The Banks Peninsula Forests and Akaroa Cocksfoot: Explaining a New Zealand Forest Transition

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ABSTRACT

This paper traces the dynamic of a rapid transition from forest to grass on Banks Peninsula, South Island, New Zealand, from 1850 to 1900, as well as the subsequent partial transition back towards forest. At an early stage a symbiotic relationship emerged between forest clearance and pasture cropping for cocksfoot seed, wherein the success of the conversion in one locality aided and abetted similar conversions elsewhere. For fifty years, 'the seed that followed the sawmill' was the basis for an international trade in cocksfoot, turning a peripheral area into a key production hearth in the global grass seed trade. The local and international conditions that led to the demise of the industry after the First World War are explored, to assess why the cocksfoot industry proved little more sustainable than the Peninsula's timber industry had been. In turn, it made way for the regeneration of the forest which is increasingly evident today.

KEYWORDS

Banks Peninsula, New Zealand, forest transition, grass seed, cocksfoot

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INTRODUCTION

In 1840, when organised European settlement began on Banks Peninsula, an eroded volcanic landscape protruding on the east coast of New Zealand's South Island, half or more of it was covered with indigenous forest. Yet by the start of the twentieth century, only isolated fragments of this forest remained, its place having been taken by a simplified landscape of European pastures. The speed and extent of this deforestation was remarkable, given that the Peninsula's hilly terrain meant that a good deal of the forest could not be harvested by sawmillers. Even the highest hilltops and steepest gullies, however, would prove no match for the invasive purpose of the new grassland farmers.

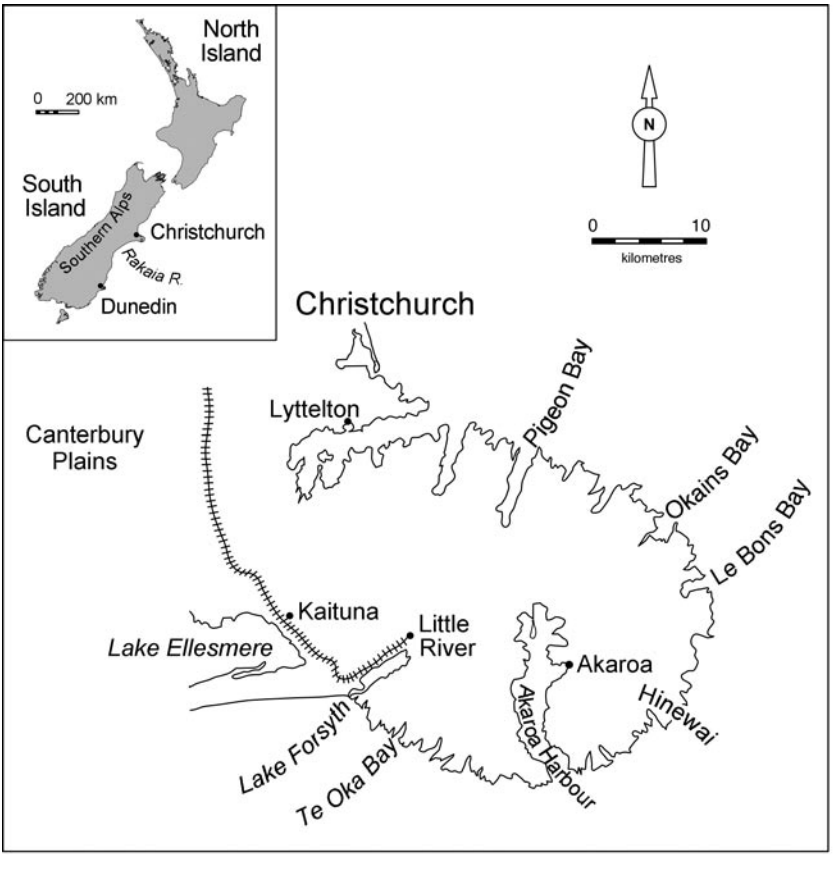

FIGURE 1. Location map.

Outwardly it might have seemed far easier to introduce grasses to the extensive plains stretching over 200 km to the south and 100km to the north of Christchurch, which in the 1850s became the main town of the Canterbury region (Figure 1). What was exceptional about the forest to grass transition on the Peninsula, however, was that the livestock being depastured soon became less important than the grass crop itself. One grass in particular, cocksfoot (*Dactylis glomerata*), sourced from Europe, thrived in the conditions to such an extent that 'Akaroa cocksfoot' (named after the Peninsula's largest harbour) gained renown throughout the temperate European and neo-European lands of the world, as well as becoming the seed of choice when settlers elsewhere in New Zealand proceeded to clear forest lands. An area of not more than 1000km^2 in size thus became for a time a key production hearth in the global grass seed trade.

Akaroa cocksfoot was nevertheless a fading star by the 1920s, and by the 1960s the industry had disappeared altogether. In the second half of the twentieth century, a new suite of landscapes, designed to provide tourism and recreation goods as much as agricultural exports, was created in the place of cocksfoot pastures. In keeping with this change, the forests of the Peninsula, which have come to be perceived as valuable sites of scenic amenity and biodiversity, have begun to repossess the Peninsula's slopes.

The purpose of this paper is to trace the developments which have shaped this transition from forest to grass and back towards forest on Banks Peninsula. It examines the changing factors over time which promoted the conversion from forest to grass. In doing so, it also highlights the symbiotic relationship that developed between forest clearance and the production of Akaroa cocksfoot for wider markets, wherein the success of the conversion in one locality aided and abetted similar conversions elsewhere. It also examines why the cocksfoot industry proved little more sustainable than the Peninsula's timber industry had been, and thus made way for the regeneration of the forest which is increasingly evident today. The literature on forest transitions is employed to frame an understanding of these trends in a wider analytical context, whilst in turn the paper seeks to enlarge this literature with an historically and geographically grounded case study.

FOREST TRANSITIONS

The concept of the 'forest transition' is a relatively new one in the literature of environmental history. When first coined by Mather in the 1990s, it was used to describe the turnaround observed in many countries from a sustained period of deforestation in the past to a slow recovery in the area under forest in the present.[1] Mather himself used it in relation only to the turning point in the forest cover trajectory, although in this paper it will be used in a wider sense, that is, incorporating the phases of decline and recovery.[2] A primary concern of

forest transition literature is to explain why the extent of forest in many areas worldwide is recovering. In this respect, forest transition studies look beyond the deforestation phase which is commonly the subject of longitudinal forest area research, as exemplified by the title of Williams's opus on the subject, *Deforesting the Earth*.[3]

To date, most forest transition scholarship has focused on establishing where in the transition trajectory particular regions are at (typically by comparison of national-level forest data) and/or identifying the causes underlying the transition, on the basis of modelled and real-world mesoscale studies. In their recent review of such literature, Rudel et al. identified two main causes for the recovery phase, the first being the abandonment of marginal agricultural land as a result of scarce agricultural labour, and the second being afforestation with exotic trees due to concern about the future supply of scarce forest commodities.[4] A third rationale, identified by studies of change in metropolitan and peri-urban landscapes, is regeneration of indigenous forest for the purposes of environmental amenity, in line with the increasing significance to urban populations of the values of 'beauty, health and permanence' highlighted as environmental drivers by Hays.[5]

Historical research has, however, focused more readily on the widespread deforestation that, especially on colonial frontiers, was a recurring feature of environmental change during the eighteenth and nineteenth centuries. Williams has shown that, between 1700 and 1920, the area under temperate forest worldwide dropped from 1.745 to 1.430 billion hectares, with 135 out the 315 million-hectare loss occurring after 1850.[6] Several factors drove this unprecedented global assault.[7] Firstly, mechanisation of the milling industry enabled timber to be extracted far more quickly than had hitherto been possible. The introduction of steam-powered saws, in particular, enabled cutting rates to increase tenfold between the late seventeenth and mid-nineteenth centuries.[8] Secondly, rapid growth in demand for construction timber and firewood was generated by urbanisation and industrialisation. Williams observes that as late as 1867, fuelwood supplied four-fifths of energy consumed within the United States.[9] Thirdly, improved transportation systems and networks allowed much larger quantities of timber to be freighted across the world, as well as consuming, in the ship-building trades, railway construction and the erection of telegraph lines, vast amounts of timber on their own account. These same networks also facilitated the movement of farm produce from faraway places, thus creating a fourth imperative for forest destruction, that is, to make way for the continued expansion of the capitalist agricultural marketplace. The notion that forests were a sure sign of rich soil gave agricultural settlers further encouragement to clear the forest soils of their sylvan overburden. Finally, the long-held perception of the forests as dark, dangerous places which needed to be 'improved' had yet to be effectively countered by the aesthetic and environmental appreciation of the value of trees. Even in those places where authorities and communities were of

a mind to conserve forests, the general weakness of social and legal control on the forest frontier made such intentions difficult to police.

DEFORESTING BANKS PENINSULA

All of these factors contributed at various times, and to varying degrees, to the demise of the forest on Banks Peninsula. Limited areas of forest in the bays had been removed by small populations of Maori people, and in the 1830s by European whalers. Opinion has been divided on the extent of the forested area at the time organised European settlement began in 1840, although Petrie's historical reconstruction (see Figure 2) suggests that it was around 120,000 acres, or roughly half the area of the Peninsula.[10] Despite the relatively modest size of this forest by international and New Zealand standards, at first little fear was held for its survival – for example, the chief surveying officer of HMS *Acheron*, which visited the Peninsula in 1849 in the course of a hydrographic survey, reckoned that it contained sufficient timber to supply 'twenty Canterbury Settlements for centuries'.[11]

Being by far the largest wooded area close to Christchurch,[12] it was inevitable that Banks Peninsula quickly became its source of firewood and timber. Initially, this was cut by sawyers operating at the heads of the various bays, but from the mid-1850s, these began to be replaced by mechanical mills, with the first water-driven mill being established near the head of Akaroa Harbour in 1854, and the first steam-powered mill at Le Bons Bay in 1857.[13] Early anxieties that wasteful extraction might squander the timber resource, and also reduce the future price of Peninsula land (since settlers would be left to clear low-value trees) prompted the Canterbury provincial government to keep a tight rein on timber licensing, with no new Peninsula cutting licences being issued between 1856 and 1864. While the subsequent publication of notices against illegal cutting suggests that this was not entirely effective,[14] regulation was reflected in both the limited change in forest acreage – Petrie suggests that as little as 4000 acres were removed between 1840 and 1860[15] – and the supply of Banks Peninsula wood entering the Christchurch market. In the year up to June 1862, for example, Banks Peninsula supplied but 1.21 million out of 4.77 million super feet of timber entering Christchurch via its two ports (Lyttelton, and Ferrymead on the Heathcote River).[16] Given the estimated forest yield of 10,000 or more super feet per acre,[17] this annual cut was probably derived from as little as 120 acres. Contemporary newspaper comment demonstrates that Christchurch's demand for firewood was not being satisfied either, even though the almost 2200 cords of firewood sourced from Banks Peninsula in the same period equates to a larger quantity of wood than the sawn timber.[18]

The assault on Banks Peninsula's forests therefore did not begin in earnest until the 1860s, when the Canterbury economy was boosted by high wool

prices and infrastructure development. During the middle years of this decade, Petrie has found, the amount of timber being shipped out of Akaroa alone was consistently between 1.5 and 2 million super feet per annum. Due to imperfect reporting of cargoes even this was probably a considerable underestimate.[19] One factor facilitating this increase in supply was freer access to forested land. The Canterbury provincial government began issuing new cutting licences after the survey of freeholded land on the Peninsula was completed in 1863 (since it now knew that these would not encroach onto other settlers' land). It also created several timber reserves, making it possible for sawmills to obtain exclusive cutting rights to public lands up to 500 acres in area.[20] This change in regulation was accompanied by an increase in both the number and potential output of sawmills, and an increase in timber-handling capacity of vessels servicing the Peninsula.[21] Of the 26 sawmills established prior to 1880,[22] the two largest in terms of potential output were William White's at Little River (1864), and John Thacker's at Okains Bay (1872) which could produce up to 60,000 and 70,000 super feet per week respectively, although Henry Piper's Duvauchelle sawmill was probably the most productive overall, churning out more than 20 million super feet over the course of two decades.[23]

This timber went towards not just heating and housing the people of Christchurch – around 80 per cent of Canterbury houses were constructed of wood[24] – but increasingly was needed for public works, notably railways. The first Canterbury railway between Ferrymead and Christchurch began operation in 1863, but network expansion really took off after the Christchurch-Lyttelton rail tunnel was completed in 1867.[25] Several Banks Peninsula sawmills were closely associated with railway projects, notably William White's at Little River, which supplied the timber (perhaps 1.3 million super feet)[26] used in the 1.77 km long rail bridge across the Rakaia River, built between 1870 and 1873. Extracting the timber for this bridge was an engineering feat in itself, which involved taking it by tramway and raft along the edge of Lake Forsyth and across Lake Ellesmere, and then carting it from the latter's western shore south to Rakaia.[27]

Even more timber was lost, however, in unintended fires, which spread either from those lit by pioneer settlers trying to clear bush, or from those left burning in sawyers' huts and encampments. Gusty north-westerly föhn winds and the dead wastewood left in the bush by sawyers and sawmillers created a volatile mix, and in some years large conflagrations consumed swathes of forest across the Peninsula.[28] In the great fire of 1863, for example, it was reported that 'the whole of the timber in Akaroa harbour appeared to be in a blaze'.[29] All told, it was reckoned in 1869 that fire had swept through 30,000 acres of forest in the previous decade.[30] Some of the affected area was probably already cut-over, but it was clearly a major contributor to the 34,000 acre decline in forest area (Figure 2) that Petrie suggests for the period 1860 and 1880.[31]

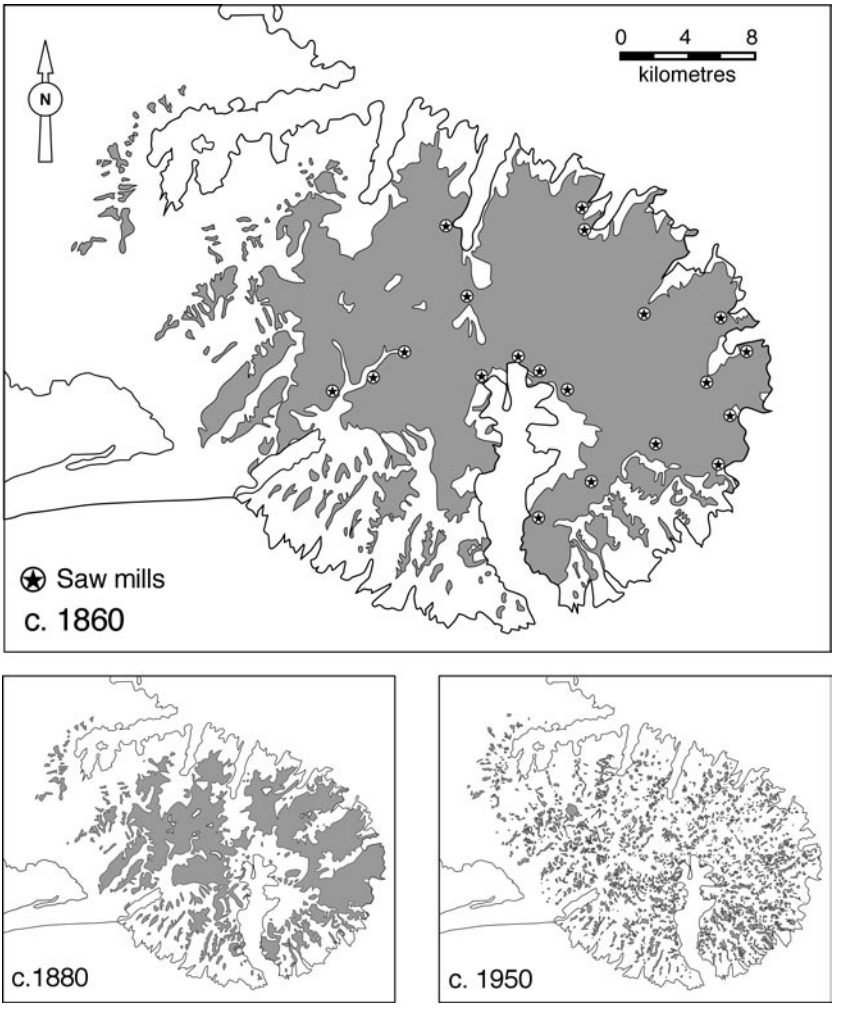

FIGURE 2. Maps of Banks Peninsula forest. The shaded areas represent forest cover c.1860, 1880 & 1950. Until 1880, clearance is confined to the heads of the major valleys, whereas thereafter it becomes almost total. Adapted from L.M. Petrie, 'From Bush to Cocksfoot: An Essay on the Destruction of Banks Peninsula's Forests' (M.Sc. thesis, University of Canterbury, 1963), Figs 2, 3 & 13

These fires significantly shortened the heyday of sawmilling. As early as 1876, a report to the newly established Conservator of State Forests observed that 'the timber trade on Banks Peninsula is nearly at an end'.[32] Improved transport access, such as the railway from Christchurch to Little River, opened in

1886, which the sawmill industry had prompted, now facilitated the opening of the Peninsula for agricultural settlement.[33] As the 1876 report put it, 'the main object of the landowners' was now to 'get the ground cleared of timber and bush, and converted into pasture as rapidly as possible'.[34] To do this required a 'bush-burn', which was undertaken after waste timber and unwanted trees were allowed to dry out over the summer.[35] Such burning created an ash layer on the newly cleared land, the fertility of which did much to reinforce earlier reports of the productivity of Banks Peninsula's soils; one resident of Okains Bay, for example, had written in 1861 that one acre there was 'worth many five acre blocks on the plains'.[36] This process was soon being widely practised across the Peninsula, hence the observation in 1886 in the Peninsula's newspaper, the *Akaroa Mail*, that there was a case for describing Little River as 'the valley of a thousand fires'.[37] While individuals such as the amateur botanist Thomas Potts were distressed to see so much forest going up in smoke,[38] on the whole observers saw this as the way to improvement. As H.C. Jacobsen, long-time editor of the *Akaroa Mail* put it:

> Many regret the passing away of the old order of things, and sentimentalise over the loss of those timbered solitudes where supplejacks were thick and the wild pig luxuriated; but we cannot help fancying to the thinking person the present landscape is far more gratifying. True gloomy Rembrandt like shadows have disappeared, and the tui no longer plumes his jewelled wings on the summit of some forest monarch; but in the stead of the past beauties are smiling slopes of grass…[39]

In this case, however, the smiling slopes of grass came quickly to represent something of quite specific value.

FROM TIMBER TO GRASS SEED

Canterbury already possessed millions of acres of indigenous tussock grassland on the Plains and in the high country bordering the Southern Alps. From the 1850s, Merino sheep were producing fine fleeces that runholders were able to sell at a handsome profit. Nevertheless, settlers soon formed the opinion that in the more temperate parts of the province, greater productivity could be supported by introduced 'English' grasses. Robert Wilkin, for example, who became a leading pastoral farmer and wool broker, noted in an 1861 handbook that once extensive sheep runs were converted to 'artificial pasturage', they were found to 'treble or quadruple their capabilities'.[40] This low carrying capacity was due to the patchy nature of the mixed tussock sward, and the unpalatability of old tussock growth. The latter problem was resolvable by regular burning, but such a practice was not compatible with intensive farming and closer settlement.[41]

The question therefore arose for settlers of where they ought to establish introduced grasses. All the available biomes (the tussock, coastal wetland, and the forests of the Peninsula and Alpine foothills) had pros and cons. Areas clothed in tussock and bracken were most readily converted to grass, but a combination of poor soils and lack of moisture retention meant that once a few crops had been taken off the land, it proved difficult to establish quality pasture. Areas of wetland vegetation had higher fertility, but owing to the high cost of drainage were developed piecemeal in the decades after 1850. The consequence was that rural settlement in Canterbury tended first to skirt around the wetland margins, where soils were not too waterlogged, but still relatively fertile.[42] A third option, forest, also held the promise of higher fertility, but the problem of tree roots left behind after it was cleared meant that it would be many years before it was ploughable. If forested land was as hilly as Banks Peninsula, ploughing was never an option anyway. As a result the initial farming efforts on the Peninsula were confined to the flat alluvial bottoms of the various bays.[43] What they lacked in quantity, these pioneer farmers made up in quality, and by the 1850s 'Port Cooper' cheeses were making a name for themselves on the Victorian goldfields.[44]

The conversion of forest to grass on Banks Peninsula was transformed, however, by what was to become known as 'Akaroa' cocksfoot. Despite its local moniker, this grass was in fact introduced to New Zealand from Europe. It reached the Peninsula in the 1850s, when a few farmers began testing seed imported by the Christchurch nurseryman William Wilson. These individuals, notable amongst them the Hay family of Pigeon Bay, soon found that cocksfoot prospered in the conditions left by a bush-burn, to the point where it more or less excluded other grasses.[45] There were several reasons for this. Firstly, cocksfoot thrives when sown near the surface in a firm, clean seedbed – accordingly it grew strongly in the fertile ashbed left by the bush-burn, without need of ploughing. Secondly, it prefers shade to strong sunlight, so was ideal for forest clearings. Thirdly, it was favoured by the Peninsula's climate and soils. In the autumn and winter, cool misty weather provided the soil moisture that cocksfoot needed, while the free draining nature of the volcanic soil prevented the waterlogging that cocksfoot does not tolerate; then in the hot dry summers, cocksfoot really came into its own, as a result of its unusual capacity to withstand drought.[46]

The fact that Banks Peninsula's cocksfoot pastures tended to form a monoculture gave its farmers the opportunity to do something their counterparts elsewhere could not readily emulate – turn the grass itself into a crop. Better still, Akaroa cocksfoot was of a particularly persistent type which gave up seed year after year without any form of cultivation, so long as livestock were kept off it as the plants matured.[47] By the end of the nineteenth century, tens of thousands of sacks of cocksfoot seeds were being produced from the very bays and valleys that previously had been the centre of the timber trade (Figure 3).

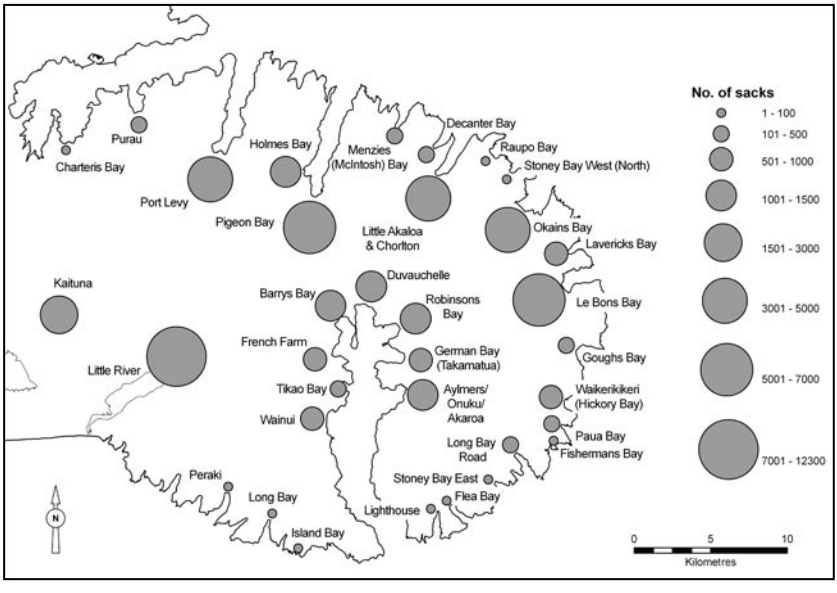

FIGURE 3. Mean annual production of cocksfoot (in sacks) from Banks Peninsula locations over the years 1891–1908. Based on data collated by Moritzson & Hopkin (later Moritzson & Co.), and reported in the *Akaroa Mail*, 1894-1908. One sack weighed about 40kg.

Markets for Akaroa cocksfoot were, however, not easily created. Throughout much of the nineteenth century cocksfoot suffered in the eyes of both New Zealand and British farmers because of its coarse herbage, and its tendency to become unpalatable to stock if allowed to seed.[48] Nevertheless, by the 1870s pioneer growers had established an export trade to Australia.[49] But the export industry took off in the 1880s, in response to concerns in British farming circles that perennial ryegrass (the usual mainstay in both British and Australasian introduced pastures) did not persist long enough to justify its inclusion in seed mixtures intended for renewing or re-establishing permanent pasture. In its stead, perennial ryegrass critics advocated the use of a select group of hardier grasses, of which the foremost was cocksfoot.[50] This debate was soon picked up in New Zealand,[51] and thus the farmers who began burning their way through the North Island bush in the 1870s and 1880s, who were also in need of permanent pastures, were convinced they ought to sow cocksfoot-dominant pastures as well. Some of this North Island demand was met by local production, but it also provided an important market for Akaroa cocksfoot.[52]

This symbiotic relationship between forest clearance and cocksfoot production was not limited to the seed itself, but also extended to labour flows. A

drawback of the industry was that the harvest was labour intensive, with the cutting, threshing, and riddling (sieving) operations all being done by hand on steep hillsides. Every summer it was typical for a thousand or more casual labourers to migrate to the district to work.[53] Many of these came from the forest frontier in the North Island, as after working during the winter months in sawmills there, and simultaneously preparing their land for a bush-burn, they could then come south for the harvest, and collect, as part of their pay, the cocksfoot seed they would need when they burnt their land on returning.[54] The formal trade, meanwhile, was dominated by a handful of large South Island companies (based mainly in Christchurch and Dunedin), who controlled the industry because they possessed the mechanical seed cleaning plant necessary for seed export.[55] Generally the commercial seed sent overseas went to foreign seed merchants, while within New Zealand it passed through local seed suppliers (such as Nimmo & Blair) or stock-and-station agents (such as Dalgety & Co.) rather than going directly to farmers.[56]

By examining data on New Zealand's export trade in grass seed (Figure 4), which from 1880 until about 1910 was almost synonymous with Akaroa cocksfoot,[57] it can be seen that overseas demand continued to climb until about 1900. During this period, Banks Peninsula provided much of the high quality

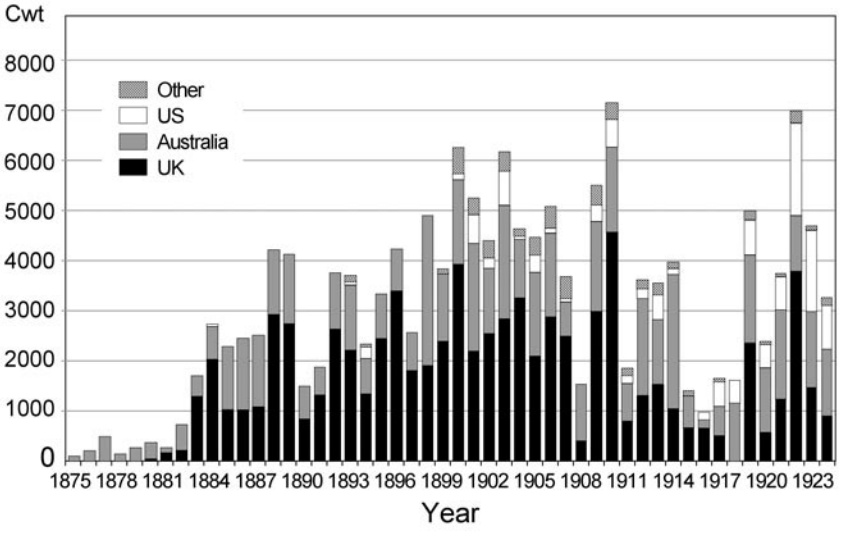

FIGURE 4. New Zealand grass seed exports 1875–1924. Note the 'take-off' in exports to the UK occasioned by the 'ryegrass controversy' in the 1880s, and the fall off during the First World War. Thereafter exports rose, but mostly through species other than cocksfoot. Based on trade statistics in the annual *Statistics of the Colony* [or later *Dominion*] *of New Zealand* volumes.

seed in the British market, as Robert Wallace, the Scottish agricultural professor, observed in his account of visiting Australasia in 1891.[58] At the time, its main competitor in supplying the British market had been the United States,[59] but as Figure 4 shows, by the 1900s, it was starting to make inroads in the American market as well. In terms of recorded acreage, the industry reached its peak in 1904–5, when 31,918 acres were set aside for seed production.[60]

The rapid growth of the cocksfoot industry up until the 1900s was of considerable significance for deforestation on the Peninsula, as no piece of forested land, however inaccessible, was safe from conversion into grass. Indeed, some of the best cocksfoot grew on the wilder reaches of farms, because here farmers had less qualms about shutting them off from the livestock[61](Figure 5). As the *Akaroa Mail* reflected in 1905, the twin discoveries that 'cocksfoot grass would grow luxuriously in the ashes' and that it 'so appreciated the volcanic soil that it produced finer seed than could be grown in any other part of the world' had ultimately 'knelled the doom of the Peninsula forests'.[62] Most cocksfoot was grown either on the north side of the Peninsula, or in the Little River valleys (Figure 3), which received both more sun and more shelter from cold, wet southerly

FIGURE 5. Grass seeders threshing cocksfoot on Banks Peninsula, c.1900. Image from Christchurch City Libraries, File Reference: CCLPhotoCD 5, IMG0057, I1.

winds, whilst the highest proportion of forest cover was left in the south-facing bays (see 1950 map in Figure 2). As of 1906, this forested area was estimated to be just 800 acres – which was barely 1 per cent of the forest cover in 1880, and only about 0.7 per cent of what there had been in 1850.[63]

The period of decline of the Akaroa cocksfoot industry can be dated to about 1910. Cocksfoot seed exports were already becoming erratic by this time (Figure 4), and then the First World War had a negative effect on the industry from which it never recovered. In the post-war period, it not only became much more difficult to keep up the quality of the supply, for reasons which will be discussed below, but there was also less call for Akaroa cocksfoot from both New Zealand farmers and their counterparts overseas.

In terms of overseas demand, the main problem was the emergence of strong competition from Denmark. Danish seed could be mechanically harvested, so the higher labour costs after the war meant that Banks Peninsula growers could no longer compete in terms of price.[64] For the same reason, Akaroa growers also suffered domestically against their counterparts on the Canterbury Plains and in Southland.[65] The changing nature of pastures also affected demand. In New Zealand, with the agricultural frontier reaching its furthest extent, particularly in the North Island, the proportion of grass seed being used in permanent pastures as opposed to short-rotation and temporary pastures fell; in the latter forms, farmers tended to use the short-lived but rapid-growing Danish cocksfoot, if they used cocksfoot at all.[66] Even for permanent pastures, Akaroa cocksfoot was also losing its lustre, as improved standards in the perennial ryegrass trade were helping to resolve the persistence problem with the latter, and grassland scientists such as Bruce Levy in New Zealand were finding that dairy production on cocksfoot-based pastures was inferior to that on perennial ryegrass-based pastures.[67]

The difficulties in maintaining the supply of high quality cocksfoot, meanwhile, were caused by a mixture of environmental degradation and unfavourable economic circumstances. With less labour being expended in the fields during and after the First World War, weed infestation, disease and pests, such as the cocksfoot thrip (*Chirothrips pallidicornus*),[68] began to take an increasing toll. Once degraded, it was easier for farmers to convert cocksfoot seed producing paddocks to grazing. Furthermore, dairying and fattening lambs had become more profitable during the post-war years in any case, so even if pastures had not deteriorated, farmers may still have shut up less land for seed production.[69] The latter option was particularly detrimental to the industry, since close grazing by sheep, owing to the high crown of the cocksfoot plant, was incompatible with seed production.[70] After decades of seed harvesting from some fields, yields were also dropping through declining soil fertility.[71] The greater exposure of the cocksfoot to wind now that most of the forest was gone also had an effect. Germination rates were reduced because the seed had to be harvested early to prevent it from being wind-blown.[72]

Hopes of reviving the industry nevertheless continued on into the late 1920s and 1930s, with the Department of Agriculture carrying out trials to determine the response of cocksfoot pastures to top-dressing, and a seed certification scheme being established, as seed quality was of the utmost importance to buyers. For the first time, a seed growers' association was also formed, so that problems in the industry could be dealt with in a united manner.[73] But the onset of the Second World War again put the industry into a downward trajectory, which was more or less terminal.[74] Breeders had developed new cocksfoot strains which could combine rapid growth and long life (some of which, such as the British cultivar S37 and New Zealand's C23, were derived from Akaroa cocksfoot)[75] and consequently a direct supply of Akaroa cocksfoot was superfluous. As a result, by the 1960s, the cocksfoot seed industry on Banks Peninsula was manifest only in casual harvesting of seed taken from the roadsides.[76]

THE POST-COCKSFOOT LANDSCAPE AND THE FOREST TRANSITION

Today, New Zealand still exports cocksfoot seed, but the industry is no longer based on Banks Peninsula.[77] Instead, cocksfoot production has joined the ranks of industrialised agriculture, in the same way that timber production is now based on industrialised silviculture, both being located on extensive areas of readily mechanised land. In retrospect, Akaroa cocksfoot, and the forest clearance for pasture with which it was symbiotic, represented the last vestiges of what might be termed pre-scientific 'improvement' in agriculture. Today's Peninsula landscape is very much a hybrid one, with the dichotomy between indigenous forest and introduced pastures now being complicated by the infusion of exotic forestry, lifestyle blocks and tourist networks. As elsewhere in New Zealand, the old segregation of land uses is giving way to a new multifunctionality.[78] In recent decades the appreciation of naturalised spaces, both amongst farmers and the general public, has grown, at the same time as farming activity has intensified on the more accessible land, creating conditions for forest regeneration elsewhere. Often this trend is intentional, the best known example being that of the privately owned 1000-hectare Hinewai reserve.[79] It is now the turn of the forest to advance, and the cocksfoot to retreat, with the present proportion of the Peninsula covered by either indigenous forest or scrub being estimated to be around 15 per cent (which equates to around 37,000 acres, or 15,000 ha).[80] This process of recovery has had a long gestation though, as Petrie estimated the forest area as 6000 acres in 1950, while agricultural returns suggest a forest area of between 3000 and 4000 acres in 1916.[81] In the remote south-eastern corner of the Peninsula, Primdahl and Swaffield estimate it has increased from about 13 per cent of land cover in the 1960s to over 30 per cent today.[82]

In summary, the forest on Banks Peninsula has followed Mather's classic forest transition curve – fast decline to a very low point (although 0.7 per cent, if reliable, is pushing this to an extreme),[83] followed by a long period of partial recovery. Clearly, it also matches Rudel et al.'s supposition that one of the reasons for such recovery is the loss of rural labour to other sectors, although in this case such loss was an underlying factor in decline of the cocksfoot industry in favour of dairy cattle and sheep. More recent changes in the economics of agriculture have encouraged the abandonment of pastoral uses on marginal lands, and their reallocation to activities in which high scenic value is at a premium, such as recreation, tourism and rural residence. Even so there is also a transition to reforestation in areas far from the usual tourist gaze, as shown by two recent studies of Te Oka Bay and the Kaituna Valley.[84]

This study has used the concept of the forest transition to explain the transformation of a heavily forested place into grass and more recently back towards forest. It has sought to extend the literature on such transitions, by focusing not just on forest recovery but also on the reasons for initial forest decline. It has also sought to complement work in forest history, by exploring the wider environmental history of the transition, rather than that of forest industries *per se*. In so doing, it has drawn attention to the broader historical and geographical conditions of forest transitions. Banks Peninsula timber was sought not only for construction purposes, but also for the space that it took up. This was space that for half a century after was more profitably occupied by a locally grown version of a European grass that was instrumental in forest transition dynamics elsewhere in New Zealand as well as in agricultural improvement in many parts of the world, including Europe. This is a history and a geography long obscured by the subsequent re-emergence of the forest in place of grass.

NOTES

[1] Thomas K. Rudel, Oliver T. Coomes, Emilio Moran, Frederic Achard, Arild Angelsen, Jianchu Xu and Eric Lambin, 'Forest Transitions: Towards a Global Understanding of Land Use Change', *Global Environmental Change* **15** (2005): 23, doi:10.1016/j.gloenvcha.2004.11.001.

[2] Alan Grainger, 'The Forest Transition: An Alternative Approach', *Area* **27**, 3 (1995): 243–4.

[3] Michael Williams, *Deforesting the Earth* (Chicago: University of Chicago Press, 2003).

[4] Rudel et al., 'Forest Transitions'.

[5] J. Gottmann, *Megalopolis. The Urbanized Northeastern Seaboard of the United States* (New York: The Twentieth Century Fund, 1961); S.D. Hays, *Beauty, Health and Permanence. Environmental Politics in the United States, 1955–85* (Cambridge and New York: Cambridge University Press, 1985).

[6] Williams, *Deforesting the Earth*, 277 & 394.

[7] See, for a discussion of these drivers, Williams, *Deforesting the Earth*, 244–58 & 267–9; John Dargavel, *Fashioning Australia's Forests* (Melbourne: Oxford University Press), 17–36; Michael Roche, *History of New Zealand Forestry* (Wellington: New Zealand Forestry Corporation Ltd. in association with GP Books, 1990), 437–40.

[8] Williams, *Deforesting the Earth*, 246–7.

[9] Williams, *Deforesting the Earth*, 250.

[10] Petrie's 1840 estimate was derived by using contemporary illustrations and the pattern of soils to work backwards from c.1860 survey maps. It is not dissimilar to the figure of 134,000 acres (54,000 ha), or exactly half the Peninsula's estimated area, given by the surveyor Captain Thomas in 1849. The botanist Robert Laing suggested in 1919 that forest had once covered two-thirds of the Peninsula, or around 170,000 acres (70,000 ha), but if Petrie's 1860 estimate of 116,000 acres (47,000 ha) is reliable, Laing's figure is too high for 1840. L.M. Petrie, 'From Bush to Cocksfoot: An Essay on the Destruction of Banks Peninsula's Forests' (M.Sc. thesis, University of Canterbury, 1963), 2 & 10–13; Robert M. Laing, 'The Vegetation of Banks Peninsula, With a List of Species (Flowering Plants and Ferns)', *Transactions and Proceedings of the New Zealand Instititute*, **51** (1919): 358.

[11] Chief Surveying Officer of *HMS Acheron*, 8 May 1849, [*Canterbury Papers* 1–2 (1850)]. Republished in *Canterbury Papers 1850–1852* (Christchurch: Kiwi Publishers, 1995), 30.

[12] According to the surveyor Thomas, the combined forest area in the Canterbury settlement only added up to 240,000 acres, or 12% of the total land area (Roche, *History of New Zealand Forestry*, 75).

[13] Roche, *History of New Zealand Forestry*, 78–9; Gordon Ogilvie, *Banks Peninsula: Cradle of Canterbury,* 2nd edn (Wellington: GP Publications, 1994), 5–6, 126 & 167.

[14] Roche, *History of New Zealand Forestry*, 75–6.

[15] Petrie, 'From Bush to Cocksfoot', 12–13.

[16] 'Approximate Return of Timber and Firewood Imported into Lyttelton, and the Heathcote River during Year Ended 30 June 1862'. Canterbury Provincial Council papers (CH 287, CP 606b). Archives NZ, Christchurch.

[17] A rough estimate in an 1863 forest fire report put the average timber yield across the Peninsula at 10,000 super feet per acre, while the yield of the forest milled at Okains Bay was 12,000 super feet per acre. The maximum yield claimed for any area, however, was 60,000 super feet per acre (*Lyttelton Times*, 7 February 1863; Petrie, 'From Bush to Cocksfoot', 46).

[18] *Lyttelton Times*, 31 May 1862; 'Approximate Return of Timber and Firewood'. Canterbury Provincial Council papers (CH 287, CP 606b). In theory 1536 super feet converts to a cord of wood, but the factor in reality will be considerably less, since a stacked cord contains air-space, and wood is lost when cutting the logs into timber planks (squaring off round edges, and through the sawcut itself).

[19] Petrie, 'From Bush to Cocksfoot', 58–9 (and fig. 8).

[20] Roche, *History of New Zealand Forestry*, 75–7.

[21] Initially, timber cargoes were restricted by vessel size to about 12,000 super feet, but in later years larger vessels could carry 50,000 super feet (Petrie, 'From Bush to Cocksfoot', 41n & 58).

[22] For a list of early sawmills and their years of operation, see Ogilvie, *Banks Peninsula*, 5.

[23] H.C. Jacobsen, *Tales of Banks Peninsula* 3rd edn (Akaroa: Akaroa Mail, 1917), 281; Petrie, 'From Bush to Cocksfoot', 51–2.

[24] See graphs in F.E. Hutchinson, *A Forest Survey of Canterbury* (Christchurch: Canterbury University College, 1926), Pt 1, 59–60.

[25] J.P. Morrison, *The Evolution of a City* (Christchurch: Christchurch City Council, 1948), 46–8.

[26] The contract for the 1.04km long Waitaki River bridge, also built in the 1870s on the same line, was for 780,000 super feet. Enclosure to W. Bray to J. Blackett, 16 May 1871, in 'Papers Relating to the Construction of Railways. IV. Railway Bridges', *Appendices to the Journals of the House of Representatives* 1871, D6-C, 11.

[27] Singleton, *Ellesmere: the Jewel in the Canterbury Crown* (Leeston: Selwyn District Council, 2007), 378–80; Patrick Hudson, *Bridges of New Zealand* (Wellington: IPL Books, 1993), 17. Similarly, the Pigeon Bay sawmill was operated by Lyttelton tunnel contractor George Holmes, and Coop's Springvale mill in Little River supplied timber for the Rangitata bridge; Coop's sawmill, together with one at Barry's Bay and Thacker's at Okains Bay, also provided railway sleepers (Ogilvie, *Banks Peninsula*, 90, 184, 233; Roche, *History of New Zealand Forestry*, 79).

[28] R. Townend to C. Davie, 23 March 1869, in 'Correspondence Relative to the Present Condition of the Forests of New Zealand', *Appendices to the Journals of the House of Representatives* 1869, D-22, 10.

[29] *Lyttelton Times*, 7 February 1863.

[30] Townend to Davie, in 'Correspondence Relative to the Present Condition of the Forests', 11.

[31] Petrie, 'From Bush to Cocksfoot', 16–17.

[32] Daniel Robertson, 'Report…upon the Forest Lands in the Province of Canterbury', Appendix C to 'Report of the Conservator of State Forests', *Appendices to the Journals of the House of Representatives* 1877, C-3, 58.

[33] Parts of this line were being used to transport Banks Peninsula timber before 1886. In the year to 31 March 1885, freight traffic from Lincoln to Christchurch included 2287 tons of timber and 2435 tons of firewood; in comparison, 2080 tons of timber and 2445 tons of firewood were dispatched from Little River in the year to 31 March 1887. Rollo Arnold, *New Zealand's Burning – The Settlers' World in the Mid-1880s* (Wellington: Victoria University Press, 1994), 140.

[34] Robertson, 'Report … upon the Forest Lands in the Province of Canterbury', 58.

[35] Petrie, 'From Bush to Cocksfoot', 67–8.

[36] One celebrated early yield was Ebenezer Hay's 22 tons per acre of potatoes at Pigeon Bay (*Lyttelton Times*, 19 March 1853 & 2 January 1861).

[37] *Akaroa Mail*, 12 March 1886.

[38] In 1868, Potts observed in Parliament that 'he had often seen Banks' Peninsula covered, for weeks together, with thick and lurid smoke' (Graeme Wynn, 'Pioneers, Politicians and the Conservation of Forests in Early New Zealand', *Journal of Historical Geography* **5**, 2 (1979), 179).

[39] Jacobsen, *Tales of Banks Peninsula*, 296.

[40] Peter Holland and Ray Hargreaves, 'Tussock into Wool', in *Rural Canterbury: Celebrating its History* eds. Garth Cant and Russell Kirkpatrick (Wellington: Daphne Brasell, 2001), 55 & 57; Wilkin to Hursthouse, n.d., in Charles Hursthouse, *New Zealand, the 'Britain' of the South* 2nd edn (London: Edward Stanford, 1861), 220–1.

[41] Peter Holland, Kevin O'Connor and Alexander Wearing, 'Remaking the Grasslands of the Open Country', in *Environmental Histories of New Zealand* eds. Eric Pawson & Tom Brooking (Melbourne: Oxford University Press, 2002), 69–72 & 78–9.

[42] Garth Cant, 'The Agricultural Frontier in Miniature: A Microstudy on the Canterbury Plains, 1850–1875, *New Zealand Geographer* **24**, 2 (1968): 163–6.

[43] Petrie, 'From Bush to Cocksfoot', 63.

[44] Jacobsen, *Tales of Banks Peninsula*, 354.

[45] Jacobsen, *Tales of Banks Peninsula*, 346–7; R. McGillivray, 'The Akaroa Cocksfoot Crop', *New Zealand Journal of Agriculture* **60**, 1 (1940): 37.

[46] S. H. Saxby, *Pasture Production in New Zealand* (Wellington, 1946), 38–9; J.G.H. White, 'Herbage Seed Production', in *Pastures: Their Ecology and Management* 2nd edn, ed. R.H.M. Langer (Auckland: Oxford University Press, 1990), 386; V.B. Wallace, *Cocksfoot Seed Production: Ashburton County, 1935–36: A Comparison with Banks' Peninsula* (Christchurch: Canterbury Agricultural College, 1936), 8–9; Canterbury Chamber of Commerce, *Cocksfoot for Pasture and Seed* (Christchurch, 1932), 1.

[47] R.G. Stapledon, 'Herbage Seed Production in New Zealand: III – Cocksfoot', *Journal of the Ministry of Agriculture*, **34**, 5 (1927), 413–4 & 416–7; William Davies, *The Grass Crop: Its Development, Use and Maintenance* 2nd edn (London: E. & F.N. Spon, 1960), 138; 'Pakeha', 'Cocksfooting on Banks Peninsula', *New Zealand Illustrated Magazine*, **8**, 5 (1903), 349.

[48] See, for example, David Moore, *Concise Notes on British Grasses* (Dublin: McGlashan & Gill, 1856), 40; *Otago Witness*, 28 July 1883 & 27 February 1886.

[49] *Weekly Press*, 10 January 1874.

[50] A. Lazenby, 'British Grasslands: Past, Present and Future', *Grass and Forage Science* **36** (1981): 247; Davies, *The Grass Crop*, 135.

[51] See Thomas Mackay, *A Manual of the Grasses and Forage Plants Useful to New Zealand* (Wellington: Government Printer, 1887), 98–112; William Ivey, 'A Short Contribution to the Ryegrass Controversy', *Weekly Press*, 27 July 1889.

[52] P.D. Sears, 'Cocksfoot: Its Role in the Agricultural Geography of New Zealand' (M.A. thesis, University of New Zealand, 1944), 43–5; J.K. Coulson, *Golden Harvest: Grass-Seeding Days on Banks Peninsula* (Palmerston North: Dunmore Press, 1979), 25.

[53] Petrie, 'From Bush to Cocksfoot', 75–7.

[54] Coulson, *Golden Harvest*, 23.

[55] For descriptions of two seed cleaning businesses (Canterbury Seed Co., and Moritzson & Hopkin), see *Weekly Press*, 6 September 1894; *Akaroa Mail*, 8 February 1895.

[56] Canterbury (N.Z.) Seed Co., 'Sales Journal, 1897–9' and 'Sales Journal (nos.9 & 10)', Canterbury (N.Z.) Seed Co. archives, ARC 1991.89, Canterbury Museum.

[57] Export statistics in the annual *Statistics of the Dominion of New Zealand* volumes show that around 90% of grass seed was exported through the port of Lyttelton. Canterbury was not a noted exporter of any other grasses during the period, so most of these Lyttelton cargoes must have been Akaroa cocksfoot.

[58] Robert Wallace, *Rural Economy of Agriculture in Australia and New Zealand* (London: Sampson, Low and Marston, 1891), 305.

[59] G.H. Hicks, 'Grass Seed and its Impurities', in *Yearbook for the United States Department of Agriculture 1898*, ed. G.W. Hill (Washington D.C.: Government Printing Office, 1899), 486.

[60] Coulson, *Golden Harvest*, 57. Sears notes that seed may have been harvested from up to 50,000 acres in 1890 (Sears, 'Cocksfoot', 55), but in the absence of statistics before 1896, this may not be easily compared to the 1904/05 figure, which does not include harvestable grazed land or road-sides.

[61] Stapledon, 'Herbage Seed Production', 416.

[62] *Akaroa Mail*, 23 May 1905.

[63] Johannes C. Andersen, 'The Early History of Canterbury', in *Natural History of Canterbury*, eds. R. Speight, Arnold Wall, and R.M. Laing (Christchurch: Philosophical Institute of Canterbury, 1927), 27.

[64] Stapledon, 'Herbage Seed Production', 412 & 417–18.

[65] Coulson, *Golden Harvest*, 94.

[66] Stapledon, 'Herbage Seed Production', 412–13; Wallace, *Cocksfoot Seed Production*, 23.

[67] Sears, 'Cocksfoot', 68 & 81.

[68] The larvae of this insect feed on cocksfoot seed heads. R.P. Pottinger, 'Pests of Grassland and Small Seeds Crops', in *Pastures and Pasture Plants*, ed. R.H.M. Langer (Wellington, A.H. & A.W. Reed, 1973), 389.

[69] Coulson, *Golden Harvest*, 95–6; R. McGillivray, 'Banks Peninsula and its Pastures', *Proceedings of the 4th Conference of the New Zealand Grasslands Association* (Christchurch: New Zealand Grasslands Association, 1935), 2–3; Wallace, *Cocksfoot Seed Production*, 23.

[70] Petrie, 'From Bush to Cocksfoot', 74–5.

[71] Coulson, *Golden Harvest*, 89–90.

[72] R.J. Veale, 'Stage of Cutting Cocksfoot for Seed', *New Zealand Journal of Agriculture* **33**, 2 (1926): 115.

[73] A.W. Hudson & A.Y. Mongtomery, 'Pasture Topdressing in Canterbury', *New Zealand Journal of Agriculture* **41**, 6 (1930): 388–395; Coulson, *Golden Harvest*, 74–9 & 92–3; Wallace, *Cocksfoot Seed Production*, 6–8.

[74] See Coulson, *Golden Harvest*, 84–8.

[75] Davies, *The Grass Crop*, 231; J.W. Calder, 'College Cocksfoot (C23 strain), *New Zealand Journal of Agriculture* **61**, 1 (1940): 37.

[76] Petrie, 'From Bush to Cocksfoot', 93.

[77] M.J. Hill, '*Dactylis glomerata* L. (Cocksfoot) in New Zealand'. In *Forage Seed Production, vol.1: Temperate Species*, eds. D.T. Fairey and J.G. Hampton (New York: CAB International, 1997), 341–3. For a contemporary account of cocksfoot growing for export, see the [Christchurch] *Press*, 26 May 2006.

[78] J. Primdahl and S. Swaffield, 'Segregation and Multifunctionality in New Zealand Landscapes', in *Sustaining Agriculture and the Rural Environment: Governance, Policy and Mulitfunctionality*, ed. F. Brouwer (Cheltenham: Edward Elgar, 2004), 266–85.

[79] Hugh D. Wilson, *Hinewai. The Journal of a New Zealand Naturalist* (Christchurch: Shoal Bay Press, 2002), 9–11.

[80] Wilson, *Hinewai*, 8; Wilson, *Banks Peninsula Ecological Region. Port Hills, Herbert and Akaroa Ecological Districts*, Protected Natural Areas Programme Survey Report No 21 (Christchurch: Department of Conservation, 1992), 27.

[81] Petrie, 'From Bush to Cocksfoot', 89; *Statistics of the Dominion of New Zealand for 1915* (Wellington: Government Printer, 1916), III, 49. The 1915 agricultural returns give a figure for 'standing virgin bush' of 2913 acres (1179 ha), but this would not have included bush in scenic reserves on the Peninsula. At the time, these accounted for no more than 1700 acres (700 ha), and on some of them, the forest cover was less than half the total area (see Andy Dennis, *Banks Peninsula Reserves* (Christchurch: Department of Lands and Survey, 1986), 53 & 76).

[82] Primdahl and Swaffield, 'Segregation and Multifunctionality in New Zealand Landscapes', 278.

[83] At a national scale, the lowest percentage for forest cover at the transition point noted in Rudel et al. is 3% for Scotland ('Forest Transitions', 26).

[84] J.M. Egan, 'The Correlation Between Indigenous Forest Cover and Agriculture Policy Changes from 1941–2001 in Kaituna Valley, Banks Peninsula', B.For.Sc (Hons.) diss., University of Canterbury, 2001, 29–35; C.J. Bradley, 'Vegetation Changes in Te Oka and Tumbledown Valleys, Banks Peninsula, from 1984–2005, and the Accuracy of Using GIS Aerial Photograph Categorisation in Identifying Vegetation Types', B.For.Sc.(Hons.) diss., University of Canterbury, 2005, 25–7.