

The Ecology of Tussock Grasslands

Chairman: Prof. T. W. Walker

The Plants of Tussock Grassland

Miss L. B. Moore

One fifth of New Zealand carries tussock or bunch grass vegetation related to the so-called steppes of the world (1). Tall-tussock grassland has long been distinguished from low-tussock grassland, but further subdivision awaits basic field work. Failing a classification of vegetation types a plant capability survey reviews the restricted range of growth forms present.

Indigenous plants of the primitive grassland are predominantly long-lived, evergreen, mostly spot-bound, poor in seeding and/or seedlings, and with restricted regeneration from either above-ground buds or subterranean perennating organs. Many, like the tussock grasses, consist of loose-knit potentially independent parts that theoretically need never reach senility; it is not at all unusual for a tussock to live 20 years or more. Growth is slow. Fescues in the Waimakariri doubling their number of leaves in three years (2) contrast strongly with ryegrass in which "vigorous tillers can increase in numbers by 70-100% per week, given adequate light" (3). Size is no guide to age—starved tussocks have remained 2in. high with 6-8 leaves for ten years. Such long-lived plants influence the underlying soil, affecting temperature and frost action (4) and also water relations.

Accompanying plants are often long-lived [e.g. *Dracophyllum longifolium* 110 years old (5)] and annuals and biennials are few. Summer-green perennials include the deciduous shrubs *Discaria toumatou* and fuchsia. Of less woody things that die to ground level in autumn some sprout in spring in the same place (e.g. *Chrysobactron hookeri*, orchids, gentians, forms of *Craspedia*, *Epilobium* spp.); others have extensive underground runners and spread vegetatively, binding soil and shingle (many sedges, the half-buried *Muehlenbeckia axillaris*, the dwarf *Coriarias*, *Urtica aspera*, bracken and

some other ferns). Amongst smaller grasses only one (*Danthonia exigua*) is a real twitch. Creepers root along the soil surface mostly in damper spots (*Hydrocotyle*, *Mentha*, *Nertera*, *Mazus*, *Cotula*, *Pratia* spp.) but species of *Acaena* and *Raoulia* of this growth form extend into drier places. The *Raoulias* grow slowly and live very long though some, e.g. the scabweed *R. lutescens*, are acutely sensitive to shading.

Root system and water requirements have been little studied. Comparatively shallow roots are recorded in *Poa caespitosa* which is particularly successful in moist, shallow soils with good granulation and aeration. *Danthonia flavescens*, *Celmisia spectabilis*, and *Festuca novae-zelandiae* all have longer roots (2 metres or more), but while the *Danthonia*, with crown partly buried, is extremely hard to dislodge, fans of the fescue often come away easily, partly because of insect damage.

Studies of seed production and seedling vigour in tussock grasses (Dunbar, Sewell, Connor) are largely unpublished. The tall *Danthonias* have "seed years"; profuse flowering following burning (6) cf. prairie grasses in Wisconsin (7) perhaps results from greater temperature changes at more exposed growing tips. Little is known of extent and effect of grazing of seed, of seed dispersal, and of soil penetration mechanisms. Few seedlings succeed in bare soil between tussock clumps in badly depleted areas and the reasons are being sought (8).

The more palatable native plants like aniseeds and speargrasses have decreased, but there is much to be learned about the grazing of shrubs. Tussocks are mostly eaten only as young growth or in times of dearth, but big snow-tussocks are cropped by horses and cattle (and *Notornis*) and deer may select between strains. Sedges provide much fodder in seepage areas, and *Hercus* is study-

ing winter sheep use of native grasses in west Otago. Slow growth hinders recovery after defoliation. After spring burning on Maungatua Mark (5) records elimination of snowtussock under heavy, and survival under light, grazing; less palatable shrubs (*Cassinia* and *Hebe* spp.) increased. Fire and grazing generally alter the growth form spectrum, favouring plants with better protected buds, the less palatable, the lower-growing, widely-rooting and mat-forming species, and those with efficient seed dispersal and seedling vigour.

Exotic plants include a host of free-seeding and fast-germinating annuals and biennials not yet fully distributed through the country. Amongst introduced grasses cocksfoot approaches tussock form, sweet vernal and yorkshire fog make a close sward, and turf-forming indigenous *Danthonias* have increased greatly; browntop (affecting water runoff) and *Poa pratensis* are of the twitchy habit previously little represented. These grasses are palatable at some stage, produce plenty of good seed, and fill available ground under higher rainfalls. The most important new creeping plant, white clover, has reached damp gullies remote in fescue tussock grassland. Sheep's sorrel with tough extensive roots to several feet deep, well protected buds, and free seeding is even more widespread; it is a good soil binder, tolerates grazing, resists frost and drought, and prepares bare ground for invasion by yorkshire fog. *Hypochaeris radicata*, also far-ranging, is eaten seasonally (9) and should be nutritious (10). Flatweeds of the genus *Hieracium* will certainly spread further and are grazed in hard places (11). The deciduous shrubs briar and gooseberry

provide some forage, have efficient seed dispersal and germination and sprout vigorously after damage, briar often from roots distant from the main plant. *Pinus murrayana*, a tree that throws good seedlings when still young, is spreading.

Good management maintains low-growing palatable plants between protecting tussocks but under higher rainfalls scrub is a serious problem. In drier parts exotic annuals and biennials and low-growing natives are the main cover, suggesting that we would have much more desert if exotic plants had not come in along with exotic animals. Though snow-tussocks occupy some relatively low-lying and easy-contoured land the steeper tall tussocks die, unless scrub invades, more soil of introduced plants and there, as the snow-tussocks die, unless scrub invades, more soil is exposed to erosion, with spectacular, costly and apparently irreversible results.

To sum up, the total area of tussock grassland, offering a huge variety of growing conditions, is occupied by plants with a limited but largely undetermined range of response to climate and utilization. A primary need is a stocktaking and subdivision into ecological units correlated with the potentialities and limitations of the plants present, leading to a definition of those niches for which no suitable species are at hand. As long as tussock grassland is to be retained it must be remembered that, because its dominants are perennials with very long lives, it has many of the characteristics of a forest and few of those of a short rotation pasture. Like a forest, it is the product of a long slow development, and like a forest it is much easier to destroy than to rebuild.

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