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Deforestation and Sugar Cane Growing in Eastern Australia, 1860–1995

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ABSTRACT

Deforestation associated with the cultivation of sugar cane in the coastal lands of Eastern Australia commenced in the 1860s. Beyond the initial large-scale clearing of the native vegetation to create arable land, the growing of sugar cane placed other demands upon the native forests. The vegetation was cleared to provide timber for buildings, railway sleepers, to supply the firewood for the sugar mill boilers and in some instances to supply the timber used in at least half a dozen Australian sugar mills that were adapted to manufacture lumber in the non-crushing season. Newspapers descriptions, archival records and scientific reports are used to reconstruct the methods adopted to clear the forests and the speed and extent of the loss of forests in the sugar cane growing lands of Eastern Australia. The environmental consequences of the loss of the native forests, such as increased incidence of frost, river bank erosion, weed invasions and declining biodiversity, are also considered. Despite the commencement of localised tree planting schemes in some sugar cane growing districts, the paper will highlight that forest clearing to enable the expansion of sugar cane cultivation in Eastern Australia has continued during the 1980s and early 1990s.

KEYWORDS

Queensland, deforestation, sugar cane, frost, weeds, riverbank erosion

INTRODUCTION

Deforestation has long been associated with the cultivation of sugar cane. Barbados, for example, was one of the Caribbean islands where forests were destroyed entirely to enable sugar cane cultivation. This process commenced during the 1640s, but according to David Watts, by 1665 all but the 'most isolated patches of forest, on steep gully sides, had been cleared' and the island's landscape had become predominately an 'open one'. On nearby Antigua, sugar cane had become the preferred crop by the 1660s. By 1750, 'scarcely a vestige of the original forest cover' was left on the island, the trees having all been cleared to make way for sugar plantations. The Cuban historian Manuel Fraginals wrote of the 'death' of Cuba's forests during the first half of the nineteenth century. He noted that two processes operated: forested land was cleared to enable the planting of more cane and trees were cut down to supply firewood for the island's many sugar mills. Mauritius was another island to suffer deforestation following the cultivation of sugar cane. Initially this process commenced under the Dutch during the seventeenth century and was expanded under the French during the eighteenth century. A considerable upsurge in deforestation occurred following the British occupation of the island after 1810. By 1872, only 6,800 ha or four per cent of the island remained forested. British demand for raw materials was also responsible for the loss of most of the forests in the Ganga-Yamuna Doab in northern India. During the first half of the nineteenth century, approximately 50,000 square kilometres were cleared to allow the cultivation of sugar cane, indigo and cotton. Moreover, deforestation to make way for sugar cane has continued throughout the twentieth century. In eastern Cuba, Hispaniola and Puerto Rico, for example, American interests financed the formation of new plantations between 1900 and 1920. More recently, a program initiated in the 1970s by the Brazilian government to produce ethanol from cane led to an increase in the area of cane cultivation at the expense of forest, particularly in the State of Alagoas.¹

Three main environmental changes have emerged following deforestation for sugar cane cultivation, although these changes are not extensively documented. First, climate change, especially a decline in precipitation, was observed in some areas where sugar cane replaced the forests. By the late fifteenth century, visitors to the Canary Islands and Maderia, for example, commented upon the local aridification and drying up of streams and rivers. Rainfall decline on Jamaica during the eighteenth century was linked to deforestation and the expansion of sugar production. By the mid-nineteenth century, the clearing of the forests throughout the Ganga-Yamuna Doab in northern India was believed to have contributed to increased temperatures, irregular and declining precipitation and increased hot winds that originated in the deserts.² Second, soil erosion, gullying and increased flooding followed deforestation for sugar cane cultivation. The

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combination of these processes was noted on Madeira and the Canary Islands during the fifteenth century, on the Caribbean plantation islands between 1600 and 1800 and throughout Cuba during the late nineteenth century. Third, the loss of the forests and their replacement with landscape dominated by sugar cane has been linked to significant changes in the distribution of individual plant species. David Watts, for example, has documented how deforestation on Barbados during the 1600s contributed to local extinctions of a large number of native plant species and how this native vegetation was replaced by alien grasses, shrubs and tree species. David Harris has studied the same process throughout the Outer Leeward Islands of the West Indies, showing that many sugar plantations suffered from an invasion by both woody and herbaceous weeds, which were alien species.³

In Eastern Australia, most of the forested tropical and subtropical coastal lands were still untouched by intensive farming in the early 1860s, after nearly 80 years of European settlement. Timber getters, miners and pastoralists had caused some environmental disturbance, but they had not engaged in extensive deforestation. As the Europeans began occupying the tropical and sub-tropical regions of Eastern Australia, they encountered environments not suited to the cultivation of wheat, barley, oats and other temperate crops (e.g. apples, pears, hops). Farmers commenced clearing the coastal forests, and experimented with crops such as sugar cane, cotton, tobacco, coffee and bananas that preferred warm and humid climates. Of these crops, sugar cane emerged by 1900 as the most favoured in the coastal districts between Mossman in northern Queensland and Grafton in northern New South Wales (see Figure 1). A century later, it remains the most dominant crop throughout the tropical and subtropical coastal regions of Eastern Australia.

The purpose of this paper is to add to the literature on the environmental consequences of deforestation associated with sugar cane cultivation with an examination of the example of Eastern Australia. The topic has not been considered previously, with the historical accounts of the Queensland sugar industry failing to mention deforestation, probably because most deal mainly with the issue of the industry's labour supply.⁴ Historical studies dealing with more recent developments in the Queensland sugar industry have concentrated on documenting the introduction of mechanical harvesting, not the continued clearing of forested land to permit the expansion of sugar cane growing.⁵ Therefore, this paper will also redress this omission in the historiography of the Australian sugar industry.

I begin with a brief review of the industry from its origins until the early 1990s. Next, I examine the process of deforestation, highlighting that it was not only associated with the initial clearing of the vegetation to produce arable land, but also to provide building material, railway track right-of-way, timber sleepers and firewood for the sugar mills. I continue by analysing the environ-

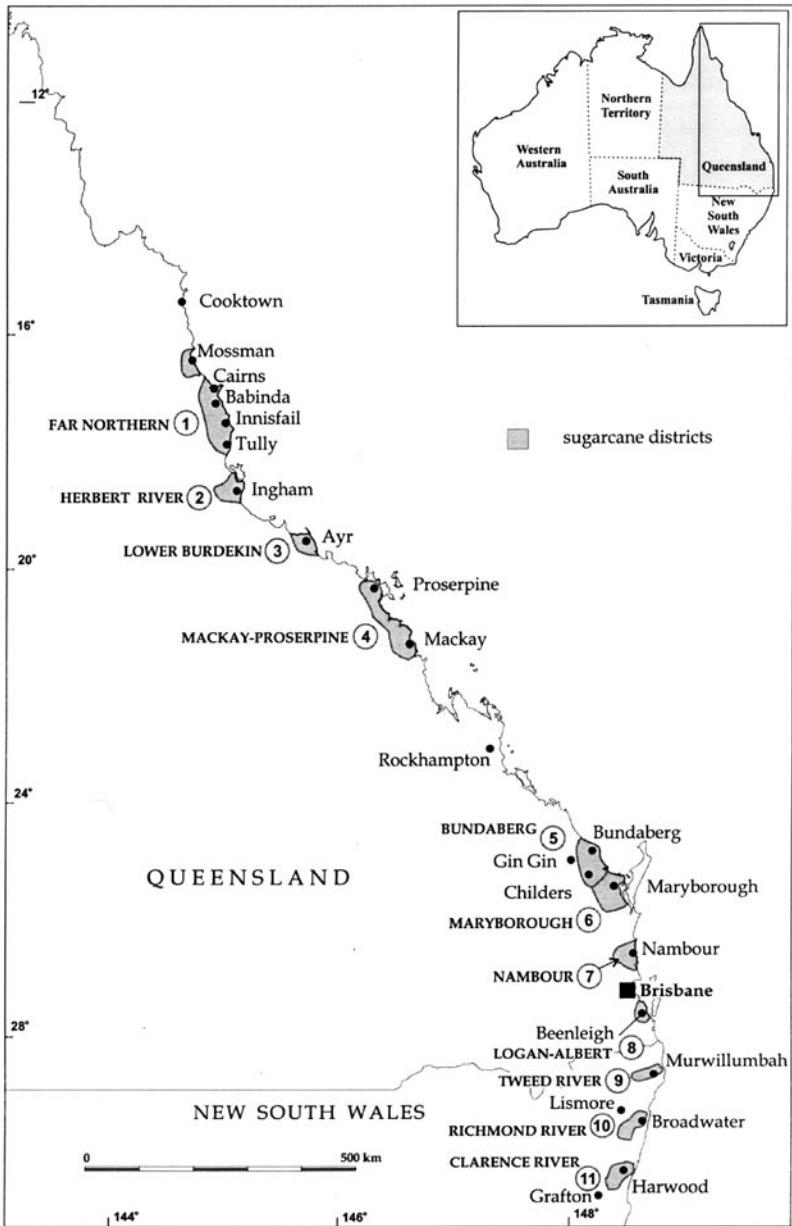


FIGURE 1. Sugar cane growing districts of Eastern Australia.

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mental consequences of deforestation. In Eastern Australia, the loss of forests associated with cane growing contributed to a reputed increased incidence of frost, the invasion of foreign plants, the emergence of endangered species of flora and fauna and riverbank erosion. In the conclusion, I reflect upon how similar or different were the environmental changes following deforestation for sugar cane cultivation in Eastern Australia compared with other sugar producing regions around the world.

THE SPREAD OF CANE CULTIVATION IN EASTERN AUSTRALIA

The sugar industry in Eastern Australia was established during the 1860s in two colonies – Queensland and New South Wales – almost two hundred years after other colonial sugar industries were founded in the Caribbean, Louisiana and Brazil. Over the next half century, the growth in the area under sugar cane cultivation was mostly steadily upwards (Figure 2). During this period, sugar cane cultivation became concentrated primarily along the deltaic and levee soils of the main rivers and creeks in eleven discrete areas, separated by areas of unreliable rainfall and/or unsuitable soils (Figure 1).

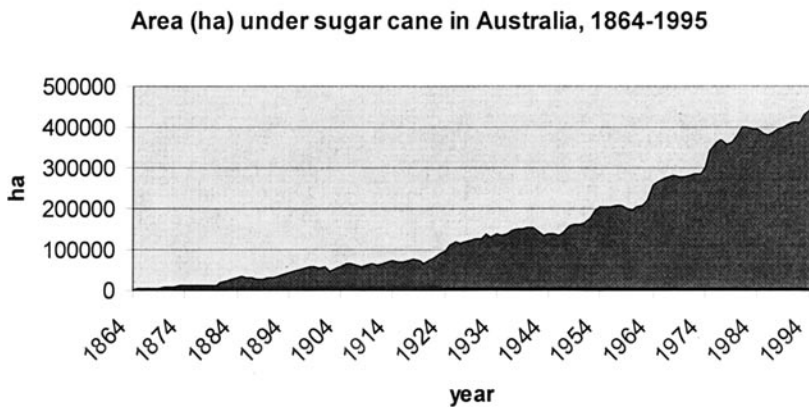


FIGURE 2. Area (ha) under sugar cane in Australia, 1864–1995

Source: Assembled from figures in the *Statistics of the Colony of Queensland 1865–1901*, *Statistical Registers of New South Wales, 1865–1888*, *Official Yearbook of the Commonwealth of Australia (later Year Book of Australia)*, 1901–1985 and data supplied by the Australian Bureau of Statistics.

Initially, the sugar industry in Queensland mirrored the established production model, being based on plantations, although the field workers were indentured Melanesians or Asians, not slaves. In contrast, few plantations were established in New South Wales, with the dominant production model being European farmers on small farms supplying proprietary central mills. However, after 1880 the practice of recruiting Melanesians for the Queensland sugar industry was increasingly opposed by residents of all the Australian colonies. This opposition to the employment of non-European workers in the Queensland sugar industry and the implementation of the White Australia Policy after 1900 led to a transformation in its production structure during the 1890s and 1900s. Large numbers of European-owned small family farms supplying sugar cane to cooperative or proprietary sugar mills took the place of plantations.⁶ This arrangement in Queensland and New South Wales still existed in the early 1990s, when approximately 6,800 small farms, with between 30 and 100 hectares of cane, supplied 28 sugar mills.

The steady expansion in sugar cultivation during the late nineteenth and early twentieth century was a result of a combination of private investment in sugar production and the Queensland government's promotion of land settlement schemes in the tropics via its funding of the erection of cooperative central sugar mills. This interest in sugar production occurred to meet the growing domestic demand for sugar, as colonial Australians consumed ever increasing amounts of the product during the late nineteenth century. However, after 1923 (and ever since), increasing amounts of Australian-produced sugar have been exported overseas, first to Great Britain and more recently to Asian markets.⁷

After the considerable increase in sugar production during the 1920s, the expansion in the area cultivated with sugar cane slowed during the 1930s (Figure 2). Fears of overproduction resulted in some attempts by industry and the Queensland government to regulate the annual sugar output of each mill. Growth resumed after World War Two as the Queensland government approved the establishment of new farms which were to be settled by ex-servicemen, although these properties were all located in existing sugar producing districts. A further upsurge in the area cropped with sugar cane occurred in the early 1950s (Figure 2), after the Queensland government sanctioned a major industry-wide expansion. However, the authorities did not permit the cultivation of cane to spread to new districts, preferring to concentrate the growth in the existing sugar producing regions. In the early 1960s, better world prices for sugar led to an inquiry by the Gibbs Committee into the possible expansion of the Australian sugar industry.⁸ As a result of these investigations, the Queensland government sanctioned a growth phase. An additional 70,000 hectares were brought under cane cultivation between 1960 and 1968 (Figure 2). Growth was again permitted following improvements in the world price of sugar in 1972, but no new growers were admitted to the industry. Essentially this expansion was a 'filling in' process, with growers being allowed to increase the area under cane

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by cultivating previously unused land on their properties. High prices for sugar in the early 1980s prompted the Queensland government to approve a further expansion.⁹ As a consequence, the area cultivated with sugar cane continued to rise steadily in the 1980s and early 1990s (Figure 2).

CLEARING THE FORESTS

The sugar cane producing lands of Eastern Australia once were covered by a variety of forests. In the humid tropical region between Tully and Mossman, vine forests (commonly known as rainforest) originally extended from the coastline inland up to 70 kilometres. Vine forests are very complex floristically and structurally; tree species from the genera *Ficus*, *Alstonia*, *Syzygium*, *Flindersia*, *Cryptocarya*, *Dysoxylum* and *Endiandra* are commonly found in these forests. Throughout the Ingham, Lower Burdekin, Proserpine and Mackay districts, the coastal plains were once dominated by grassy forests or woodlands which had a more open understorey and a thicker grassy ground cover. The characteristic trees in these regions included Moreton Bay ash (*Eucalyptus tessellaris*), Blue gum (*E. tereticornis*), Poplar gum (*E. alba*) and Weeping paperbark (*Melaleuca leucadendra*). Pockets of rainforest were also found in more well-watered localities. Further south, pockets of rainforest were once found throughout the Bundaberg region, but the dominant vegetation for much of coastal southern Queensland was shrubby forest. Eucalyptus trees such as Spotted gums (*E. maculata*), Narrow-leaved iron barks (*E. crebra*) and Red bloodwoods (*E. gummifera*) formed the upperstorey, growing above a variety of shrubs and ferns. In Northern New South Wales, sub-tropical rainforest once covered the alluvial soils along the Clarence River until Grafton, up to Casino on the Richmond River, and along the Tweed River. South of the Tweed River lay the 'Big Scrub', an extensive area of rainforest growing on red basalt soils.¹⁰

The cultivation of sugar cane called for the large-scale clearing of the native vegetation. The overall ecological effect of this massive change was to convert the diverse coastal ecosystems into those favouring a limited number of cultivated and/or exotic plant species, many of which came to be considered agricultural weeds (see below). Sugar cane was the dominant crop, although during the nineteenth and early part of the twentieth century vegetables, particularly potatoes, were grown on the sugar estates to provide food for the workers. Some settlers also established fruit orchards or planted exotic food bearing trees such as mangoes (*Mangifera indica*) and coconut palms (*Cocus nucifera*) in the extensive gardens that surrounded their homesteads. In addition, canegrowers grew maize, which was fed to the teams of horses providing the draught power on the small farms and plantations. However, maize growing was phased out during the 1930s and 1940s as the horses were replaced by tractors after the widespread mechanisation of field activities.¹¹ The earlier activities of Aborigines

and timber-getters had a slight effect in comparison with the sharp ecological discontinuity that accompanied the deforestation associated with the pursuit of sugar cane growing.

From 1860 to 1945, forested land acquired by those intending to cultivate sugar cane was cleared by hand. Before 1900, this clearing was often done by teams of indentured Melanesians or Chinese who undertook contracts to do this work. Other Chinese immigrants obtained clearing leases from Europeans who were not interested in clearing their blocks of land. In return for a five year lease, the Chinese paid a small amount of rent, felled the timber and grew vegetable and/or fruit crops, particularly bananas.¹² After the deportation of the indentured Melanesians in 1906, European settlers continued the task. Brush-hooks were used to remove any vines or undergrowth and the trees and larger shrubs were felled by axe or cross-cut saw (Figure 3). This process was usually conducted during the wetter summer and autumn months, so that during the drier winter and spring months the felled and stacked material could dry out. Walter Figg, an English bricklayer who commenced canegrowing in the late 1910s on the Inkerman Estate, near Ayr (Lower Burdekin district), recalled the countryside each night being 'ringed by fires as each selector burned the timber he had fallen'. Other intending canegrowers used fire to clear the forests. Edwin Brady who toured throughout Queensland in the early 1920s claimed that canegrowers gained great satisfaction using fire for 'a good burn – which leaves only blackened stumps of forests standing – saves money and labour'. In due course, the first crop of sugar cane was planted amongst the ashes. Bigger tree stumps that may have survived any fires just rotted away, usually in three to five years, but sometimes longer.¹³ Because of the expense associated with stump removal, only the bigger sugar cane growing companies with their larger financial resources (e.g. Colonial Sugar Refining Co; Melbourne-Mackay Sugar Co.; Messrs A.H. & E. Young) stumped their paddocks entirely at the time of their formation during the late nineteenth century.¹⁴

Beyond the initial clearing, the growing of sugar cane placed other demands upon the native forests. Building materials were necessary for dwellings, the sugar mill, stables and sheds, fences and seasonal repairs. Many Australian sugar mills also operated private railway networks, where steam locomotives running on narrow gauge rail tracks greatly enlarged the range over which mills could draw their cane supplies. Forests were cleared for railway track right-of-way and to provide timber for rail sleepers. Moreover, in at least half a dozen Australian sugar mills, the machinery could be adapted to mill timber in the off-season, thereby ensuring maximum use of the capital invested in the milling side of operations.¹⁵ Most important, however, were the loads of firewood needed to fuel the boilers during the processing season. Before 1950, Australian sugar mills were steam-driven, generally requiring one ton of firewood to make a ton of sugar. The firewood was used to supplement the megass – the fibre that remained



FIGURE 3. Clearing rainforest by hand to form a sugar cane farm near Babinda, Far North Queensland, 1914.

Source: *The Queenslander*, 7 February 1914.

after the juice had been extracted from the harvested cane in the crushing rollers – which was dried and also burnt in the boilers. W. Farquhar, the Inspector of Mills for the Colonial Sugar Refining Company (hereafter CSR), for example, reported in April 1895 that 8,000 tons of firewood had been stockpiled at Victoria Mill (near Ingham) and this amount would enable the mill to operate without purchasing coal during the forthcoming crushing season.¹⁶ Hence, pre-1950 photographs of Australian sugar mills often showed large stacks of firewood that had been stockpiled during the ‘slack’ season in preparation for when it was needed during the crushing season (see Figure 4).

To meet this demand for firewood, nineteenth century mill owners initially used timber cleared from their own plantations or purchased timber from other landowners, who were clearing their properties and establishing cane farms. Shortages of firewood, however, became apparent by the early 1890s. In 1893, Arthur Neame of Macknade plantation (Herbert River district) noted in his diary that ‘latterly, we had a very considerable distance to go for the wood’. In 1895, Charles Young, Manager of Kalamia plantation (Lower Burdekin) complained to the estate’s London-based owners that the shortage of firewood had caused him to clear nearby mangroves, but this practice was becoming unsustainable. John

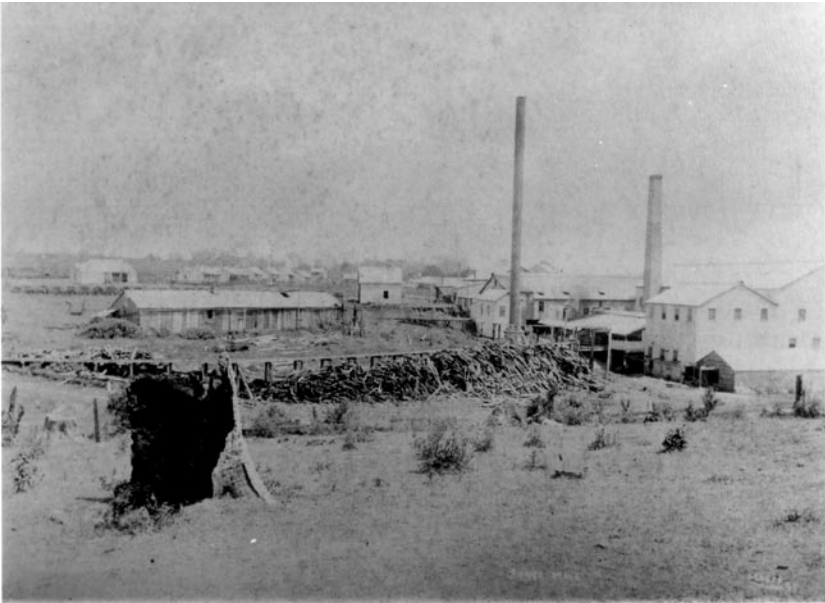


FIGURE 4. A large pile of firewood stacked near Rous Sugar Mill, Richmond River District, New South Wales, c. 1900.

Source: Courtesy of Richmond River Historical Society, Lismore.

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Drysdale, Managing Director of Pioneer Mill and a neighbour of Charles Young, also faced firewood shortages in the early 1900s. Eventually as firewood shortages became more acute during the late 1900s, both Kalamia and Pioneer Mills were forced to rely increasingly on coal sourced from Bowen, approximately 100 kilometres south of the Lower Burdekin.¹⁷ Further south in the Mackay district where ten mills competed for firewood, the Local Land Commissioner noted in 1908 that 'the lands in the vicinity of the mills have been almost cleared, and fuel is becoming scarce; the mills are running portable lines out to tap new country'. In 1911, CSR's Chief Engineer advised the firm's engineers in a circular that 'in North Queensland each year it is more difficult and costly to obtain good wood fuel'. CSR sanctioned the expenditure on new machinery to improve fuel economy, including economisers. However, coal shipped in from Newcastle, nearly 2,500 kilometres south of CSR's northern-most mill, had to be used more frequently as supplies of suitable firewood dwindled.¹⁸

The extent of the coastal forests cleared in the sugar producing regions of Eastern Australia before 1945, and the speed of this clearing which was all done by hand, is quite remarkable. In 1873, a reporter visiting Maryborough, one of the first localities cultivated with sugar cane in Queensland in the late 1860s, noted that once along the Mary River a 'dense mass of scrub on both banks' hung out over the river. At the time of his visit, he remarked that few patches of scrub were seen and 'for mile after mile, in many stretches, both banks of the river are cultivated'.¹⁹ At Mackay, a special reporter from *The Australasian* (Melbourne) wrote in 1882 that 'with the exception of a few small patches, all the scrub on the low lands have long been since cleared off'. He observed that 'the higher hills are still crowned with scrub, but the axes of the woodmen are slowly, but surely hewing out great gaps on their steep ridges'. Sugar cane cultivation had only commenced in this region fifteen years earlier. A similar fate awaited the Isis Scrub, an area of forest located forty kilometres south of Bundaberg. The district was first settled with canegrowers in the late 1880s. A visitor returning to the Isis district in 1895, remarked that once 'dense scrub' existed as far as the eye could see in every direction, but 'now that has almost completely disappeared, with its place taken by waving fields of cane'.²⁰ In northern New South Wales, Howard Willoughby who visited the 'Big Scrub' in 1888 observed:

the dense scrub growth covered all a half-century ago, and huge cedar trees towering above the jungle overhung the river; but now along many a mile the scrub has been cleared away, and the cane-fields surround the settlers' houses.²¹

Deforestation in the sugar cane producing lands from Childers northwards also occurred as canegrowers sought to protect their annual crops from the ravages of white grubs, the larvae of native beetles that were found in coastal areas of Queensland. Newly hatched grubs are located in the soil in sugar cane growing regions and feed upon soil organic matter. If present in fields of sugar

cane, the growing grubs ate the roots of the cane plants, arresting their growth and sometimes killing the plants. By the early 1890s, canegrowers observed that cane paddocks near vegetated areas were liable to be more damaged by grubs than fields surrounded by cleared land.²² Belts of forest near creeks, tree-filled swamps and uncleared remnant vegetation on properties afforded the necessary shelter and food for the beetles when they swarmed. As a result, some canegrowers rid their properties of remaining vegetation, particularly Moreton Bay ash (*E. tessellaris*), fig (*Ficus* spp.) and paper bark (*Melaleuca* spp.), trees that were preferred as feed trees by the beetles. W.T. Paget of Nindaroo plantation (near Mackay), for example, advised canegrowers at an agricultural conference in 1899 that he reduced the impact of grub attacks on his property by clearing thirty square kilometres of headlands (i.e. non-cultivated areas on cane-growing properties) of what he described as 'beetle bushes' or those trees he had observed the beetles favouring.²³ Farmers in the Herbert River district during 1907 were reported as being 'engaged in wholesale destruction of feed trees such as the Moreton Bay Ash' on the lands adjacent to the cane areas.²⁴ In 1935, a group of farmers near Mourilyan decided to make a co-operative and large-scale effort to combat grub losses by clearing the adjacent slopes of the Basilisk Range. By 1939, they had cleared 450 ha, mostly by firing the slopes. The Queensland Bureau of Sugar Experiment Stations reported in 1940 that since the clearing of this range, previously infested farms had remained clear of the pest. A second large-scale beetle-feeding tree destruction scheme occurred on the Burdekin River delta during the early 1940s.²⁵

Pre-harvest burning of fields of sugar cane and post-harvest burning of trash (i.e. leafy material at the top of the cane plants, leaves and husky material around the plant that remain after harvest) were additional agricultural practices that contributed to the loss of forests. One purpose of pre-harvest burning is to get rid of the trash. Piles of trash provided ideal breeding places for the beetle borer (*Rhabdoscelus obscurus*), which damaged crops by eating tunnels into the stalks of cane. Pre-harvest burning of crops and piles of trash were found to be effective in reducing numbers of the insect and reducing the reinfestation of subsequent crops. Second, pre-harvest burning of crops was done as a health precaution. Burning rid the fields of rats, thereby reducing the incidence of Weil's disease (*Spirochetal jaundice*) amongst cane cutters.²⁶ However, often the fires escaped into nearby forested areas. In 1935, the Sydney-based author Frank Davison and amateur naturalist Brooke Nicholls, travelling throughout coastal Queensland, described the impact of this neglect:

No care is taken to confine the fire to the cane paddock. It is allowed to run into the hills. The result is that all the cane-growing areas are ringed about, between the edge of the cultivation and the higher slopes of the ranges, with a ragged belt of burnt-over jungle. The fires have overrun all the foot-hills and penetrated for a considerable distance up the valleys. The spectacle is one of a scattering of fire-blackened snags sticking up out of a tangle of weeds.²⁷

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Concern about the impact of escaped cane fires on surrounding forests was raised in 1960 by James Buzacott, a senior officer with the Queensland Bureau of Sugar Experiment Stations. He noted that after every year's crushing season, fires had consumed more of the rainforest-clad hills and that 'larger and larger areas were denuded of trees'. Eventually, fire use by canegrowers was partially regulated following the introduction of the *Regulation of Sugar Cane Prices Act* of 1962, which required canegrowers to only burn between 5.30 pm and 7.30 am next day, and to avoid dangerous weather conditions. By the late 1980s, some canegrowers were reducing the use of fire as the industry moved to green cane harvesting (i.e. no pre-harvest burning of fields) and trash blanketing (i.e. no burning of trash). Nevertheless, a 1993 study of remnant vegetation in the coastal regions within a fifty kilometre radius north of Mackay concluded that local canegrowers were still 'burning excessively and destructively', thereby 'destroying fauna habitat and preventing forest regeneration'.²⁸ Thus, the landscape legacy of the past and continued indiscriminate use of fire by canegrowers is the absence of forests on hillside areas throughout sugar producing regions in North Queensland.

Since 1945, deforestation to enable the expansion of sugar cane cultivation has continued in Eastern Australia, although bulldozers have replaced the brush-hook, axe and cross-cut saw. The modern process of clearing involved bulldozing equipment pushing down the trees and ripping out the root systems of the trees (see Figure 5). Sometimes stumps were blown out with explosives. After the heavy timber had been shifted to the edge of the cleared fields, grubbers went through bringing any remaining roots to the surface and a specialised piece of machinery known as a 'sweeper' swept the roots into rows. The final clearing operation was done by a tractor-drawn rake which piled the roots in smaller bundles, before all the assembled material was burnt. Mechanical clearing became favoured because of post-World War Two labour shortages and it saved time, allowing canegrowers to get the land under crop in a shorter period. Twenty to thirty hectares blocks of virgin forest land could be cleared and planted with cane in approximately three to four months.²⁹

Over the last fifty years, deforestation in the sugar cane growing lands of Eastern Australia has occurred at two scales. First, land settlement schemes involving the clearing of extensive areas of forested land have been pursued. The Abergowrie Land Settlement Scheme, near Ingham, became one of the first localities to be cleared extensively by bulldozers. Here, approximately 4,000 ha covered mostly with rainforest and eucalypt woodlands were brought under cane cultivation in the early 1950s. More recently in the early 1990s, approximately 3,500 ha of eucalypt-dominated woodlands have been cleared as part of the increase in sugar cane growing throughout the Burdekin River Irrigation Area (near Ayr).³⁰ Second, as each successive expansion in the Australian sugar industry occurred after 1945, some canegrowers who were allowed to grow additional tonnages increasingly cleared the fragments of remaining forests on

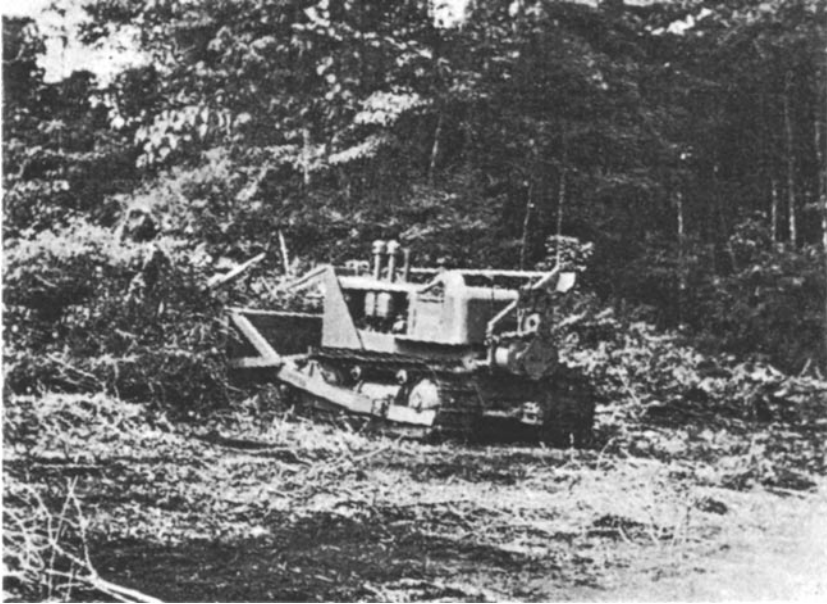


FIGURE 5. Bulldozer in the Innisfail area clearing rainforest for future canefields, 1953.

Source: *Australian Sugar Year Book*, 1953, p. 60.

their properties. This trend is illustrated in the Herbert River district, where a study found that the mean island size of remnant eucalypt woodlands decreased from 546 ha in 1943 to 465 ha in 1977 and 392 ha in 1996.³¹ Even in the mid-1990s, patches of eucalypt-dominated forests were still being cleared to enable an expansion of sugar cane cultivation on freehold land in localities between the Johnstone River and Cardwell, in the Rollingstone-Toobanna area immediately south of Ingham and between Koumala and Carmila, south of Mackay.³²

ENVIRONMENTAL CONSEQUENCES OF DEFORESTATION

Invasion of foreign plants

Deforestation stimulated further a range of additional, sometimes severe, biological responses, which changed the nature of many plant and animal communities throughout the sugar producing districts forever. In particular, the transformation from forests to cultivated lands created environments ripe for the invasion by sun-loving species, both native and alien. Some of these plants became agricultural weeds, infesting cultivated fields, headlands (i.e. uncultivated land surrounding

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fields that allowed the movement of tractors and mechanical harvesters around properties), land being fallowed, irrigation and drainage ditches, cane tramway easements and roadsides throughout sugar cane producing districts.

Reconstructing when particular native and alien plant species became problems for the Australian canegrowers is difficult for three reasons. First, nineteenth century descriptions of sugar cane growing in Australia contain some mention of 'weeds' or other 'noxious growths' in fields of sugar cane, but provide no clues as to what plants were being considered as weeds.³³ Second, the dates associated with the introduction of particular alien plants are often unknown. Third, although many plants have been introduced into the sugar cane growing lands of Eastern Australia and have become naturalised, there is a lag between introduction and recognition as an agricultural weed. Nevertheless, some fragmentary details have survived which can allow a limited reconstruction of when particular native and alien plant species became perceived as agricultural weeds throughout the sugar cane growing lands of Eastern Australia.

Lantana (*Lantana camara* L.), an ornamental shrub introduced into Australia probably in 1843, was one of the earliest plants to be considered an agricultural weed in the sugar cane growing lands of Eastern Australia. This alien plant species is a vigorous coloniser of cleared, but non-cultivated land. By 1888, its presence caused problems to surviving sugar cane growers in the Richmond River district, for the shrub was invading large areas of former sugar cane growing lands that had been abandoned due to the downturn in sugar prices. Stinking Roger (*Tagetes minuta*) was observed to be choking the fields of sugar cane in the Brunswick in 1900. CSR officials at its Hambledon plantation (near Cairns) complained in 1904 of the fields being increasingly infested with 'burs, sida retusa and other weeds'. By 1925, Johnson grass (*Sorghum halepense*) was reported as being a 'great nuisance' to canegrowers in the Ripple Creek district, near Ingham, after being introduced into the district by the sugar planter R.M. Boyd a quarter of a century earlier.³⁴

The most troublesome weed, however, was nut grass (*Cyperus rotundus*), a native sedge. This plant has been described as one of the world's worst agricultural weeds, because its extensive system of underground runners and tubers makes eradication particularly difficult. By 1893, canegrowers along the Clarence River in New South Wales complained that their fields had become 'infected' with this agricultural weed, following its dispersal after frequent floods. In the same year, CSR's Manager at Homebush plantation (Mackay) reported that the field staff had commenced trials to try and eliminate nut grass on the plantation, as parts of the property had become 'badly infested' with the plant. Remarkably, both CSR and W. Hyne of nearby Meadowlands plantation planted lantana on fallow fields in an attempt to see if this plant would smother the nut grass, although their experiments appeared to be futile. Moreover, it is likely that their experiments helped spread this agricultural weed throughout the Mackay district. Another cane growing organisation to be troubled with nut grass was Messrs

Young Brothers, who operated Avondale plantation in the Isis district. In 1910, they reported that nut grass was ‘making great headway’ on this property and this was causing cultivation difficulties.³⁵

Comprehensive lists of plant species considered agricultural weeds in the sugar cane growing lands of Eastern Australia were finally constructed in the 1950s. These lists were assembled by scientists from the Queensland Bureau of Sugar Experiment Stations who conducted trials to determine the effectiveness of the hormone-type weedicide 2,4-D on the many plant species that invaded disturbed sites and cultivated fields of sugar cane throughout Eastern Australia. By 1960, nut grass and lantana continued to infest cane growing areas, but many more introduced grasses and broad-leaved plant species had emerged as major agricultural weeds in the sugar cane growing lands of Eastern Australia (Table

TABLE 1. Common broad-leaved and grass weeds of the sugar cane growing lands of Eastern Australia, 1960.

Common name	Botanical name	Common name	Botanical name
Bathurst burr*	<i>Xanthium spinosum</i>	Pigweed	<i>Portulaca oleracea</i>
Bell vine	<i>Ipomoea plebeian</i>	Star of Bethlehem*	<i>Ipomoea quamoclit</i>
Billygoat weeds*	<i>Ageratum</i> spp.	Stinking Roger	<i>Tagetes minuta</i>
Bindweed*	<i>Convolvulus arvensis</i>	Streaked rattlepod*	<i>Crotalaria mucronata</i>
Blue Snakeweed*	<i>Stachytarphaeta jamaicensis</i>	Barnyard grass*	<i>Echinochloa crus-galli</i>
Castor oil plant*	<i>Ricinus communis</i>	Couch grass	<i>Cynodon dactylon</i>
Common sida	<i>Sida rhombifolia</i>	Guinea grass*	<i>Panicum maximum</i> var <i>typical</i>
Flannel weed	<i>Sida cordifolia</i>	Johnson grass	<i>Sorghum halepense</i>
Giant sensitive plant*	<i>Mimosa invisa</i> Mart.	Mossman River grass*	<i>Cenchrus echinatus</i>
Khaki weed*	<i>Alternanthera repens</i>	Nut grass	<i>Cyperus rotundus</i>
Knobweed*	<i>Hyptis capitata</i> Jacq.	Para grass*	<i>Brachiaria mutica</i>
Lantana*	<i>Lantana camara</i>	Reed (common)	<i>Phragmites australis</i>
Noogoora burr*	<i>Xanthium pungens</i>	Summer grasses*	<i>Digitaria</i> spp.

* Introduced plant species

Source: Based upon the following: H. Young, ‘Weed Control’. Special Issue of *The Cane Growers’ Quarterly Bulletin*, 25, 4 (1962); W. Parsons and E. Cuthbertson, *Noxious Weeds of Australia*, 2nd edition (Melbourne: CSIRO Publishing, 2001); & Charles Lamp and Frank Collet, *Field Guide to Weeds in Australia* 3rd edition (Melbourne and Sydney: Inkata Press Pty. Ltd., 1989).

1). These plants still trouble Australian canegrowers, but since 1960 additional plant species have joined this list.³⁶ Grader grass, sometimes known as Habana Oat Grass (*Themeda quadrivalvis*), an introduction from India, became a serious nuisance in the Macaky district during the 1960s. Milkweed (*Euphorbia heterophylla*) emerged as a problem plant throughout the Bundaberg district in the early 1980s. During the mid-1990s, the introduced semi-aquatic perennial grass, Hymenachne (*Hymenachne amplexicaulis*), native to South and Central America, had become naturalised and commenced infesting agricultural drains and cane fields in districts north of Mackay.³⁷ These new additions have added to the growing weed infestation of the lands that were once covered by native forests.

Climate change

The decline of forests in Australia's sugar cane growing lands and a possible link to a changing climate did raise some concern amongst settlers, journalists and officers from sugar-producing companies such as CSR. Loss of forests in other sugar-producing regions throughout the world was often associated with declining rainfall, but such a trend was not reported in coastal Australia. Instead, settlers in northern New South Wales by the early 1880s blamed the destruction of the forests for increasing frost incidence and more severe frosts.³⁸ Frost is the scourge of canegrowers, for the crop they are trying to cultivate is a member of the grass family, so yields fall in frost-affected cane and in some instances the plant may even be killed. CSR sought to reduce frost damage by lighting fires at intervals around the fields throughout the Clarence River and Isis districts during the 1890s and early 1900s, but found such a strategy had no impact upon the damage done to the cane. A similar practice was tried in the Nambour district in 1910 and 1911, but abandoned after frost damage to the crops was not reduced. Ironically, when Isis district canegrowers in the mid-1890s asked Dr Reed, Manager of CSR's Childers Mill, how to minimise the affects of frost, he replied that 'narrow belts of scrub' should have been left standing around the canefields to break the flow of the damaging cold air and winds.³⁹

Riverbank erosion

Another of the unfortunate outcomes of deforestation was the destruction of riparian vegetation along the watercourses that flowed through the sugar cane producing lands of Eastern Australia. In both Queensland and New South Wales sugar cane was once cultivated right to the banks of streams. Sometimes this clearing was done to maximise the land available for cane production, and sometimes in the often mistaken belief that removing riparian vegetation would improve drainage from paddocks and assist in the speedier removal of floodwaters. By the mid-1990s the Queensland Department of Primary Industries

had concluded that the recommended minimum width for riparian vegetation was 20 to 30 metres each side of the watercourse. However, there are very few situations in the sugar cane growing lands of Eastern Australia where surviving riparian forests exceeded 30 metres each side of a watercourse.⁴⁰

The loss of riparian vegetation meant that riverbanks began eroding. As early as 1882, a journalist travelling up the Herbert River noted that 'the shores were in general low' and that the 'soil is so soft that wherever the fringe of scrub has been interfered with landslips occur which are difficult to stop'. To slow this erosion, CSR reputedly commenced planting Para grass (*Brachiaria mutica*), a native of Barbados, along the banks of the Herbert River in 1884, thereby contributing to the emergence of this agricultural weed in North Queensland (see above). In 1926, an extension officer with the Queensland Bureau of Sugar Experiment Stations, observed that the erosion of river banks in the Babinda district had been brought about by the 'injudicious practice of removing the trees and undergrowth from the banks of speedy-running and winding streams'.⁴¹ Riverbank erosion also became prevalent along the lower reaches of the Burdekin River in the 1930s. A major flood in 1940 severely damaged the banks, created new watercourses through cane farms, deposited sand and debris on some farms and in other localities removed considerable amounts of topsoil.⁴²

The investigation into the impact of the 1940 Burdekin River floods concluded that the predisposing cause of the damage was 'cultivation extending to the river banks'. In response, the Queensland government introduced legislation enabling river trusts to be established with the aim of reducing erosion, repairing flood damage to rivers throughout the State and eliminating cultivation along riverbanks. Since 1940, at least eleven river trusts have been formed. These organisations have modified some of the major watercourses that flow through the sugar cane producing lands of Eastern Australia to reduce erosion and flooding. The type of work that has been undertaken along the Mulgrave, Barron, Herbert and Haughton Rivers, for example, include removing vegetation and silt which is impeding the flow of water, deepening, widening or straightening the river, building levee banks and bank stabilisation by rock fill or stone pitching. Canegrowers were encouraged to cease cultivating along the riverbanks and to establish buffer zones between the fields and riverbanks.⁴³

Loss of wildlife

The forested lands of Eastern Australia before the arrival of canegrowers were home to a rich variety of flora and fauna.⁴⁴ Early canegrowers and visitors to the emerging sugar-producing regions remarked particularly upon the abundance of birds. Charles Eden, the co-founder of a plantation near Tully in the late 1860s,

wrote that 'vast flocks' of Torres Strait pigeons (*Carpophaga luctosa*) used to pass over the estate at sunset. Harold Finch-Hatton who resided near Mackay in the 1870s observed 'swarms of ducks of every description' throughout the district. The Danish immigrant, T. Weitemeyer, who visited the Herbert River district in the late 1870s noted that 'parrots and all other birds flew about in great numbers'. Ellis Rowan, an artist who stayed on several sugar plantations in North Queensland during 1890–91, marvelled at her frequent encounters with cassowaries (*Casuarius casuarius johnstonii*), kingfishers, water fowls and fruit-eating pigeons in the rainforests still surrounding the sugar estates. She also expressed concern about the nightly visits of carpet pythons (*Morelia spilotes*) that made meals of the poultry found on the sugar plantations.⁴⁵

The total clearance of much of the forests in the sugar cane growing lands of Eastern Australia has probably contributed to numerous examples of local extinctions of species of flora and fauna and a reduction in the local range of more widespread species. Many of these extinctions probably went unnoticed. Moreover, as native habitats were transformed into fields of sugar cane, potential refuges for native species diminished ever more in size and number. These processes were augmented by the competition for the natural resources which remained, especially from European grazing herbivores, and hunting of wildlife by the local settlers.⁴⁶ Hence some species of plants and animals that survived the initial forest clearing during the late nineteenth century slowly became rare or threatened with extinction.

Examples of rare, vulnerable or endangered species of terrestrial fauna and flora in the sugar cane growing lands of Eastern Australia in 1995 are listed in Table 2. Of the animal species, the cassowary (*Casuarius casuarius johnstonii*) has long been considered at risk of becoming extinct. As early as 1888 the Queensland historian W. Frederic Morrison noted that cassowaries were 'rapidly disappearing from the country'. At the turn of the century, Archibald Campbell called for the creation of a reserve for the bird due to the cassowary's 'naturally restricted area being taken up by planters and others'.⁴⁷ Such calls went unheeded and during the twentieth century much of the bird's lowland habitat was cleared for sugar cane farms. Interestingly, as the Australian sugar industry expanded during the early 1990s, attempts to clear remnant forests in the Herbert River district led to the 'rediscovery' of the Mahogany glider (*Petaurus gracilis*), after it was considered 'lost to science'. Funds were set aside by the Queensland government in 1995 to repurchase remnant forests critical for the Mahogany glider's survival. However, the clearing of forested land in other districts was threatening the continued survival of the species of plants and animals listed in Table 2.⁴⁸

TABLE 2. A selection of the main rare, vulnerable and endangered terrestrial flora and fauna species in the sugar cane growing lands of Eastern Australia

FLORA

Species	Common name	Type of plant	Locality or district
<i>Dendrobium mirbelianum</i> **	Dendrobium orchid	Orchid	Innisfail northwards
<i>Phaius tancarvilleae</i> **	Swamp orchid	Orchid	Brisbane to Cooktown
<i>Graptophyllum ilicifolium</i> *	Holly-leaved graptophyllum	Understorey tree	Mackay
<i>Syzygium hodgkinsoniae</i> *	Red Lilly Pilly	Small tree	Lismore to Cairns
<i>Eucalyptus hallii</i> *	Goodwood gum	Tree	Isis
<i>Triunia robusta</i> **		Small tree	Nambour
<i>Diploglottis campbellii</i> **	Small-leaved tamarind	Tree	Lismore to Beenleigh
<i>Arenga australascia</i> *	Arenga palm	Palm	Cairns to Cardwell

FAUNA

Species	Common name	Type of animal	Locality or district
<i>Petaurus gracilis</i> **	Mahogany glider	glider	Herbert River
<i>Sminthopsis virginiae</i> #	Red-cheeked dunnart	marsupial, size of a small mouse	Mackay
<i>Dasyurus hallucatus</i> **	Northern quoll	native marsupial cat	Cairns to Mackay
<i>Dasyurus maculatus gracilis</i> +	Spotted-tailed quoll	native marsupial cat	Mossman to Mackay
<i>Casuaris casuaris johnsonii</i> **	Southern cassowary	bird	Ingham to Cooktown
<i>Ninox rufa</i> +	Rufus owl	bird	Mackay
<i>Hipposideros diadema</i> +	Diadem horseshoe bat	bat	Ayr northwards
<i>Phoniscus papuensis</i> +	Golden-tipped bat	bat	Cairns

** Endangered * Vulnerable # Possibly extinct + rare

Source: Based upon Chenoweth and Associates, *Nature Conservation in Sugar Cane Areas* (Brisbane: Queensland Department of Environment and Heritage, 1995), 16–19.

PRESERVING FORESTS

Several commentators were pleased that cane fields replaced the coastal forests. In 1915, Ernest Scriven, the Director of the Queensland Bureau of Sugar Experiment Stations, for example, observed that ‘a wonderful change has been brought about during the last few years’ at Daradgee (near Innisfail). He noted that ‘the immense scrubs have been laid low, and miles of beautiful cane fields are now visible’.⁴⁹ A handful of canegrowers, however, did spare some trees on their properties and when they did so the practice usually attracted the atten-

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tion of visitors. In the early 1870s, the owners of Helensvale Plantation (near Beenleigh) were observed to have left square belts of timber around their fields to protect them from damaging icy winds. The reporter noted their approach was exceptional in the district. Similarly, in a 1904 description of changes in the Isis district, the reporter noted that most of the forest had vanished, except that two German canegrowers, like 'sensible people', had preserved a 'few acres of standing scrub' on their properties. Charles Barrett, who travelled throughout Queensland just after World War Two, noted that only a small area of the original Woongarra Scrub (near Bundaberg) covering approximately 8,000 ha remained intact. Barrett suggested that this small remnant had been 'spared by a farmer with vision, who would have his descendants know what pioneers had to face when they commenced to clear land of dense tropical vegetation'.⁵⁰

A few settlers and visitors to the sugar-producing lands of Eastern Australia actually objected to the diminution of the forests. John Spiller, the founder of Pioneer Plantation (near Mackay) told a *Mackay Mercury* reporter who visited his estate in 1877 that he looked upon the 'entire destruction' of the district's magnificent forests as 'something near akin to vandalism'. Dr Reed, Manager of CSR's Childers Mill in the mid-1890s, commented that it had been a 'mistake' felling the entire Isis Scrub. Ellis Rowan thought it a 'sacrilege to cut down the beautiful timber'.⁵¹ The clearing of so much coastal forest, however, failed to raise much interest from the Queensland government. Historically, agrarian goals and promoting the yeomen ideal had been a major focus of Queensland government policy. Thus, as late as 1967, no national parks existed along the mainland coastal tropical belt below 350 metres in altitude.⁵² This situation was eventually reversed during the 1970s and 1980s, following the campaign by John and Alison Bust and CSIRO ecologists Len Webb and Geoff Tracey to preserve remnants of the coastal forests in the sugar cane growing lands of Queensland.⁵³ Yet, as mentioned earlier, forest not protected in national parks continued to be cleared as the sugar industry expanded after 1945.

So, in the early 1990s, approximately how much and what type of forests have been cumulatively lost in the sugar cane producing lands of Eastern Australia? On the coastal lowlands (below 80 metres in altitude) between Cooktown and Townsville, 60 per cent of the rainforest has been cleared. In particular, most of the complex mesophyll vine forest dominated by a variety of tree species (e.g. *Ficus*, *Findonesia*, *Alstonia*, *Castanospermum*) and the mesophyll vine forest dominated by a dense canopy of mainly palms (*Archontophoenix alexandrae*) and *Calamus* vines has been cleared. Fragments of this vegetation now survive only in small national parks or on privately owned land.⁵⁴ In the coastal plains of the Proserpine, Mackay, Lower Burdekin and Ingham districts, the entire open forest and woodland communities dominated by Morteon Bay ash (*Eucalyptus tessellaris*), Blue gum (*E. tereticornis*), Poplar gum (*E. alba*) and Weeping paperbark (*Melaleuca leucadendra*) have been destroyed.⁵⁵ In northern New South Wales, the 'Big Scrub' by 1900, had been reduced from 75,000 ha to

a mere 300 ha scattered over ten small remnants of which 200 ha was on the northern margin of the area.⁵⁶

CONCLUSION

The ecological impact of the development of the Australian sugar industry has received less academic attention than its social and demographic dimensions. By 1900, sugar cane became the preferred crop in the tropical and sub-tropical coastal districts of Eastern Australia between Grafton in New South Wales and Mossman in Far North Queensland, out-competing all other crops. As the industry expanded in the nineteenth century, initially to meet domestic demands and then to supply the international market after 1920, more and more forested land was cleared. Much of the earliest clearing was accomplished following the large-scale introduction of indentured Melanesians and to a lesser extent indentured Chinese, Javanese and Japanese workers into Queensland during the late nineteenth century. Under European supervision and using hand tools such as axes, brush-hooks and cross-cut saws, they felled the trees and burned the debris after clearing. Later during the twentieth century, European small canegrowers using saws, axes, fire and then bulldozers continued the process, which was still being pursued in the early 1990s.

The environmental consequences of deforestation and disturbance have been examined in this account. These consequences fall into four broad categories: invasion of disturbed sites by sun-loving plants, many of which became agricultural weeds; riverbank erosion; extinctions of species of flora and fauna and the emergence of rare and endangered species of plants and animals; and increased incidence of frost in sugar cane growing districts south of Mackay. These outcomes are similar to those observed in other sugar cane growing lands around the world where extensive deforestation has occurred, with two exceptions. First, there was no reported link between loss of rainfall and deforestation in Australian sugar cane growing lands, unlike other places, especially islands, where sugar cane became the dominant crop (e.g. Hawaii, Mauritius and Barbados). Second, the clearing of so much forest to grow sugar cane in Eastern Australia did not lead to any mention of soil erosion within the nineteenth and early twentieth century extant records associated with sugar production in Australia. Undoubtedly loss of soil did occur, but even when soil erosion starts to be documented in Australian sugar cane growing areas during the 1930s and 1940s, its cause is linked to poor agricultural practices and farming sloping land, not loss of forest cover.⁵⁷

Finally, this paper has highlighted that some enlightened individuals in the nineteenth century were concerned about the damage the growing of sugar cane did to the environment. Yet little official thought was given to the long-term environmental consequences of deforestation in the sugar-producing lands of

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Eastern Australia. Instead both governments and the organisations representing the industry focused upon the continued expansion of sugar cane growing. Changing public opinion in the 1960s and 1970s, however, forced a reassessment of what the growing of this crop had done to the forests. Today, the Australian sugar industry is much more concerned about the environment and is trying to reduce the impact cane growing has on the environment. Moreover, some cane-growers are trying to repair the damage that their predecessors have wrought upon the landscape through tree planting schemes, especially replanting riparian vegetation.⁵⁸ Yet they have a long way to go before the environment resembles even a fraction of what the pre-European landscape looked like when the initial cane-growers commenced cutting down the forest on their newly selected blocks of land.

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