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An Outline of the Vegetation of the Snares Islands

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Abstract

FOREST and tussock grassland are the two principal groups of plant communities comprising the vegetation of the Snares Islands. The forest is dominated by *Olearia lyallii*. *Senecio stewartiae* also occurs but is less common throughout the forest. The grassland is dominated by two maritime tussock species, *Poa foliosa** and *Poa astoni*.

The Snares Islands are the breeding ground of a large number of migratory sea birds, which influence the plant cover. Notable among these birds are the Snares crested penguin (*Eudyptes robustus*) and the sooty shearwater or mutton bird (*Puffinus griseus*). The sea birds largely affect the plant cover through trampling and burrowing, but in some areas the accumulation of excreta also influences the vegetation.

The islands support no introduced vermin, and as the influence of man has been slight, the vegetation is still in its primitive state.

INTRODUCTION

THE Snares are a small group of uninhabited rocky islands lying some 65 miles in a southerly direction from the South Cape of Stewart Island (Figs. 1 and 2). With the exception of the Bounties, which are devoid of vegetation, the Snares are the northernmost of the New Zealand subantarctic islands. Their botany was first described by Kirk (1890). Comparatively little has been written on the vegetation since the visit of Cockayne (1909).

The Snares are botanically interesting. The flora shows affinities with other subantarctic islands and with the mainland of New Zealand, as well as possessing

* A revision of the gramineae from the Subantarctic Islands of New Zealand is at present being undertaken by Mr V. D. Zotov, Botany Division, Department of Scientific and Industrial Research. Since submitting this account he has re-examined the poas from the Snares and now considers specimens previously labelled as *Poa foliosa* to have been incorrectly identified. These are now identified as *Poa tennantiana*. Until details of this revision are published the name *Poa foliosa* will be retained in this paper to avoid confusion with previous accounts of the vegetation of the islands.

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a small endemic element of its own. The ecology of the Snares Islands is of particular interest. Among the subantarctic islands they are one of the few remaining groups without introduced vermin, and since the visits of man have been rather infrequent, the vegetation is still largely in its primitive state. The vegetation is not undisturbed though, for the islands support a large population of migratory sea birds which use the islands as their breeding grounds. Notable of the various species of sea birds are the sooty shearwater or mutton bird (*Puffinus griseus*) and the Snares crested penguin (*Eudyptes robustus*), because of all the birds these two species have the most pronounced influence upon the vegetation structure, which they modify chiefly through burrowing and trampling.

The plant cover of the Snares is comparatively simple in structure and composition. Some twenty-five species comprise the flora (Allan, 1961) and of these less than half are important in the structure of the vegetation. Most of the larger communities have only one or two dominant species and, as these often have a similar growth habit, there is typically little structural differentiation within the community.

On the Snares Islands the plant communities fall into two principal groups: forest and tussock grassland (Plate 1, fig. 1). The forest is a shrub-forest type, while the grassland is essentially a subantarctic maritime tussock grassland. Within the forest and grasslands a few smaller communities also occur. Typically, however, these form parts of either the forest or the grassland, usually in areas which have been modified by animals.

FOREST COMMUNITIES

Forest covers most of the Main Island of the Snares in the form of a low close-set shrub-forest formation dominated by *Olearia lyallii* (Plate 1, figs. 1 and 2). Broughton Island, the second principal island of the Snares, is also partly covered with forest. *Olearia lyallii* is a much branched tree with a shrub-like growth habit, reaching a height of up to thirty feet in sheltered situations. The height of the canopy, however, seldom exceeds twenty-eight feet. The leaves of the *Olearia* are large and leathery and conspicuous by their covering of white tomentum. It is this upper surface tomentum of the leaf that gives the forest its silvery grey appearance when seen from a distance. The only other forest dominant is *Senecio stewartiae*. This plant is similar in habit to the *Olearia* but less abundant, occurring mainly on the east side of the Main Island in the vicinity of the Boat Harbour (Plate 1, fig. 2). It stands out from the *Olearia* by its dark green foliage. Except on the eastern side of the main island where both *Senecio stewartiae* and *Olearia lyallii* occur together, the forest is dominated by *O. lyallii*, which may often be the only vascular plant present over quite large tracts (Plate 2, fig. 3).

The interior of the forest is quite unusual compared with forest communities on the mainland. It is characterised by a tangled mass of branches and fallen tree trunks (Plate 2, fig. 3). Many of the trunks are prostrate upon the ground—often for several yards—with several main branches ascending to the canopy. At the canopy the numerous stems repeatedly branch, ultimately forming a mass of stout interlocking twigs which bear the foliage. Because of the close set and rigid nature of the twigs, the canopy does not yield readily to the wind which blows frequently over the islands. Besides the tangled mass of branches, the bareness of the forest floor and the generel paucity of understorey plants are other striking features of the forest's interior. Throughout most of the forest, the floor is an expanse of bare peat strewn sparingly with small quantities of leaf and twig litter. Even bryophytes are rare on the ground, being confined chiefly to the trunks of trees. The few understorey plants which do occur are found mainly

in the gullies or areas of the forest where the canopy is less dense. In the gullies *Polystichum vestitum* and *Blechnum durum* are often common, as well as *Asplenium obtusatum*. Of these, the *Asplenium* is not confined to the gullies but occurs more freely throughout the forest as well as in the grassland. In parts of the forest where the canopy is more open, vigorous stands of the Snares endemic *Kirkophytum* (*Stilbocarpa*) *robustum* usually flourish. This striking plant also grows equally well in grassland communities, particularly in the moister and more shaded localities.

Apart from the *Olearia* and the *Senecio*, the only other woody plant found on the Snares is *Hebe elliptica*. This plant differs slightly from the Stewart Island and Mainland forms by possessing larger leaves and flowers which are almost pure white. On the Snares the *Hebe* grows all over the islands, but in the forest it is confined mainly to clearings formerly occupied by penguin rookeries or to areas of a more open structure. While the *Hebe* is not part of the forest climax formation proper, outside the forest it is generally more abundant. Between forest and grassland it frequently forms large patches (Plate 1, fig. 3; Plate 2, fig. 1). In some parts of the island these clumps appear to have more recently invaded the grassland communities, as decaying tussock mounds beneath the plants suggest. An earlier stage of this succession is also shown by young *Hebe* plants growing up in the inter-tussock areas, particularly in localities where the grassland has been disturbed by birds.

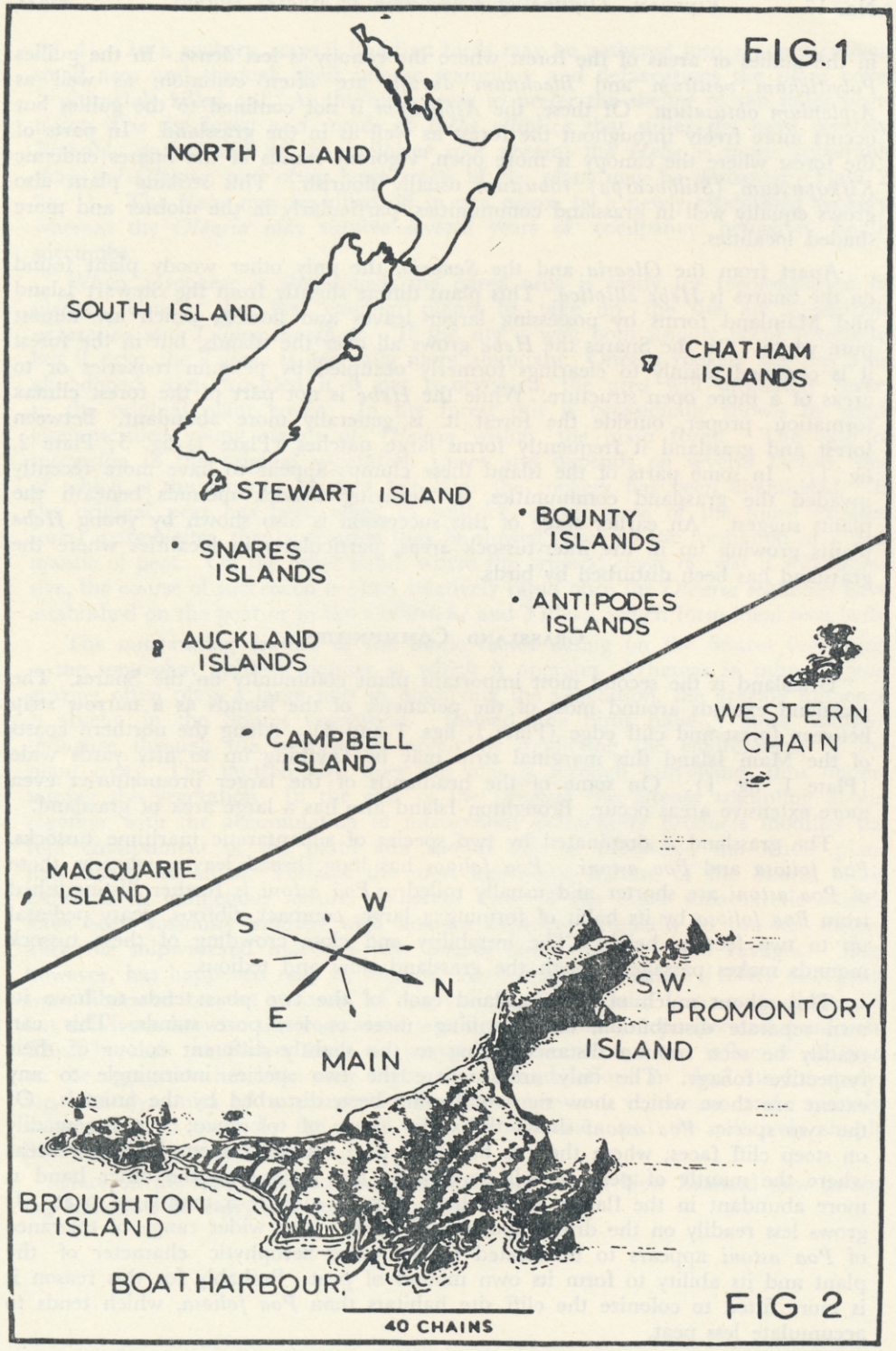
GRASSLAND COMMUNITIES

Grassland is the second most important plant community on the Snares. The grassland extends around most of the perimeter of the islands as a narrow strip between forest and cliff edge (Plate 1, figs. 1 and 3). Along the northern coasts of the Main Island this marginal strip may be anything up to fifty yards wide (Plate 1, fig. 1). On some of the headlands of the larger promontories even more extensive areas occur. Broughton Island also has a large area of grassland.

The grassland is dominated by two species of subantarctic maritime tussocks, *Poa foliosa* and *Poa astoni*. *Poa foliosa* has long, broad leaves, whereas those of *Poa astoni* are shorter and usually rolled. *Poa astoni* is further distinguished from *Poa foliosa* by its habit of forming a large, compact, fibrous, peaty pedestal up to two feet in height. The instability and close crowding of these tussock mounds makes passage through the grassland slow and tedious.

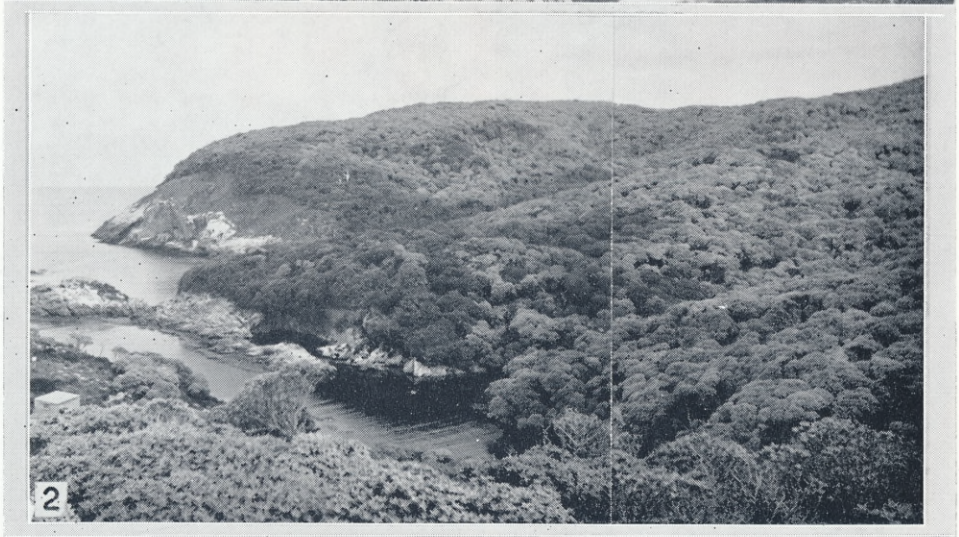
Throughout much of the grassland each of the two poas tends to have its own separate distribution, each forming more or less pure stands. This can readily be seen from a distance owing to the slightly different colour of their respective foliage. The only areas where the two species intermingle to any extent are those which show signs of having been disturbed by the animals. Of the two species *Poa astoni* shows the wider range of tolerance; it grows readily on steep cliff faces, where there is but little peat, as well as on the flatter areas where the mantle of peat is well developed. *Poa foliosa* on the other hand is more abundant in the flatter areas where there is already a mantle of peat. It grows less readily on the drier exposed cliff faces. The wider range of tolerance of *Poa astoni* appears to be related to the more xerophytic character of the plant and its ability to form its own mound of peat. Probably for this reason it is more fitted to colonize the cliff site habitats than *Poa foliosa*, which tends to accumulate less peat.

Throughout most of the grassland, intertussock plants are wanting, the ground between the plants being bare peat and compressed leaf litter.



TEXT-FIG. 1.—The Snares Islands in relation to the mainland of New Zealand and the other subantarctic islands.

TEXT-FIG. 2.—The Snares Islands. showing their general topography and vegetation cover. Forest covers the central portions of the Main Island while around the perimeter is a strip of tussock grassland. The drawing is a two point perspective and the horizontal scale applies only to the front of the diagram; the vertical scale is exaggerated Drawing modified after Fleming *et al.* (1953), with permission.



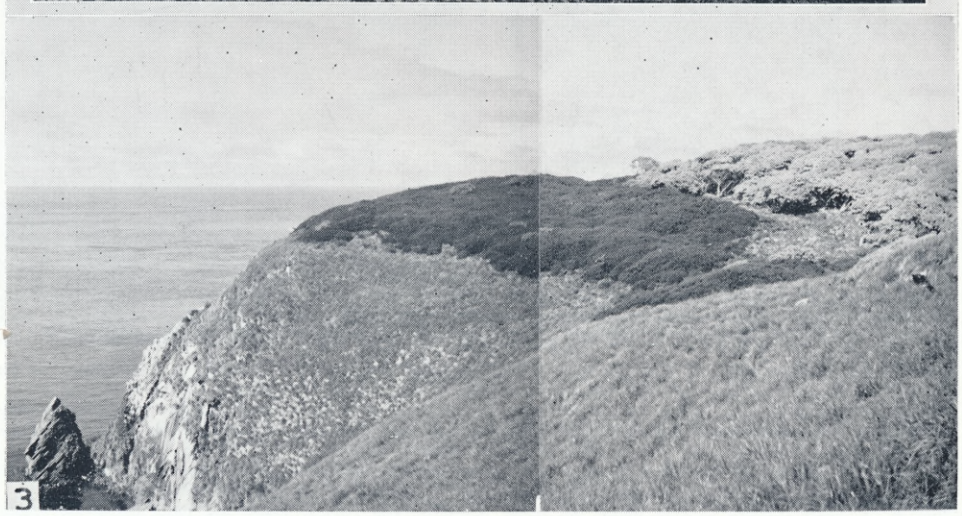


FIG. 1.—View along the north-west coast towards the south-west promontory. The forest on the left is separated from the cliff edge by a narrow strip of tussock grassland.

FIG. 2.—East side of the Main Island, showing the forest in the vicinity of the Boat Harbour. The dark foliage belongs to trees of *Senecio stewartiae*, the lighter trees are *Olearia lyallii*. The new Biological Station is shown to the left of the photograph.

FIG. 3.—A grassland area showing a compact clump of *Hebe elliptica* extending out from the forest margin.

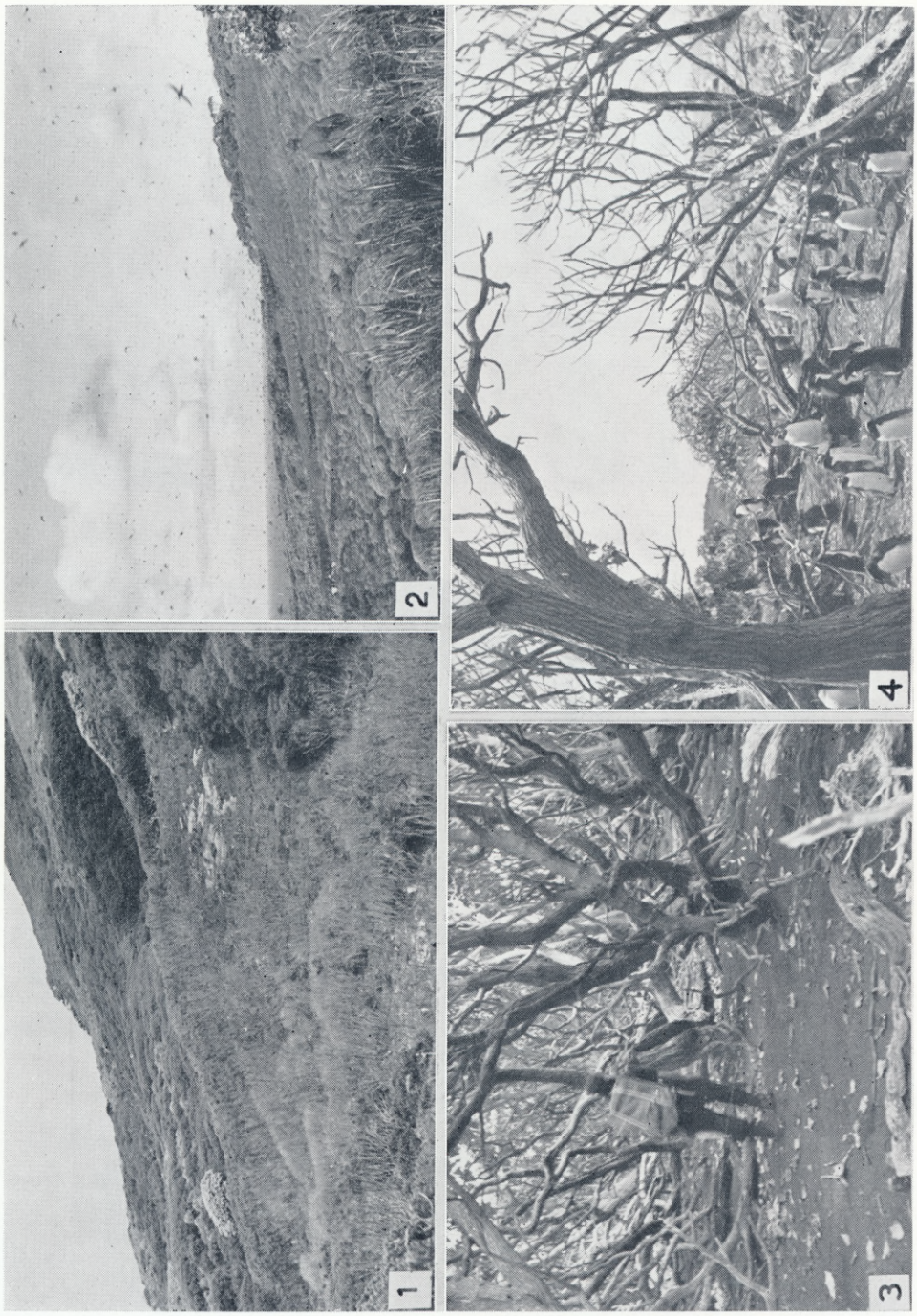


FIG. 1.—An extensive area of *Hebe elliptica* in the neighbourhood of the "Sinkhole". The *Hebe* in the foreground has been recently killed out by penguins.

FIG. 2.—A grassland area along the north-west coast showing the two tussock species: *Poa foliosa* near foreground, *Poa astonii* mid-foreground. The photograph is taken towards evening and shows the sky dense with returning mutton birds.

FIG. 3.—The interior of the forest showing the typical tangled appearance of the branches and the semi-prostrate habit of the trunks. The forest floor is bare peat, except for occasional litter.

FIG. 4.—A small penguin rookery along the forest margin. The *Olearia lyallii* has been killed out where the birds are congregating.

INFLUENCE OF SEA BIRDS ON THE STRUCTURE OF THE VEGETATION

The migratory sea bird population of the Snares is large. The birds breed all over the islands throughout the vegetation with the result that most communities show signs of their presence. For example, the condition of the interior of the forest is attributable largely to the activities of the mutton bird and other burrowing petrels.

The mutton bird is present in enormous numbers on the islands—probably the most numerous of all the sea birds—and through its habit of scratching burrows in the peat to rear the young, the ground becomes honeycombed and the vegetation undermined. This predisposes the trees to being uprooted or to a semi-leaning habit. The weight of the trees and the pressure of wind at the canopy are probably the factors which finally bring this about. Cockayne (1903) considered the prostrate habit of *Olearia* to be inherent in the plant and suggested a study of seedlings in support of this theory. Recent observations of seedlings, however, show that most are normally orthotropic in growth habit, even up to the young tree stage, and not procumbent as Cockayne believed. Further, trees growing in areas where the ground has not been disturbed by burrowing are usually upright in growth. All this suggests that the habit of *Olearia* throughout most of the forest is an expression of the influence of burrowing petrels rather than of the growth habit of the plant itself.

The general bareness of the forest floor is also a result of the activity of the mutton bird and other petrels which inhabit the forest. Scratching and burrowing prevents growth on the forest floor to a certain extent, but perhaps even more effective is the continual trampling of the birds across the ground. Most of this trampling takes place when the birds are returning to or leaving their burrows, in the evenings and mornings respectively. During the day the forest is quiet with the birds away in search of food at sea or in the burrows with their chicks, but in the evening when the birds return (Plate 2, fig. 2) the interior of the forest comes to resemble an extensive poultry run with birds scampering in all directions in search of their burrows. While such an intense daily trampling takes place, it is little wonder that bryophytes and seedlings have a struggle to become established on the forest floor. The only places, therefore, where seedlings grow readily within the forest are areas where the birds are less numerous or on fallen logs and mounds of peat inaccessible to the trampling of the birds. Sites where seedlings grow readily in the forest are former penguin rookeries where the mutton bird seldom burrows.

The general paucity of litter on the forest floor is also connected with the activities of the birds. Much of the litter is found lining the burrows, presumably having been dragged in by the occupants to line their nests. The remaining surface litter becomes finally trampled into the ground by the birds or is blown into hollows where it compacts down to form peat.

Tussock grassland areas also support large numbers of mutton birds, but here their influence is less conspicuous because of the lower stature of the vegetation. Nevertheless, the birds burrow into the peat and amongst the bases of the tussocks. In the case of *Poa astoni* the burrowing into the tussock causes the supporting pedestal to become very unstable. This adds to the difficulty of the traveller making his way through the grassland, as do the burrows in the peat into which one is continually sinking, often to the protestations of the inhabitants. Scratching, burrowing and trampling prevents plant cover in the intertussock areas, as it does on the forest floor.

The second dominant biotic influence beside the mutton bird is the penguin. Unlike the mutton bird, which seldom completely destroys the plant cover, the penguins often kill off the vegetation entirely where the birds congregate (Plate 2,

fig. 4). In a rookery, several hundred birds may be gathered into a comparatively small area and through their intense trampling and defaecations the plant cover is ultimately killed out. As the birds seem to prefer the shelter of the taller vegetation it is the forest and stands of *Hebe elliptica* that suffer the most severely. Probably on account of its shallower root system, the *Hebe* is more vulnerable than the *Olearia*, and often large tracts of the plant may be destroyed (Plate 2, fig. 1). The *Hebe* may be killed off in one season by a newly established rookery, whereas the *Olearia* may survive several years of occupancy before it finally succumbs.

When a rookery is abandoned, the bared area is ready for recolonization by plants. Usually the first vascular plants to take up the site are *Callitriche antarctica* and *Tillaea moschata*. If the site is wet, both usually occur profusely, but if drier the *Tillaea* is generally more abundant. Once a rookery site has been abandoned, and provided it is not re-occupied, the area will ultimately revert to the original plant cover. In the forest this is occasionally shown by small circumscribed young stands of *Olearia* within the main forest. The rate of succession to the original vegetation varies and depends on several factors, one of which is the amount of peat left after the rookery has been abandoned. If the original peat has been worn to bedrock, as on some of the more exposed forest margin sites, then succession may be slowed down by the formation of a new mantle of peat. On the other hand, where the original cover of peat is still extensive, the course of succession is often relatively rapid once the *Olearia* seedlings have established on the peat or in the *Callitriche* and *Tillaea*, which form ideal seed beds.

The outstanding feature of the biotic factor acting on the Snares vegetation is the somewhat indirect manner in which it operates. Whereas in other regions grazing often plays a large part in modifying the vegetation, the grazing influence is absent in the Snares vegetation. Instead, the birds have a more indirect influence through the substratum largely by modifying the environment of the plant roots. The mutton bird does this mainly through burrowing, thus undermining the vegetation. In the case of the penguin the intense trampling action together with the accumulation of nitrogenous defaecatory products modifies the root environment of the plant and should this be prolonged the whole plant may finally be killed. Perhaps the most interesting feature of the Snares biotic factor is its indigenous nature. Whereas most of the other subantarctic islands have been variously infested with noxious animals—originally to provide sustenance for shipwrecked mariners—the Snares have escaped these ravages. This, however, has happened only by chance. According to Reischek (1888) two goats were liberated on the occasion of his visit to the islands; fortunately these did not survive otherwise the vegetation would now be in a depauperated condition. Thus, because the Snares have no introduced vermin and the influence of man on the vegetation has been only slight, these islands afford an ideal site for studying the dynamics of a primeval association between vegetation and animals, enhanced even more by the small size of the islands and the relatively simple flora and vegetation structure.

Here on the Snares Islands is an original part of old New Zealand now awaiting biologists to carry out further studies.

ACKNOWLEDGMENTS

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A NOTE ON THE 1961 SNARES ISLANDS EXPEDITION

During January and February, 1961, a small party of biologists from the University of Canterbury visited the Snares Islands and spent several weeks studying the flora and fauna. The expedition was arranged by the Zoology Department and was led by Professor G. A. Knox. Other members of the party included Dr B. Stonehouse and Mr I. Mannering, of the Zoology Department, and the author, who represented the Botany Department. Finance for the expedition was obtained from grants received from the Nuffield Foundation and the Research Committee of the University Grants Committee (No. C 29). This financial assistance is gratefully acknowledged.

The Snares Islands were selected as a site for biological studies principally on account of their undisturbed nature and interesting flora and fauna. Their relative proximity to the mainland of New Zealand, and the fact that comparatively little is known of their biology, also favoured the selection of the Snares Islands as a site for subantarctic biological research.

In visiting the Snares, the 1961 party had a twofold purpose—namely, to erect a small prefabricated dwelling and to make an initial survey of the flora and fauna of the islands. The hut was erected to accommodate the party and to serve as a biological station for future expeditions—for which it has been fully equipped. The hut replaces the old provision depot—the only other shelter on the islands—built in the eighteen nineties as a refuge for possible shipwrecked mariners. The old depot is now largely in disrepair.

After building the hut, the party set out on their main objective of examining the flora and fauna of the islands, the various members of the expedition concentrating on their respective fields. Professor Knox and Mr Mannering studied and collected mainly invertebrates, recording many new species from the islands. Professor Knox also made a collection of the littoral marine flora and fauna. Dr Stonehouse concentrated on the bird life—ringing a large number of individuals—and on the seals and sea lions. In addition he gathered meteorological data during the expedition's stay and also commenced a detailed mapping of the Main Island. The botanical side of the expedition was covered by the author. This included making a comprehensive collection of vascular plants, bryophytes, lichens and fungi. This collection is now catalogued and housed in the Herbarium of the Botany Department, University of Canterbury. Peat samples were also collected for the Soil Bureau of the Department of Scientific and Industrial Research for soil micro flora studies. Besides the various collections, preliminary investigations were made into the structure and dynamics of the vegetation. Permanent plots were laid down in forest and grassland communities and a belt transect was laid across an inhabited penguin rookery, with the aim of following future changes.

The various biological studies commenced by the 1961 party were but preliminary investigations designed to determine the scope and nature of work that might be carried out in the future. Now that a biological station has been established on the islands, it is hoped that in the near future there will be greater impetus for research on the Snares, as part of the general revival of scientific interest in the New Zealand subantarctic islands.

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