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GENERAL TRENDS IN FOREST MODIFICATION BY INTRODUCED ANIMALS

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The title of this paper is an absurd one and was chosen for this very reason. There are, in fact, no such things as general trends in forest modification by introduced animals other, perhaps, than those implied in the bald statement that animals preferentially graze or browse forest species and may eliminate some species of extreme palatability or susceptibility which, in turn, may sometimes be replaced by species of lesser palatability or greater resistance. Yet it is commonly assumed that a general trend should be discernible and describable. Thus, if a simple and ready answer cannot be given to the frequent question, "What harm do introduced animals do to the forests?", the usual reaction is that, clearly, we do not know enough about the matter and should not express any opinion until, by dint of further research, we can reply in a dozen or so words of one syllable.

On the last occasion on which I was asked this question, it was by a man well skilled in grassland management. I replied by asking him if he would sum up for me, in a word or two, the effects of animal grazing on grasslands, avoiding all qualifications as to the kind and condition of the grassland, the species of grazing animal concerned and the duration and intensity of grazing, and avoiding any reference to climatic, topographic, soil, or other environmental factors? He should give me a simple answer that would hold true no matter whether the animals concerned were sheep or cattle, horses or goats, rabbits, geese, or opossums, or of these or other grazing animals in any combination, no matter what the duration or intensity of grazing, and no matter what the kind of grassland, be it ryegrass/white clover, cocksfoot, browntop, fescue tussock, snowgrass, or even nassella tussock grassland as all these types of grassland exist throughout their full geographic ranges.

In this case an apology was promptly forthcoming, an apology that such a question should have been asked, when so little thought had been given to the matter. But usually I am expected either to apologise for my ignorance or, at least, to plead the necessity for further research. Further research is, of course, needed, but not in the vain hope that thereby a few broad generalisations can be formulated that will permit any layman in this field of study to comprehend the situation in its entirety, once and for all. There is no one situation and there is no 'once-and-for-all'. Further research is necessary in exploration of the full diversity of situations that exist, and further research will always be necessary because of the frequent rapid and sometimes unpredictable changes that may occur in the elements of any one situation. But a plea for further research is not a plea of ignorance.

In the time I have available I cannot hope, however, to develop this theme fully. There are, as you will all be aware,, many different kinds of forest in New Zealand, both native and exotic or, increasingly, of admixed native and introduced species. In North Auckland, alone, 20 distinct types of native forest have been recognised (McKelvey & Nicholls, 1959), these being cover types each one of which could be further split up into subtypes, differing significantly in their reaction to animal use, according to the species composition of subordinate forest tiers. In western Southland more than 50 distinct types of forest have been mapped (Holloway, unpublished National Forest Survey reports). All told, including the exotic forests and the mixed forests and the forests that have been variously modified by human agency, there must be many hundreds of types of forest in New Zealand that will respond in distinct fashion to grazing and browsing.

But this diversity of forest types is only the first source of complexity and confusion. If we consider but one forest type as it occurs in separate localities, the duration and intensity of animal use will rarely have been the same in all instances. Modification of the type can proceed in one direction under one set of circumstances and in a completely different direction where the species of animals, or combinations of species, or population levels have not been the same. In effect, if we are to speak of animal modifications to forest, not only must we be specific as to the type of forest referred to, but we must also be specific as to the species of animals concerned, the period of time for which they have been present, and their population levels throughout this period.

Some indications of the diverse paths and trends in animal modification of distinct types of forest have already been given (e.g. Holloway, 1950; Holloway & Naylor, 1959; Holloway, 1959; McKelvey, 1959; Holloway *et. al.*, 1963), and I do not propose to enlarge upon these reports here. I propose, rather, to consider briefly the simplest possible case, outlining variations in trend in the modification of one exceptionally simple and uniform type of forest by a single species of introduced animal. The example I have chosen is pure mountain beech forest inhabited by red deer. The point I want to make is that, even in this case, if trends in forest modification are to be fully understood, we must study the whole forest, and much more than the forest. Generalisations based upon study, no matter how detailed, of only a portion of the forest, can be misleading or even worthless.

We will assume, and such situations do occur, the existence of a sizable tract of pure mountain beech forest in mountainous country, there being only minor variations in the condition of the forest and the composition of forest understoreys according to altitude and local soil or aspect factors. In such a forest, despite its uniformity, and despite the presence of but one species of animal, there must be intense local variation in the direction and, more particularly, the degree of modification by animals. This is the result, largely, of the habits and requirements of the animals themselves.

Red deer, if they are to thrive, must have access to grasslands and scrublands as well as to the forest. If there is no readily accessible grassland or scrubland, population growth is likely to be restricted. There may be an early sharp rise in numbers but, once the preferred, highly palatable food plants of the forest interior are exhausted, the population level declines and thereafter stabilises at a comparatively low level. But where there are accessible grasslands and scrublands, conditions for red deer are much more favourable. Not only will the initial population peak be higher but the period of overpopulation following exhaustion of preferred food plants is likely to be more prolonged, and the final population level, adjusted as much to the condition of the grasslands and scrublands as to the condition of the forests, will also be higher. In the first case the forest may be able to sustain the weight of animal use, at the stabilised level, indefinitely. But in the second case, depending upon the proportions of forest to grassland and scrubland, forest modification will at least proceed much more rapidly, and may, where the area of forest is small in relation to the area of grassland, lead to the rapid and complete destruction of the forest.

Further complications arise when we consider the types of grassland or scrubland concerned. If these are of types relatively unattractive to red deer (e.g. *Chionochloa rubra*, *C. oreophila* or *C. australis* grassland, or *Leptospermum* scrubland) the rate of forest modification will generally be intermediate between that experienced where there is no accessible grassland or scrubland at all, and that experienced where there is a good balance of forest and preferred scrubland and grassland. The seasonal availability of the grassland is likewise a factor to be considered. Where the grasslands contiguous with the forests are snow covered for much of the year, the trend of events in the forest will differ to some degree from the trend experienced where the grassland is available to the animals at all seasons.

In other words, if we are to evaluate forest trends, with a full understanding of them, we cannot study the forest alone. We must go outside the forest to study the adjoining vegetation types that the animals also use, and we must study the animals themselves. Within the forest, even where all external factors are equal, there will be an uneven spread of animal use. Where red deer are concerned, use will be heaviest on slopes of sunny aspect, particularly where these closely adjoin areas of preferred

grassland and scrubland. Cold aspect slopes remote from preferred grassland and scrubland may be little used and in near primitive condition long after the forest in other areas has undergone severe depletion. Likewise, the forest on steep slopes mantled with deep bouldery rubble will also, commonly, remain little used even though adjoining areas are heavily overpopulated. And finally, on unstable terrain, where forest modification or depletion leads towards acceleration of erosion rates, the end product of animal use will obviously be different from that where the terrain is stable and there is no acceleration of erosion.

In sum, even in the simplest case, there are many factors to be considered, but the situation will rarely be as simple as that outlined. Generally there are many types of forest within the one area and many types of scrubland and grassland. Generally, too, several species of animals are involved and there has been profound disturbance of the animals by hunting, resulting in a modification of both their habits and population trends, which in turn necessarily affects the overall pattern of forest modification. There is no gainsaying the fact that this is a field of study of very considerable complexity. It is not a field for casual, amateur investigation even though the frequency with which opinions are volunteered might lead one to believe that it is.

In our own work (Protection Forestry Branch, Forest Research Institute), though we attempt, by team work, to cover all major facets of the ecosystems with which we are concerned, we usually discover that these ecosystems are too complex to be comprehended or even studied in their entirety. We must therefore adopt what we call the 'critical areas' approach. That is to say that we seek a basic understanding of trends in forest modification, not over the entire extent of any forest or forested river catchment, but, in the first place, only over those portions of it that are of critical importance in relation to the prevention of erosion or control of flooding. Trends in forest modification elsewhere, though possibly of great academic interest or long-term significance, do not demand such urgent attention.

This is the only practical approach. The one prime objective is the maintenance of the forests on the critical areas in a fully satisfactory condition. If this objective cannot be achieved it matter little how favourable or unfavourable trends in forest modification may be with respect to the remainder of the forests. And further, it will usually be the case that where conditions and trends on the critical areas are satisfactory, trends elsewhere will also be satisfactory.

In conclusion I would reemphasise the point that, in New Zealand at least, no general trends in forest modification are yet discernible other than, as already mentioned, the trend toward elimination of the most palatable species and their occasional replacement by unpalatables. Given a long period of time, it may be possible to be a little more specific, as Wraight (1964) has found it possible to be in the case of the grasslands. But at all times the forest situation will be more complex than the grassland situation in proportion to the increased complexity of the structure of the forests compared to that of the grasslands. In the meantime all recommendations for control of forest animals can only be based on the most careful evaluation of trends in critical areas. Expressions of opinion or generalisations, even those based on meticulous study but of forests outside the critical areas, are of no practical significance.

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