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GUEST EDITORIAL: PETER BANNISTER

Peter Bannister *was born in England, completed a B.Sc. in botany at Nottingham University and a Ph.D. at the University of Aberdeen, on the water relations of heath plants. This combination of ecology and physiology was somewhat novel at the time, and taught him to tread carefully along the narrow line between supervisors in opposing camps. Research on the water relations, resistance to drought and heat, mineral nutrition and carbohydrate economy of heath plants, and the production of a popular introductory text on physiological plant ecology, continued during lectureships at the Universities of Glasgow and Stirling. He was appointed Professor and Head of the Botany Department, Otago University in 1979. The shift to a totally alien native flora was initially traumatic (although ferns at least had familiar genera) and contributed to an unhealthy interest in introduced species (including, of course, heather in Tongariro National Park), and a desire to determine some of the physiology and tolerance limits of native plants in order to force them into (his) ecological context. As a perennial Head of Department (he is currently enjoying his fourth term) he has not had as much time for research (or even thought) as he might have liked. However, he is wholly or partly responsible for at least 60 refereed papers on various aspects of plant physiology and ecology. Sabbatical leave has been a welcome bonus that has enabled a modicum of research, writing, and thinking. He has recently returned from leave based at the University of Liverpool's Botanic Gardens at Ness, in Cheshire, England, where he re-visited his interests in heath plants, and made botanical excursions to Ireland, Crete, and Madeira. He found Madeira particularly interesting for its sub-alpine heather woodland, as the origin of many plants naturalised in New Zealand, and for its own crop of naturalised aliens, including mixed stands of gorse and manuka along montane road-sides (an apposite association in view of what follows).*

Upon this blasted heath[1]

In September 1994, I returned from a year's sabbatical leave in Britain. Some of my time was spent examining heaths and heathers, species that I studied extensively before I settled in New Zealand in 1979. I was intrigued by the contrast between European and New Zealand attitudes to the Scotch heather, *Calluna vulgaris* (L.) Hull. In Europe, heather moorland, particularly lowland heathland, is "blasted" - a degraded and threatened community which must be preserved and restored: in New Zealand heather is "that blasted heath" - an aggressive invader poised to take over vast tracts of land. How can the same species be involved in such different scenarios?

In Europe, lowland heathland has long been under threat. It is a successional community that was invaded by trees (particularly birch and pine) when management practices (usually burning and grazing) became lax (e.g., during World War II). More devastating, however, was the conversion of heathland for other uses - notably agriculture, forestry and housing. There was, and still is, considerable support to preserve the areas that were left. These were often fragmented and subjected to recreational pressure, and many of them began to decline further. In The Netherlands, heather was displaced by grasses and killed by attacks of heather beetle, whereas, in Britain, bracken was often invasive. Some of the decline may have been due to reduced management encouraging succession to occur, but other factors have been

[1]W. Shakespeare: Macbeth, Act 1, Scene iii.

eutrophication due to agricultural chemicals or to increased input of nitrogen from nitrogen oxides in atmospheric pollution. Restoration is a complex process: it may involve removal of trees, clearance of bracken and scrub with herbicides, acidification of the soil by chemical means and mulching with chopped or macerated heather, depletion of soil nutrients by repeated harvesting of above-ground vegetation, and the introduction of propagules by the application of seed, litter, or transplantation of turves (Gimingham, 1992). Successful re-establishment has not proved easy.

Heather is spreading in New Zealand, particularly on the Volcanic Plateau, and is seen as a threat to native communities, particularly tussock grassland. The main emphasis is on control and possible elimination. We obviously need European experience in what makes heather decline, while the Europeans need unstoppable New Zealand heather to recolonize their heathland.

What characteristics of heather make it a pest in New Zealand? With hindsight one can envisage many reasons. New Zealand provides many habitats which match the climatic and edaphic range of heather in Europe; heather is an early successional species which produces abundant, light and easily dispersed, seed that forms a persistent seed-bank. It also spreads vegetatively by layering and is encouraged by disturbance, including fire. There is also a lack of natural predators and the heather beetle (*Lochmaea suturalis*) is in the process of being assessed for introduction as a biological control. Heather also has some economic value as a source of honey, and is attractive to tourists - these factors have almost certainly encouraged its retention and spread. But heather is not spreading all over its range. Despite efforts to restrict its sale (Craw, 1994) there is little evidence that its primary spread was from gardens into the wild. To my knowledge, all areas of naturalized heather in New Zealand originated from deliberate seeding and planting rather than accidental introductions. New Zealanders have been more successful at synthesising heather moorland than their European counterparts, although heather does not always show invasive spread in New Zealand. For example, in the South Island it has persisted in the Mount Cook National Park for decades without obvious spread and it is confined to small bogs near Balfour in Southland, and does not spread beyond them, although it is invasive in the Wilderness Reserve near Te Anau. Even in the North Island, where outliers are now established beyond the southern margin of the Volcanic Plateau, it is not always invasive and has declined on the Pouakai Range in Egmont National Park (Rogers, 1994).

Many characteristics of *Calluna vulgaris* are shared by other introduced ericaceous species. The bell heather, *Erica cinerea* L., is a primary coloniser of heathland after burning but has not shown invasive spread, whereas the Spanish heath, *E. lusitanica* Rudolphi, is, if anything, MORE invasive and widespread than *Calluna*. What subtle differences are involved? The simple answer is that we just do not know.

The adventive flora of New Zealand may provide some answers: as we are all aware, it contains at least as many species as the native flora. While earlier floras often mentioned adventive species, Volumes I and II of the *Flora of New Zealand* studiously ignored them. Somehow, botanists were supposed to have an instinctive knowledge of what was a native plant. As a neophyte myself, it took me a long time to track down *Nemesia floribunda* Lehm., which is common in the Dunedin area and which seemed to have all the characteristics of New Zealand native herb (small, insignificant, with white flowers). I welcomed the advent of volumes III and IV of the *Flora* with considerable relief, and look forward to the volume dealing with grasses.

The separation of the flora of New Zealand into native and non-native species had always struck me as anomalous. The native flora of New Zealand is unique, a taonga, and must be studied and preserved, but there is no unmodified native vegetation in New Zealand; extinctions of native fauna and introductions of exotic fauna (including humans) have seen to that. Ignoring naturalized species will not cause their disappearance, most are here to stay, a fact well recognized by animal ecologists dealing with introduced mammals:

> "The combination is not natural, but it exists as a working, evolving community of mammal species. We may attempt to manage some species according to our present philosophy and needs; but ultimately the community will continue to evolve according to processes largely beyond our control" (King, 1990).

Naturalized plants are certainly not prime subjects for botanical research, which is hardly surprising in New Zealand where, in contrast to Europe, there is still a substantial area of relatively untouched native vegetation. Nevertheless, most of New Zealand is dominated by induced vegetation in which native species are often a minor component and, realistically, this is the vegetation of the future, and worthy of study in itself. Many adventive species are probably already distributed with respect to their environmental tolerances (Ullmann *et al*., 1995) and are therefore unlikely to become

invasive, but to preserve the native vegetation we need to predict which species (whether already established or yet to be introduced) are potentially invasive. One approach would be to order or classify adventive species by whatever characteristics we deem suitable, and ascertain whether any set of attributes is common to invasive plants. Volumes III and IV of the *Flora of New Zealand* provide a valuable data-base, and the knowledge that has been accumulated in the countries of origin of our adventive flora could be added to such a data-base. This might allow us to predict which species might become invasive.

However, expediency demands that predictions must be made. The "forest friendly" list (Craw, 1994) includes species "that have considerable potential for further environmental impact" and includes "rarer ones" which "have yet to reach anywhere near their full potential". In the same article, new successions have been predicted for forests "where African club moss or periwinkle smothers the forest floor" and "the new climax species is now morning glory or Japanese honeysuckle". It will be interesting to discover whether such predictions will be borne out in practice. If they are, then we can say "I told you so" but the damage will have been done: if not, it might or might not be due to the success of any control measures. Predictions are most likely to be successful if a species which is invasive elsewhere is introduced into areas with a similar climate, vegetation and disturbance regime. Wild ginger (*Hedychium* spp.), banana passion-fruit (*Passiflora mollissima* (Kunth) L. Bailey) and lantana (*Lantana camara* L.) are invasive weeds in Hawaii and are already well established in areas with a similar climate, such as the northern areas of the North Island. Do such invaders share common characteristics or is each a special case?

An ability, or even an attempt, to predict whether a species will be invasive, implies that we know, or think we know, what characterises such a species. How successful have attempts to find common characteristics for invasive species been? The answer is, I am afraid, "not very". The characteristics of an "ideal" weed (Barker, 1965) are often cited, but not all weeds are invasive. Noxious (and thus presumably invasive) species have been classified to identify suites of characteristics that are associated with different types of invader (Newsome and Noble, 1986), but other species with a similar suite of characters may not be invasive. Comparisons of successful and unsuccessful introductions provide one approach; e.g., the study of bird introductions to and within Australia (Newsome and Noble, 1986), or comparisons of congeners with different invasive capacities (Roy, 1990).

Ultimately, the characteristics of the invader must be considered with respect to environment which it invades (Roy, 1990). This may involve concepts such as "invasion windows" (Johnstone, 1986) which allow passage of species on to "safe sites" (Harper, 1977), but systematic investigation of the characteristics of invasive species from the adventive flora would be a first step towards a more scientific prediction of what species are likely to become invasive in New Zealand. This is not a new idea:

> " I would venture to suggest to you to urge on some of the capable members of your institution to observe annually the rate and manner of spreading of European weeds..." [Charles Darwin: letter to Julius von Haast, 22 January 1863].

What more need I say?

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