CONDITION ASSESSMENT OF PROTECTION FORESTS

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SYNOPSIS

Introduced animals have weakened the precipitation-absorbing and soil-stabilising indigenous protection forests, causing accelerated erosion and increased flooding. There is a demand from foresters and rangers engaged on animal-control work for simple techniques to enable them to assess objectively the protective efficiency of animal-infested forest in a primary reconnaissance and then, by the response of the vegetation, the effectiveness of their animal-control operations. This paper offers two simple techniques to fill this need. They are tools to be used only until the Forest and Range Experiment Station has surveyed all important protection catchments and established systems of permanent transects and plots to record vegetation changes comprehensively.

INTRODUCTION

There is much evidence that deer, chamois, thar, goats, opossums, and in places sheep, have so weakened the tight skin of vegetation that once froze our mountain profiles that accelerated erosion and increased flooding have resulted. By far the greatest area of this protective vegetation is indigenous forest, mainly beech. Although this paper refers only to forest proper, the other protective formations, timber-line scrub and mountain grassland, play vital roles (Holloway, 1956).

Foresters and rangers engaged on protection-forest management have long felt the need for techniques that would enable them first to assess objectively the protective efficiency of forest inhabited by introduced animals, and secondly, by discerning the response of the vegetation, the efficacy of their animal-control operations. To meet such a demand this paper offers two simple techniques. The first analyses the functional components of protection forest and their replacement mechanisms and provides three empirical classes of animal impairment with a simple numerical rating for each. The protective efficiency of the forest is then represented by the sum of the conditions of all these features, viz its condition rating. The second technique is photographic and is aimed at those parts of the forest most sensitive to reduction of animal numbers. No apology is made for the simplicity, almost crudity, of these techniques as

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they are first attempts in this field in New Zealand. They are essen­
tially tools to be used by foresters and rangers in the field only
until the current research of the Forest and Range Experiment
Station produces methods that are more precise and better adapted
to special localities.

PROTECTION FOREST COMPONENTS AND THEIR
REPLACEMENT MECHANISMS

Much literature is available describing the precipitation-absorbing
and soil-stabilising functions of protection forest (Bennett, 1939;
Colman, 1953, et al.), but even a brief review of such work would
be out of place here. For the purpose of this paper all that need
be stated is that in an efficient protection forest the thick crowns
of canopy trees, sub-canopy trees, and shrubs break the impact of
the frequently torrential rain so that it spatters and drips to the
thick carpet of moss, litter, and humus on the forest floor. Here it
is absorbed immediately, to filter into the porous topsoil and then
seep slowly by way of root channel and rock crevice to feed the
streams with subsurface flow. Some of the precipitation is held
by the vegetation itself, to be lost later by evaporation. In this way
runoff is reduced, attendant scouring is prevented, and water yield
regulated. The roots of the trees and shrubs bind and hold the soil
so retarding erosion and confining it largely to soil creep. On the
few slips that are normal to steep terrain the forest quickly re­
generates to resume its protective function. Our primitive protec­
tion-forest vegetation was most efficient.

Introduced animals have damaged in varying degree the functional
components of protection forest and their replacement mechanisms.
Hooved browsing animals have depleted and modified shrub storeys,
prevented the regeneration of canopy trees and by trampling destroyed
the thick absorbent covering of the forest floor so that the mineral
soil is bared and compacted. The healing of slips has been pre­
vented; indeed they have been enlarged and made more numerous.
Then the opossum ravaged the crowns of the extant canopy trees,
 killing or debilitating. All this is well known and has been described
many times (Cockayne, 1926; Holloway, McKelvey, Kean, Pohlen,
Poole, 1959 et al.). Now, the condition of a protection forest (its
soil-stabilising and precipitation-absorbing capacity) can be assessed
by evaluating the condition of its functional components and their
replacement mechanisms (canopy trees, canopy-tree replacement,
shrub storey, forest-floor cover, slip revegetation, which are all vul­
nerable to and damaged by animals), and also by record­
ing the incidence of slips. In the following, each of these six factors is
treated separately and three broad empirical condition classes are
described, designated numerically 0, 1 and 2.
Canopy

Damage here is primarily due to opossums, though insects could contribute.

(a) Where canopy trees show no defoliation give 0 points

(b) Where some or all canopy trees show light defoliation give 1 point

(c) Where some or all canopy trees are severely defoliated give 2 points

On some sites the canopy trees may be dead or wind thrown. This could be perfectly normal, and where it is obvious that opossums have had nothing to do with it give 0 points.

Canopy Replacement

Regeneration of canopy trees is vulnerable to browsing animals during the seedling and sapling stages, until the leading shoots pass above browse limit. In accordance with National Forest Survey field practice a seedling is not regarded as established until it is 6 in. high because of possible ephemerality. Therefore, regeneration here means seedlings and saplings of canopy trees between 6 in. high and browse limit. Killing of young saplings and poles by barking and antler rubbing, as distinct from elimination by browsing, is ignored here as such mortality is rarely significant in protection forests. A little more elaboration is necessary: In sites such as gullies where scrub hardwoods (fuchsia, wineberry, five-finger, etc.) are dominant, these species are regarded as the canopy trees of that site and their regeneration as canopy replacement. Finally, in certain areas forest types are being replaced by different associations; this is a normal trend and in no way associated with animals. For instance podocarps are being replaced by beech and tawa in parts of Southland and central North Island respectively. Here the seedlings and saplings of the invading species can be regarded as canopy replacement. In protection forests the presence of a canopy is more important than its composition.

(a) Where regeneration of canopy trees is thick; where light-demanding beech, southern rata, hinau, and rewarewa are concentrated under canopy gaps and the other more shade-tolerant species are more evenly distributed give 0 points

(b) Where regeneration is thin and patchy, or retarded by browsing give 1 point

(c) Where there is no regeneration of canopy species at all give 2 points

Shrub Storey

For the reason explained in “Canopy replacement” the shrub storey is regarded as being between six inches high and browse
limit. It includes tuft ferns. In undamaged forest the shrub storey is usually very dense, so that progress without a slasher is most difficult. The exceptions are in the lower-rainfall mountain-beech types and on some dry sites in other types; here the shrub storey is only moderately dense. But all shrub storeys contain one or more species, most palatable to deer and other browsing animals, which have widespread distribution and which soon disappear under the impact of animals. These species are *Coprosma robusta*, *C. tenuifolia*, *C. lucida*, *C. australis*, *Nothopanax* spp. (not *N. anomalum*), broadleaf, pate, and mahoe. These species are valuable indicator plants. As they and others a little less palatable are eliminated, unpalatable species such as pepper tree, *Myrtus pedunculata*, *Cathodes acerosa*, *Leucopogen fasciculatus*, *Blechnum discolor*, *Dicksonia lanata*, *Microlaena avenacea*, and *Uncinia* spp., become much more plentiful to fill the vacuum. Probably a dense shrub storey without palatable species is as efficient as a dense shrub storey with them, but their absence indicates a stage of depletion.

(a) Where the shrub storey is dense or moderately dense and contains one or more of the following palatables: *Coprosma robusta*, *C. tenuifolia*, *C. lucida*, *C. australis*, *Nothopanax* spp., broadleaf, pate and mahoe give 0 points

(b) Where the shrub storey is scattered, moderately dense, or dense and contains none of the palatable species listed above give 1 point

(c) Where there is nothing, or virtually nothing (canopy replacement excluded) between six inches above the ground and browse limit give 2 points

*Forest-floor Cover*

The elimination of the spongy forest-floor cover is a major part of the degradation process; when it goes run-off takes the place of infiltration.

(a) Where there is a thick covering of litter and humus and large colonies of moss, or dense herb growth, so that no mineral soil is exposed give 0 points

(b) Where there is a thin and patchy covering of litter and humus or herb growth with very little or no moss, so that patches of mineral soil are exposed give 1 point

(c) Where there is only a thin scattered covering of fallen leaves with much mineral soil exposed and compacted by hooves, and with loose scree or exposed country rock, or (in central North Island only) loose pumice visible at the surface give 2 points

*Slips*

Frequent slipping with consequent aggradation of streams is the most spectacular effect of use by animals. However, it must be
borne in mind that in many areas active faults keep triggering off
slips, a normal process that is aggravated by animals. Knowledge
of the geology of an area is of course important in interpreting the
field ratings.

(a) Where, during travel over a certain route, the observer passes
no slips in 40 chains give 0 points
(b) Where, during travel over a certain route, the observer passes
no more than two slips in 40 chains give 1 point
(c) Where, during travel over a certain route, the observer passes
more than two slips in 40 chains give 2 points

Revegetation of Slips
(a) Where slips are healing completely with woody plants
give 0 points
(b) Where slips are healing patchily with much grassy sward
induced by browsing give 1 point
(c) Where slips are not healing but are being kept active or are
enlarging give 2 points

Where 0 points are given for slips, give 0 points here also. The
revegetation of slips is assessed from the slips as above.

Condition Rating
The condition rating of the forest can then be shown as
1/2/1/1/0/0 or 2/2/1/1/0/0, etc. The components are kept in
the order in which they dealt with above. Forest in perfect condi-
tion is 0/0/0/0/0/0, forest in the worst possible condition,
2/2/2/2/2/2. A very rough idea of forest condition can be obtained
by adding all the numerals. Thus forest in perfect condition totals
0 (no damage) and forest in the worst possible condition totals 12
(most damage). These sums can not be used for comparing forests
as, of course, all the components assessed are not of equal pro-
tective value, nor is there any method at present by which the
relative importance of each can be assessed.

The technique is designed to assess condition of all forest types.
Of course similar animal populations will not induce the same
condition in different types. For example, a much more severe
browsing pressure will be needed to eliminate canopy replacement
in podocarp - mixed-hardwood forest than in beech forest; for
most canopy species in the former type are relatively less palatable
than beech and also are buffered from the animals by a richer
flora of fairly palatable secondary species.

APPLICATION IN THE FIELD TO ASSESS FOREST
CONDITION
The simple technique outlined above is for assessing the condi-
tion of the protection forest during an initial reconnaissance. The
effects of animals vary considerably with site and aspect; for example
Canopy 2; heavy opossum-induced mortality in rimu – kamahi – northern rata type of southern Ruahine; only rimu left alive.

Shrub storey 1; modified to young tree ferns, unpalatable pepper tree, and rank *Microlaena avenacea*; Hall's totara – kamahi – scrub hardwoods type; southern Ruahine.
Forest-floor cover 2; high populations of opossums and red deer have changed the forest floor to unstable greywacke scree; northern Urewera.

Slip revegetation 2; browse-induced grassy sward cannot hold slope; southern Ruahine.
the vegetation on ridges is usually more depleted than that on mid slopes, and that on warm northerly slopes more than that on cold southerly ones. Therefore any assessment of forest condition must refer to site and aspect. Six broad site classes have been chosen, and when an observer assesses the forest at any place he notes which of the site classes he is on and its aspect. These are ridge or spur crest, upper-valley slope, mid-valley slope, lower-valley slope, gully or narrow valley bottom, flat or easily undulating terrain. On each site chosen the observer assesses canopy and canopy replacement over a circle one chain in radius and shrub storey and florest-floor cover over a circle ½ chain in radius and with the same centre. If, in forest dominated by light-demanding species, dense sapling or pole stands with closely knit crowns cover the circle so that effective regeneration of canopy species is prevented, then the assessment of canopy replacement is made under the nearest canopy gap and the procedure noted. Assessment of slip incidence and slip revegetation is made on what he saw en route to the site over the last 40 chains.

It is important that the observer work, if only for short distances, across the grain of the country. This is to ensure that he samples all sites and aspects. In easier country it is possible to make long traverses across the grain, but difficult country has to be worked in short bursts from valley floors or leading ridges. The most important point is that the observer must not be influenced by personal bias in picking the sites to assess, for almost certainly he will want to select sites where he can see farthest, and this will not give a true average condition of the forest. The easiest way is to work by a predetermined, convenient time interval. It is very difficult to lay down hard and fast rules about this sampling. The main requirements are that assessment sites should be scattered reasonably evenly over the forest and that undue personal bias in site selection should be avoided.

In the office the assessed sites are plotted on a map, or aerial photograph, the condition ratings are pencilled in, and then the critical areas are delineated. This technique was used successfully last summer in Urewera, Kaimanawa, Kaweka, and Ruahine forests, over a variety of forest types by both foresters and rangers.

ASSESSMENT OF ANIMAL-CONTROL OPERATIONS BY RESPONSE OF VEGETATION

This is more difficult. The technique outlined above is not sensitive enough for this role as it would detect only major changes that would probably take years to come about. No really comprehensive assessment of the response of the vegetation can be made until the Forest and Range Experiment Station have established
their permanent transects in all the important catchments, a vast programme which will take years to complete. But it is essential that there should be something in the interim to indicate the effectiveness of animal-control operations.

The most useful tool for this task is the camera. The best way to use it is by taking photographs at intervals from fixed camera stations; and it is essential that the camera be aimed at those parts of the protection forest which respond quickly to reduction of the animals. Canopy trees, severely defoliated by opossums, quickly grow new leaves after heavy trapping and poisoning. Canopy replacement, however, is not always a quick indicator, since beech often seeds heavily only once every three, four or even up to seven years and reduction in the numbers of animals may be followed by a poor seed year. The shrub storey responds fairly quickly; hedged plants send out leading shoots, palatable species appear, and the density increases appreciably; this has been spectacularly demonstrated by animal-exclosure plots. Also the forest floor cover quickly builds up and moss appears on the ground if given a respite from trampling hooves. But in many areas, if all deer were eliminated immediately, abnormal slipping would continue for some years, until new networks of tree and shrub roots ramified through and bound the soil once again; the cessation of abnormal slipping then is not a quick indicator. But revegetation of slips that are stable (not moving scree) with woody plants proceeds apace if the pressure from animals is released. Thus the protection-forest features which most quickly indicate relief from animals are canopy foliage, shrub storey, forest-floor cover, and revegetation of grassy stable slips with woody plants.

For the permanent camera points, places showing heavy damage should be chosen: valley sides with conspicuously defoliated trees, places where shrub storeys are nonexistent, places where large areas of mineral soil are bared, slips that carry grassy swards and practically nothing else, etc. It is important that the fixed camera points be scattered fairly evenly over the forest, taking in a variety of types, sites, and aspects and be away from main access tracks and huts where control measures are concentrated. Nothing definite can be laid down about the number of photographs to be taken, except the more the better. If at the majority of the camera points marked forest improvement is shown, it can be assumed that the control of animals is effective, or that for some reason there is a natural decline in animal numbers. This possibility should be taken up with the animal ecologist who will then have to determine herd structure, condition, and population trend. Much of this information will be given by animal-control records. Only when the effectiveness of animal-control operations has been assessed by the response of the vegetation can they be manipulated appropriately.
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REFERENCES


