Friend or foe? Potential for native biodiversity in West Coast farming

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Abstract
The wet, warm West Coast climate favours tree production and pastures. Much of the land remains in indigenous forest under the control of Government agencies. In the more accessible parts of this land, and in land held under private ownership, we explore the feasibility of "farming" two examples of native biodiversity. Sphagnum moss production varies with location and differences in meso- and micro-climate. A climate model was used to predict where future sustainable sphagnum development may occur; i.e. within farming systems in the areas with the fastest growth rates. At its simplest and cheapest, this may involve flooding unimproved land and managing the moss. Another alternative could involve integration of moss production in the wet "hollow" of "hump and hollow" pasture systems. The West Coast retains several unique populations of kiwis and other indigenous birds. We advocate the future role of private enterprise (i.e. land-holders) in protecting kiwi and, in the longer-term, the local communities profiting from ecotourism centred on them.

Keywords: climate modelling, eco-tourism, kiwi, sphagnum moss

Introduction
West Coast is wetter than other parts of New Zealand, it is also remarkably sunny, subject to few frosts, and low altitude sites are relatively calm. Annual mean daily temperatures are moderate down the length of the West Coast (Table 1), but cooler temperatures can be expected at higher altitude.

The climate ensures the environment is excellent for the growth of trees, pasture and other standard crops which are harvested at a vegetative stage of growth. The indigenous vegetation in northern and central parts of Westland was podocarp/broadleaf forest with silver beech/mixed podocarps in the southern parts. Above the bush line were alpine tall tussock grassland and alpine herbfields. The layered structure and diversity of trees in podocarp/broadleaf forest encouraged a large faunal (essentially bird) biodiversity, part of which remains. The development of an impervious pan in the soil beneath some trees ensures that there are wet sites which are ideal for the growth of mosses such as sphagnum moss.

This paper studies two examples of commercial use of native biodiversity of West Coast. Neither are novel but their presentation seeks to put the special properties of West Coast in a national context, and recognises changing attitudes to our native plant and animal resources. The first study involves sphagnum moss harvesting using a climate model and measured growth rates of sphagnum to extrapolate moss growth potentials in different geographic locations in West Coast. The second looks at the concept of developing tourist enterprises around the rare experience of associating with real kiwis in the wild in New Zealand.

Example 1: Sphagnum moss
Sphagnum moss belongs to the peat moss family and thus exists in bogs and swamps. It requires water-logged conditions and regular wetting. In West Coast, mean annual rainfall is plentiful (Table 1). Rainfall is consistent; there are at least 160 rain days (at least 1mm/day) per year. Rainfall is generally in excess of soil requirements, and runoff (see Table 1) is predicted in all months at all West Coast sites.

The most commercially valuable species, *S. cristatum*, has a huge capacity to absorb moisture per unit mass of dry weight (e.g. 12- 30 times dry weight, Maseyk *et al*. 1999). For this reason and the fact that it is a relatively sterile growing media, it is largely used as a media for

Table 1 Summary of meteorological data for West Coast sites.

	Westport	Hokitika	Haast	Milford Sound
Annual rainfall (mm)	2150	2870	3490	6240
Annual rain days	169	169	na	182
Mean daily temperature (°C)	12.1	11.0	11.0	10.3
Annual sunshine (hrs)	1937	1883	1918	na
Annual frost days	27	na	37	55
Annual runoff (mm)	1510	2070	2710	5635

na long-term data not available.
source: Hessell 1982.

valuable display orchids, and as a general potting mix. Historically, New Zealand troops at Gallipolli may well have had their wounds bound in bandages containing sphagnum, which acted as an absorbent and had antiseptic properties. The mosses are supremely adapted to low fertility and are highly nutrient efficient – essentially getting all nutrients from rainfall and the atmosphere. The mosses reproduce by fragmentation and by producing large numbers of spores, which germinate in favourable areas (Sundberg & Rydin 2002).

Sphagnum grows from the low altitude coastal strip to alpine bogs. Its growth is affected by meso-climate (especially rainfall and temperature), but is also affected by site factors e.g. shade, availability of nutrients, and competition from other plants. Ideally sphagnum is harvested at about 30 cm length. Sustainability is best achieved by leaving a 20-30% residue of moss and not re-harvesting for 3 to 10 years depending on growth rate of the moss (De Goldi 1984). However, there can be problems with poaching and security of tenure which result in exploitive harvesting and reduced sustainability.

Sphagnum moss harvesting currently occurs over about 1.3 million hectares i.e. about half of the areas of moss swamps in West Coast. The non-harvested areas are in National Parks or are otherwise protected. Exporting to Japan began in the 1980's. Export returns shown in Table 2 had reached a plateau by the late 1990's.

Sphagnum growth was measured during 1990-1991 at a series of 4 sites: Lewis Pass, Maruia, Hokitika and Ianthe (Buxton *et al*. 1991; Figure 1). Annual growth rates varied from 10 cm to 0.9 cm with meso-climate (lowland to montane). Maximum growth rates were recorded at Hokitika on the lowland coastal strip. Annual growth rates were modified by micro-site variation. At Hokitika annual growth rates of sphagnum were compared in three sites: an open bog (with rushes, *Juncus effusus*); in short *Coprosma* spp. scrubland; and under a kamahi forest. Growth rates were 9.5 cm, 6 cm and 1 cm respectively (Buxton *et al*. 1991).

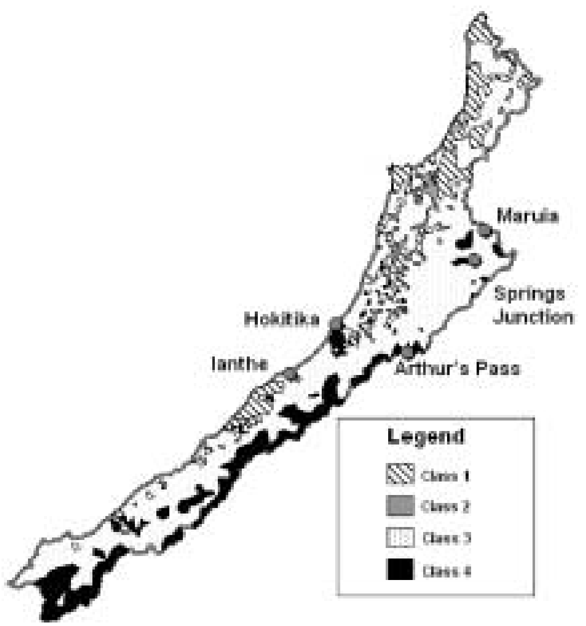
To relate moss growth rates to the different meso-climates in West Coast, we used a modelling approach that integrates topography with climate parameters such as rainfall, temperature and solar radiation (Hutchinson & Bischoff 1983; Nix 1986). Areas that have similar

Table 2 Value of sphagnum moss exports for selected years (millions of $ N.Z.; Freight on Board).

Year	1983[2]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]
Sphagnum moss	1.6	17.3	15.6	13.4	12.8	13.3

[1]ex Statistics New Zealand (e.g. Mirams M. Review of horticultural exports for year ending 30 June).
[2]De Goldi 1984.

Figure 1 Map showing climate classification (simplified to four classes) for West Coast, and sphagnum study sites (circles).



combinations of climate variables can be grouped and mapped. Plant growth can then be related to the climatic environment (Mitchell 1991; Leathwick & Austin 2001). The method provides ways to extrapolate potential moss growth rates from specific experimental sites to the West Coast Region.

A simplified classification into four classes demonstrates an initial application of the technique (Figure 1). Class 1 areas with the high growth rates (warmer, moist environments: annual rainfall 2000-3000 mm; annual hours of sunshine ca. 1900; annual mean daily temperatures 11.0 -12.1 ^{o}C; ca. 27 frost days per year) comprise 15 % of the West Coast region. Class 4 areas with the slowest growth rates (cool with high rainfall: annual rainfall >3000-4500 mm; annual hours of sunshine <1500; annual mean daily temperatures ca. 8.5 ^{o}C; ca. 130 frost days per year) represent a further 15% of the region. The remaining classes (69% of area), have intermediate environments and growth. In conjunction with other information from topographical databases, this provides a powerful planning tool for sphagnum management. The spatial mapping can be used for yield prediction and optimising resource allocation for development. Further refinement, modelling the climate at finer scales (500 m^2) and matching more sphagnum growth rate sites to climate classes will improve this mapping.

The greatest potential for future sphagnum development may occur within farming systems in the areas where the fastest growth rates were modelled. Sphagnum harvesting may be an alternative to pasture development. Some farmers, e.g. Seth Robinson and subsequently Mike Brooks near Kumara Junction, have sphagnum moss as the major source of income on their farms. Sphagnum fields were established on the Kumara Junction property by encouraging flooding and managing the moss. We suggest also investigating techniques to integrate moss production with "hump and hollow" pasture systems. De Goldi (1984) saw a similar opportunity to grow sphagnum in association with "ridge and hollow" pine planting.

The success of such ventures may depend on the extent of fertiliser nutrients movement into the "hollows" in a "ridge and hollow" system, and the practicalities of grazing pasture "humps" while protecting sphagnum "hollows" from animals. Excess nutrients are likely to encourage the growth of plant competitors of moss, which contaminate the sphagnum and increase its cleaning costs. However, small amounts of nutrients have been shown to increase sphagnum growth in a pilot greenhouse study (Smale 1997).

Example 2: Conserving and displaying native wildlife e.g. kiwi

The West Coast region has the unique advantage over most other areas of New Zealand because rare native birds such as the kiwi are still found in pockets within the native forest vegetation (Figure 2, see also Wilkinson

Figure 2 Kiwi distributions in the South Island.

Source: http://www.kiwirecovery.org.nz

& Garratt 1977; Coker & Imboden 1980). The region is richer in kiwi diversity than the North Island; there are four recognised species or subspecies of kiwi in Westland compared with two in the north (Table 3). West Coast has the Great Spotted Kiwi in the wetter (> 4800 mm) areas in the north-western part of the South Island, and Brown kiwi subspecies: Okarito Brown Kiwi about Lake Okarito, Haast Tokoeka about Haast, and Southern Tokoeka in Fiordland. This can largely be attributed to the often-maligned crown ownership of much of the land during the past 150 years (87% of region; 78% in conservation estate), the retention of native forests, and the restricted urbanisation. However, latest bird population statistics indicate that several of the kiwi populations are very small (Table 3), and many kiwi populations are declining rapidly; e.g. North Island brown kiwi are declining at 5.8% per annum due to heavy predation by the combined activities of dogs, cats, ferrets and other mustelids, rats, possums and pigs (McLennan *et al*. 1996). In natural conditions about 95% of kiwi chicks do not survive to 6 months of age when they can fend for themselves (Basse *et al*. 1999; McLennan *et al*. 1996). To maintain present populations of the birds it is estimated that chick survival has to be raised to 19% (McLennan *et al*. 1996).

"we will maintain a stated minimum population of any particular native animal or plant species within our boundaries". Claridge & Kerr (1998), in a paper to New Zealand Treasury, felt there was a need to regulate for kiwi protection and provision of appropriate habitat. We believe the initiative for protection of kiwis has to be taken at a community level; that the community should recognise that it is taking the initiative on behalf of the majority of New Zealanders who do not have the inclination to take such positive action; and the community should thus expect some benefit from its actions. Such benefits may be in the form of grants to get the systems running, removal of bureaucratic barriers, and eventually a livelihood developed as a consequence of the conservation of the bird.

In a similar way that the early deer farmers enticed deer onto their properties, groups of West Coast landowners have the chance of encouraging survival of a viable population of the birds by removing predators (by trapping, shooting and/or poisoning) and providing them with a safe habitat. Because kiwi may have large territories, and because predator control is likely to involve several properties, and possibly because DoC is often likely to be a neighbour; the enterprise can be expected to involve groups of landholders including DoC. Predator-proof fencing has been patented (Wallace 2002); it is effective but expensive at $70-$90/meter. Fencing costs lead the Coromandel kiwi sanctuary to rely on predator trapping and enhanced public awareness to protect kiwi.

Table 3 Estimated numbers of different kiwis in 1923 and 1998 on the three main islands of New Zealand.

Species/subspecies	1923	1998	Current distribution
North Island Brown kiwi	2,640,000	35,000	North Island especially Northland (lowland indigenous forest)
Okorito Brown kiwi (*Apteryx australis*)	11,000	140	Okorito area West Coast (dense lowland forest)
Haast Tokoeka	18,000	250	Haast area West Coast (sea level to bushline)
Southern Tokoeka	530,000	6000	Fiordland (forest) mountains to sea;
	20,000	20,000	Stewart Island (sand dunes to tussock grassland)
Great spotted kiwi (*Apteryx haastii*)	1,760,000	22,000	NW of West Coast and Nelson (>4800 mm rainfall)
Little spotted kiwi	3000	0	Survives only on a few offshore islands

Sources: mainly Robertson 1999; www.learnnz.org.nz 2000.

Gross kiwi chick mortality rates must finally awaken New Zealanders to the possibility that the birds will become extinct in the wild unless they are better protected from predation. However, no one appears to take responsibility for maintaining the national kiwi stock. All South Island Regional Councils have a policy to encourage biodiversity, to support the protection of specified units of land and their accompanying biodiversities (often reserves managed by the Department of Conservation (DoC); also significant natural areas in the West Coast region), but none specifically state that

DoC's mainland island scheme of protecting fauna from predators by trapping has been a demonstrable success for kiwis at Trounson kauri park, Northland (50-85% chick survival, Gibbs 2001). Similarly, ring trapping by local communities and DoC at the three kiwi sanctuaries in the North Island (Northland, Coromandel and Tongariro), has improved chick survival rates to about 50% (J.Roxburgh pers. comm.). There are as yet no such kiwi community groups in the South Island although there are two West Coast sanctuaries (Okarito and Haast). In all existing kiwi projects it has proven necessary to employ at least one professional trapper to do the trapping and coordinate the community trapping process. Costs for kiwi protection vary with terrain, use of fences or not, and the amount of radio-monitoring of kiwi; estimated costs range from $6 to $48 per ha ($250-$770/kiwi).

West Coast kiwis exist in a wide variety of habitats (Table 2). Also Giradet (2000) has shown that the feeding behaviour of Little Spotted Kiwi varied with the diet available to it. She concluded that this kiwi could survive in most New Zealand habitats with at least a partial diet of forest invertebrates and so considered the birds were sufficiently adaptable to be tried in a range of environments.

The opportunity for farmers is to provide a safe environment for the birds, access, watching hides close to nesting burrows, a commentary on the ecology of the species and their daily behaviours; audio examples of the sounds of kiwi and other nocturnal birds and animals known to occur in the region; access and guides to other nocturnal wildlife activities in the forest canopy and on the canopy floor, in streams or possibly in caves etc.; accommodation and neighbourliness. We see wildlife tourism development as a cooperative activity. It is unlikely to be successfully undertaken by an individual, more likely by communities, ideally by the whole West Coast community. Spin-offs can be expected for many individuals in the community. Labour and skills are required for predator trapping, egg collection/incubation, bird rearing, provision of a suitable diet for juveniles reared, for gaining knowledge of where birds are nesting, for setting up hides, for developing tracks, for tourist guiding, and for hosting. Eventually the birds could become a wildlife attraction which many New Zealanders and most overseas tourists will want to see and/or hear in their natural surroundings. Thus the West Coast could market itself as a wildlife destination. The important thing is to think of the scheme as a regional one. For example, although only a handful of albatrosses initially attracted a few tourists to Otago Peninsula, the length of the Otago coast from Oamaru to the Catlins is now a tourist wildlife destination. Yellow-eyed penguins, blue penguins, other seabird and mammal life vie with the albatrosses for attention. The albatross colony at Taiaroa Head has 45 000 visitors to the colony per year, but 120 000 people visit the Otago Peninsula for the variety of sea bird and mammal life (Royal Albatross Centre pers. comm.).

These are only two examples of using endemic biodiversity; there will be many others: possibly punga plantations, or edible fungi from rain forests, or medicinal plants, or the management of other rare animal species. Current West Coast people have an opportunity to at least maintain *the* New Zealand icon in the South Island and develop industries around our biodiversity. Nurture of our indigenous biodiversity by local communities will benefit both. The first step is to develop a compatible partnership between the crown, especially DoC, and West Coast communities. There is no better time to begin than now in terms of interest, funding, and available expertise. Assistance with funding and ideas can be sought from different government and non-government agencies: e.g. the Industry New Zealand Regional Partnerships programme supports clusters of related organisations that work together to grow their businesses; the Queen Elizabeth II National Trust, the Native Heritage Fund, the Native Forest Restoration Trust, and Nga Whenua Rahui are avenues to seek government spending to protect and maintain biodiversity on private land. With kiwis, assistance with expertise will come automatically with collaboration with DoC staff, and further assistance may be available from Technology New Zealand development grants designed to assist people to develop technical skills relevant to an enterprise accepted by the sponsoring department.

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