

Botanical Factors

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Early visits to subantarctic islands were limited to a few days duration and the collecting of specimen material naturally took precedence. Cockayne (1903) and Laing (1909) wrote of the plant formations and associations and gave a remarkably complete picture of the vegetation of the day. Since that time certain aspects of the subantarctic flora have changed considerably although the essential elements are the same. In 1951 Oliver and Sorensen named the associations in accordance with the appearance of the vegetation 50 years later.

Climatic Factors: Information obtained at Campbell Island from 1941-47 shows the rainfall to be not high, and with a yearly average of 57in., but the number of days of rain in a year to be excessive, 322. A low amount of sunshine is recorded, an average total of only 685 hours a year. The mean annual temperature is 44.2°F.; the mean monthly temperature is remarkably constant although the extreme range (highest maximum minus lowest minimum) is 41.3°F. Extremely strong north-west winds are experienced and relative humidity reaches high figures.

Edaphic Factors: Soil, as generally known, exists in few places on subantarctic islands which are, in the main, covered with a mantle of peat varying from a few inches to over 40 feet in depth; true peat-bogs are not common, however. Generally there is poor soil aeration, a high organic content, a low nitrogen content, and a pH which is strongly acidic.

Topographic Factors: Altitude has not such a marked effect on vegetation as it has on larger land masses; few peaks rise above 2,000 feet. The slope of the country varies considerably, however, from sheer walls of rock to scree and talus slopes, and steep inclines; there are few flat expanses of any area. Shelter exists mainly in tree or scrub-filled valleys. Most of the country is exposed to often violent salt-laden winds.

Biotic Factors: In the past the climatic, edaphic, and topographic factors, with some influence from endemic biotic factors, have allowed a vegetation to evolve which was well suited to the rather harsh conditions which prevail in these latitudes. Endemic biotic factors still play a part and in this connection should be mentioned the aggregation of mollymawks into dense colonies on eroded ledges. These small albatrosses build large

upraised nests of mud and straw and, during incubation and the growth of the chicks, the surrounding ground is heavily fertilised. The resultant lush growth of late spring and summer is quite a feature of the islands used by these birds. In particular is there dense growth of *Poa ramosissima* and *Cotula lanata* in these places.

The burrowing of petrels, too, helps to aerate the peaty soil in many places and stands of *Olearia* on the Snares, and of *Dracophyllum scoparium* on Campbell Island, are honey-combed in places by these birds.

Penguins, particularly the rockhoppers, *Eudyptes crestatus*, aggregate into dense colonies ranging from small numbers up to thousands of birds and, in one case, at least, to over two million birds, concentrated at about seven to the square yard. In the height of the breeding season these areas are trampled to a quagmire and again heavily fertilised. The usual annual abandonment when the penguins migrate, or when they leave an area together, results in dense growth of *Polystichum vestitum*, *Poa littorosa*, *Poa ramosissima*, *Cotula lanata* and *Cotula plumosa*, in particular. Dense swards and thick clumps spring up and thrive unless further interfered with.

Few other birds show any marked effect on subantarctic vegetation.

The seals, particularly the elephant-seals, modify the vegetation near harbours and beaches. Wallowings of these animals in the softer ground consolidate adjacent areas and huge holes are created. *Poa foliosa*, *P. littorosa* and *Chrysobactron rossii*, as well as many smaller herbaceous plants and grasses, tend to disappear from these places and to be replaced by shorter sedges and grasses on the firmer areas, and water plants in holes.

Insect depredation is comparatively small. Indeed the only plant noted on Campbell Island to be attacked at all severely was *Chrysobactron rossii*, and then only in isolated patches. Attack here is by a large and handsome weevil.

The process of modification of the existing vegetation began when the islands were discovered by sealers at the beginning of the 19th century. Just when rats and mice were introduced cannot be stated with certainty, and their effect on the vegetation is probably not great. The same cannot

be said of most of the other introductions deliberately made with the high ideal of providing food for castaway sailors. Today rabbits have reduced a good part of Enderby Island to a close-cropped turf, whilst cattle on the same island, having eaten out the accessible taller grasses and edible shrubs, such as *Coprosma* spp. and *Nothopanax edgerleyi*, now trim the lower parts of *Metrosideros robusta* and search the sandy beach for kelp.

The introduction to the main Auckland Island of pigs and goats has affected the vegetation there, the goats nibbling shrubs and herbs, and the pigs rooting and disturbing plant associations in their search for edible roots and burrowing petrels. Fortunately, these two animals, and rabbits, although liberated on Campbell Island, failed to survive there.

On Campbell Island sheepfarming was carried on from the latter part of the 19th century until about 1927 and, as early as 1903, the effects of sheep, and of the cutting and burning of tussock and scrub, were evident. In the succeeding years the effects have become more apparent. Cockayne in 1903 describes the fondness of sheep for *Danthonia flavescens*, *Pleurophyllum speciosum*, *Anisotome latifolia*, *Stilbocarpa polaris* and *Pleurophyllum hookeri*. The smaller grasses and tussocks are also mentioned as being attacked by sheep and many other plants are susceptible to their ravages. This destruction has resulted in the almost complete disappearance on Campbell Island of *Danthonia flavescens*, and a noticeable confinement to sea-cliffs and other inaccessible places of the *Pleurophyllum* spp., *Stilbocarpa* and *Anisotome*. The fact that *Celmisia vernicosa* and *Chrysobactron rossii* are not touched by sheep was also mentioned by Cockayne and this fact is illustrated today by the abundance of these plants.

Cockayne mentions the destruction of the *Dracophyllum* stands by cutting and burning. Regeneration of these areas is slow and has not advanced a great deal since 1903 when he described the ground as being covered with *Acaena* mixed with *Epilobium linnaeoides*, *Stellaria decipiens* and *Polystichum vestitum*. Apart from

some juvenile *Dracophyllum* bushes and some *Poa littorosa*, there is little more in these areas today, whilst *Danthonia flavescens* has never regenerated at all on the areas from which it was burned. There is no doubt that the overgrazing by sheep is responsible for this retarded regeneration, and for the erosion scars which are beginning to pock-mark the landscape.

Since Laing's survey of 1909, introduced plants have become more widespread and numerous on Campbell Island, most having arrived accidentally with ship's stores, packing straw, and so on. *Poa annua*, *Stellaria media*, *Rumex acetosella*, *Cerastium vulgatum* and *Hypochaeris radicata*, are foremost amongst these and, even today, when many have spread over almost the whole of the island, Tucker Cove in particular and Perseverance Harbour generally, support a much more concentrated growth of introduced plants than any other part.

The cropping-off of *Poa littorosa*, and the almost complete disappearance of *Danthonia flavescens* and *Poa foliosa*, has resulted in an entirely new association on many parts of Campbell Island. This is an induced association of the introduced *Poa annua* and the native *Chrysobactron rossii*. Many of the less peaty areas show this association in a marked degree, the *Chrysobactron* being dominant in the spring and summer months, and *Poa annua* for the rest of the year.

Perhaps I can conclude by stating that it is not yet too late to remove an alien fauna from most islands and thus to allow regeneration of the peculiar and beautiful native flora of these regions.

REFERENCES

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