Cushion bog at sea level – but for how much longer?

By Kelvin Lloyd and Molly Ward

The unique cushion bog vegetation growing at sea level in Southland is well known to southern botanists, however it appears that no quantitative description of the vegetation has been published. The most accessible cushion bog site lies at the base of the Tiwai Peninsula, just behind the Toetoes Bay beach. Here the cushion vegetation is dominated by *Donatia novae-zelandiae* and *Oreobolus pectinatus*, with many smaller species also present. The areas of cushion are not extensive, the largest being approximately 10m × 20m in size, but smaller areas are scattered nearby. All are surrounded by a shrubland which is dominated by *Leptospermum scoparium* (manuka), *Dracophyllum longifolium* (inaka) and *Gleichenia dicarpa* (tangle fern), growing to 1-2 m in height. We sampled the cushion bog vegetation in June this year, as part of a wider study comparing the Tiwai cushion vegetation with similar vegetation on the Blue Mountains.

We sampled using 1m × 1m quadrats, each subdivided into 10cm × 10cm subsquares that enabled us to record the shoot frequency of each species in each quadrat. Ten quadrats were randomly placed within a ¼ ha area that included both cushion vegetation and surrounding shrubland, and 12 additional quadrats were limited to the main cushion bog area. Within each subsquare we recorded the presence of all vascular plant species, plus occurrences of rabbit dung (as a measure of raised fertility) and the moss *Sphagnum cristatum* (as a measure of substrate saturation). We analysed the quadrat information by ordination.

Thirty-five vascular species were recorded in total. The ordination (Fig. 1) separates wetland species (*Sphagnum cristatum*, *Baumea huttonii* and *Carex appressa*) at the positive end of axis 1, from a large number of cushion species at the negative end (*e.g Donatia novae-zelandiae* and *Oreobolus pectinatus*), with shrubland

species (*Baumea tenax*, *Coprosma* sp. aff. *intertexta*, *Empodisma minus*, *Gleichenia dicarpa*, *Leptospermum scoparium*) occupying the centre of the axis. The cushion vegetation supported a diverse array of species. Many of the smaller species were largely restricted to it, generally occurring only in quadrats where the dominant cushion species, *Donatia novae-zelandiae*, was present. These cushion specialists included *Actinotus novae-zelandiae*, *Drosera spathulata*, *Herpolirion novae-zelandiae*, *Gentianella lineata*, *Lycopodium ramulosum*, *Oreostylidium subulatum*, and *Stackhousia minima*. Some of the species in the cushionfield, including the only exotics sampled, are associated with the presence of rabbit faeces (Fig. 1), probably invading because of raised fertility. Five of these invading species, *Cerastium fontanum*, *Colobanthus muelleri*, *Hydrocotyle microphylla*, and *Lotus pedunculatus*, were restricted to a single quadrat that had a very high frequency of rabbit faeces.

In the 1980s there was concern that nesting behaviour by black-backed gulls was destroying parts of the cushionfield, via physical disturbance, raised fertility and invasion of weed species (Johnson, 1986; 1988). Five photo points were set up, on both disturbed and undisturbed sites, and have been monitored since 1984. During this time it became obvious that the gulls would have to be removed to prevent further destruction of the cushion vegetation. However, following removal of the gulls in 1987, the modified areas have not returned to cushionfield vegetation, and they remain dominated by exotic herbs and grasses, rushes, and the liverwort *Marchantia berteroana*.

The most striking event recorded in the photographic sequence is a dramatic increase in the height and dominance of *Leptospermum scoparium* and *Dracophyllum longifolium*. This trend is evident at all the photopoints, on both modified and undisturbed sites, and the largest increase seems to have occurred in the 1990s. However Johnson (1986) also noted that invasion by shrubs was reducing the cushion vegetation. Explanations for the recent

increase in shrub vigour at this site remain speculative, but perhaps hydrological changes, or the warming climate, have contributed. It could also simply represent the late arrival of a process that has already occurred throughout the rest of the area. Cushion vegetation has been lost from sites elsewhere in the Awarua wetland complex (Wynston Cooper, pers. com.), and it appears that without intervention, successional processes will eventually overcome it at the Tiwai Peninsula site.

Intact *Donatia novae-zelandiae* cushions have very close-packed stem apices and are remarkably solid. In the main cushion area that we studied, the *Donatia* plants tend to pack tightly together over a relatively large area, and this appears to have hindered shrub invasion. However our study found that *Leptospermum* and *Dracophyllum* were present in almost every quadrat, although sometimes their abundances were low. These shrubs appear to initially invade the cushion area where small gaps are present between *Donatia* plants, and expand laterally from these sites, overtopping the cushion plants. Interestingly, the tiny plant *Actinotus novae-zelandiae* was at its most abundant at the boundaries between *Donatia* cushions and *Leptospermum scoparium* shrubs.

What action should conservation managers take if, as we suggest, the cushion bog is being slowly overtaken by shrubland species? If the process is a natural one, should it be interfered with? We believe (as did Johnson, 1986) that the unique setting and importance for biodiversity of the cushionfield merit active intervention to save it. What sort of intervention would be required? Fire would clearly be an unsuitable tool for reducing shrub vigour, as it also diminishes the cushion vegetation (Johnson, 1986; Wynston Cooper, pers. com.). Chemical spraying would probably also be unsatisfactory, due to pollution effects and damage to non-target species. Unlikely as it may sound, perhaps hand pruning might be the best method of reducing shrub vigour while retaining cushionfield integrity. The area concerned is

small, and shrub growth rates may be slow enough to require only occasional trimming back. A complicating factor is the 'preference' of species such as *Actinotus* for shrub margins, but these could be retained while reducing shrub height. During any visit to the site, care should also be taken not to damage the cushion areas through trampling. We saw several damaged (not by us!) *Donatia* cushions during our survey, these generally being isolated plants or the edges of more extensive cushion areas. Finally, we owe Wynston Cooper a big thanks for facilitating our visit!

Species list

Act.nov: *Actinotus novae-zelandiae*
Bau.hut: *Baumea huttonii*
Bau.ten: *Baumea tenax*
Ble.nov: *Blechnum novae-zelandiae*
Car.app: *Carex appressa*
Cel.grc: *Celmisia gracilenta*
Cel.grm: *Celmisia graminifolia*
Cer.fon: *Cerastium fontanum*
Col.mue: *Colobanthus muelleri*
Copr.sp: *Coprosma* sp aff. *intertexta*
Cya.emp: *Cyathodes empetrifolia*
Don.nov: *Donatia novae-zelandiae*
Dra.uni: *Dracophyllum longifolium*
Dro.spa: *Drosera spathulata*
Emp.min: *Empodisma minus*
Gen.lin: *Gentianella linearis*
Gle.dic: *Gleichenia dicarpa*
Gon.mic: *Gonocarpus micranthus*
Gun.den: *Gunnera densiflora*
Her.nov: *Herpolirion novae-zelandiae*
Hie.red: *Hierochloe redolens*
Hyd.mic: *Hydrocotyle microphylla*
Iso.auc: *Isolepis aucklandica*
Lep.sco: *Leptospermum scoparium*
Lot.ped: *Lotus pedunculatus*
Lyc.ram: *Lycopodium ramulosum*
Ner.dep: *Nertera depressa*
Ore.pec: *Oreobolus pectinatus*
Ore.str: *Oreobolus strictus*

References:

Johnson, P.J. (1986). Waituna Lagoon Reserve: Botanical report on gull colony, bog vegetation, lagoon margin. Unpublished report, Botany Division, DSIR, Dunedin.

Johnson, P.J. (1988). Waituna Lagoon Reserve: Gull colony: Botanical Report 5. Unpublished report, Botany Division, DSIR, Dunedin.

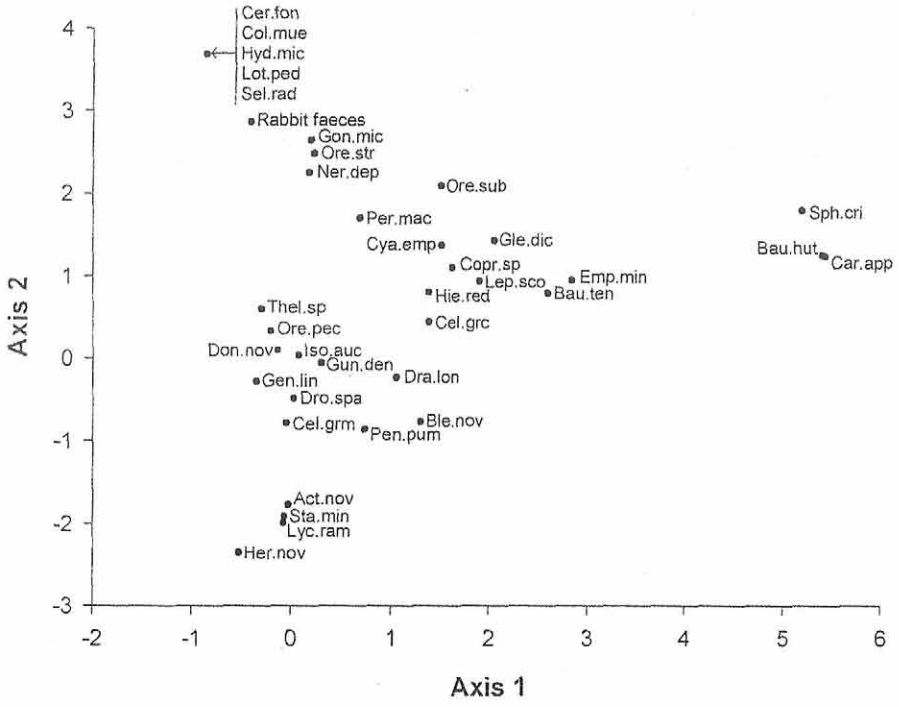

Figure 1. Ordination of species using detrended correspondence analysis (DCA). Species codes are explained in the species list. "Rabbit faeces" is included on the diagram because its occurrence was measured in the same way that plants were. An ordination is designed so that as far as possible, species that tend to occur together (*e.g. Baumea huttonii* and *Carex appressa*) are close together on the diagram, and those that tend not to occur together (*e.g. Carex appressa* and *Herpolirion novae-zelandiae*), are far apart.