

Now that South East Island has been declared a sanctuary and is soon to be cleared of livestock we can be reasonably assured that native flora will regenerate.

I believe that the right approach to some settlers would induce them to establish sanctuaries on their farms. This would not be without sacrifice such as loss of grazing, additional

fencing, maintenance of fences and possibly opossum control at frequent intervals. One family willing to co-operate in such a scheme has commenced to fence-off the sanctuary area. This Society could render a service to future ecologists by supporting schemes to preserve endemic plants in their several natural environments in Chatham Islands.

## Ecology of some New Zealand Seabird Colonies

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Effects of colonial seabirds on the vegetation amongst which they nest fall into three main categories: (a) trampling and track formation; (b) burrowing; (c) manuring. Other biotic influences, such as the grazing mammal and man with his inevitable following of alien weeds, have more general implications but also involve specific aspects. For example, the degree of mammalian grazing and trampling affects the burrowing birds, and many alien plants appear to compete more adequately than indigenous ones in the heavily manured soil of bird colonies, their local distribution being assisted by gulls.

The effects of bird trampling are largely mechanical and the lush growths induced by guano are especially susceptible to breakage. Penguins breeding considerable distances from the sea may form well-defined tracks to the nests, sometimes bare, sometimes floored by nitrophiles such as *Tetragonia trigyna*. On steep tracks trampling may be localised at halting places—bare areas surrounded by guano-splashed coprophiles. Mutton birds nesting in bush often drop vertically through the trees but take off by flapping their way along well-marked flight tracks to the cliff edge, breaking the marginal ferns and fouling the peaty soil.

The most numerous bird species are burrow dwellers and ground may be honeycombed with tunnels affecting both soil water relations and erosion. Friable mineral soils suffer from the introduction of drying air currents and high atmospheric temperatures below ground. These aggravate soil drought and the only surviving plants may be creepers rooted at a distance

(e.g., *Mesembryanthemum australe*) or ephemerals exploiting a period of wet weather (e.g., *Poa annua*). Peat soils in the shady bush and wet climate of Stewart Island get no chance to dry out in this way and burrows assist penetration of water and aggravate soil water-logging—i.e., they make dry soils drier and wet soils wetter.

Mineral soils are often harder than peats, burrowing is hindered and burrows tend to be more superficial, so roofs cave in, causing further breaks in any protective mat of vegetation. Quite large slips may result and the soil so exposed erodes very easily. Domestic livestock trample through into the burrows, consolidating the soil and lessening the amount of erosion in spite of their grazing of the plant cover. Peaty soils are more fibrous and erode less easily. They are softer and burrows tend to penetrate deeper, the surface crust collapsing less readily. On erodible slopes, most burrows penetrate the more stable soil beneath the tree roots or boulders; on slopes consolidated by stock, the looser soil of steep faces between "terraced" tracks.

Diving petrels may form tunnels above ground in *Muehlenbeckia complexa* thickets, *Poa* tussock and sedge.

Where manuring is intense as in shag and gannet colonies all macroscopic vegetation is eliminated during the breeding season, nitrophilous algae such as *Prasiola crispa* and annuals such as *Senecio lautus*, *Stellaria media*, *Poa annua* and *Hordeum murinum* occurring after the birds leave. Where nests are more widely spaced (e.g., some gull colonies), a few peren-

nials (e.g., *Mesembryanthemum*, *Coprosma repens*, *Scirpus nodosus* and *Mariscus ustulatus*) may survive and the growth of annuals is richer. Other guano-resistant plants are *Lepidium oleraceum*, *Tetragonia trigyna*, *Rhagodia triandra*, spp. of *Chenopodium*, *Tillaea*, *Solanum* and *Poa* and a host of aliens. Species able to withstand high concentrations of sea salt in the soil are often able to withstand high concentrations of manurial constituents, so there may be little local change in exposed bird colonies apart from the seasonal influx of annuals. *Urtica* and *Solanum* are examples of taller, soft-leaved coprophiles not associated with birds in the more windswept habitats. The effects of guano on plant roots are more localised in the less permeable, well-buffered peats, but the guano is leached less readily.

Trees such as *Hebe elliptica* and *Olearia colensoi* may be killed by shags nesting beneath them, whilst tree-nesting shags cause the death of branches on which they build and eventually the whole tree—usually *Metrosideros lucida* in the Stewart and Sounds districts, *M. excelsa* in the north. This process is hastened by the defoliation and plucking of twigs about the nests and perches.

Man is the prime mover in the distribution of aliens but gulls assist locally, ejecting viable seeds in pellet form. Many of these aliens are from fertile periodically disturbed soils of farmland and rubbish tips and thrive on the well-manured, partially bare soil of the bird colonies. Annuals, often the most copious seed producers, are able to take advantage of the winter absence of the birds when guano is diluted from toxic to beneficial concentration. Some colonise the nest material and the proportion of aliens to natives almost always rises in the vicinity of nests. This applies in small degree to nesting areas of the true sea birds which, although not

bringing seed, produce a suitable seed bed. Characteristic coprophiles are *Stellaria*, *Atriplex*, *Amaranthus*, *Urtica*, *Poa* and *Hordeum* with *Lolium*, *Bromus*, *Dactylis* and *Holcus* in conditions of medium fertility.

Mammalian grazing is beneficial to burrowing birds, ungrazed vegetation blocking existing burrows, hindering construction of new ones, and trapping the birds. In addition it retains moisture, prevents burrows from drying out, and necessitates the chicks living in a constantly wet atmosphere, leading to unthriftiness and mortality.

Grazed islands off Stewart Island show a mixed ground cover of about 10 equally abundant ferns, ungrazed islands co-dominance of *Stilbocarpa lyallii*, *Poa foliosa* and *Histiopteris incisa*, the last very rare on the grazed islands and possibly a temporary phase on Tia following the removal of goats (but presumably not on Herekopare and Kotiwhenu where it is commented upon by Guthrie Smith (1914, 1925)). In grazed petrel colonies of Stephens Island dominance is shared by unpalatable native tussocks and hemi-cryptophytic alien grasses; in ungrazed colonies by taller alien grasses and woody natives leading back to bush. Heavily grazed parts of the Moko Hinau group show English grasses with *Scirpus nodosus*; lightly grazed parts buffalo grass with pohutukawa pushing through after 50–70 years of no grazing; the ungrazed islands dense *Phormium tenax* with patches of *Metrosideros excelsa*, *Carmichaelia australis* and *Arundo conspicua*.

#### REFERENCES

- GUTHRIE SMITH, H., 1914: *Mutton birds and other birds*. Whitcombe and Tombs, Christchurch, N.Z.  
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