: Statistics of the Forests and Forest Industries of New Zealand. N.Z. Forest Service Inf. Ser. 33.