PREFACE

GLOBAL AND NATIONAL CONTEXT

The driving forces behind environmental change

The geographical, human and biodiversity environments of Great Barrier Island are introduced, and dealt with in detail, in later chapters. Here we aim to set the Island into a wider geo-political context, and identify the driving forces creating pressures on the New Zealand environment. Responses to these pressures have occurred at national, regional and local levels, indicating that the environment of Great Barrier Island cannot be considered in isolation from trends occurring on a much wider scale. Some of these broader driving forces, such as historical events, changes in societal attitudes and expectations, and the growth of international tourism, are both the root causes and potential solutions of the environmental issues facing the Island. Moreover, the current environmental pressures from contemporary human activity on Great Barrier Island are relatively minor compared to some arising from the legacy of kauri logging, mining and farming, outlined in Chapter 2. The challenge is to frame responses – rather than 'solutions' – in the context of reliable data, in a way that can be understood and accepted by the community, and acted upon by management agencies.

The driving forces are the background factors which have created the current pressures on the New Zealand environment, including the unique history of isolation of the New Zealand land-mass and the late arrival of Polynesian people. European colonial attitudes towards those indigenous people – the Maori - and especially their different approaches to land ownership are also driving forces behind some of the current pressures. The growth of awareness of the unique biota, the rise of biodiversity conservation, and the significance of islands in this context are also relevant themes. Finally we acknowledge the pressures derived from increasing globalisation, especially international tourism and air travel, and the growing awareness that humans may be responsible for some global scale changes in the atmosphere, biosphere and oceans of our planet. The scale of these problems seems too great for us to deal with. Here we follow the notion "think globally, act locally": only by many small incremental changes, and by setting examples, can we hope to halt the current global wave of extinctions and the degradation of the atmosphere, soil and water on which we all depend.

Evolutionary and biogeographical background

The New Zealand land-mass was once part of the huge southern continent of Gondwana, which eventually split up to form South America, Africa, India, Australia, and New Zealand[i]. This ancient New Zealand 'continent' included vast areas currently below the sea. It carried the late Cretaceous flora and fauna of eastern Gondwana, including the ancestors of moas, kiwis, tuataras, archaic frogs, giant earthworms and the southern beech forest ecosystem.

It is generally accepted that New Zealand's most ancient endemic species had their origins in Gondwana, and their closest relations are often with species now found in South America, Tasmania or New Caledonia. They have survived in New Zealand partly because they have been isolated from invasion by thousands of miles of ocean for nearly 80 million years. Thus some major evolutionary events elsewhere, such as the rise of the snakes and the land mammals, had either no impact at all, or at most a transitory one, on the evolution of the New Zealand biota.

However, sea and wind are capable of carrying animals and plants, the latter especially in the form of spores or seeds. Thus, given the vast time involved, it is not surprising that New Zealand has acquired a large number of species from elsewhere, especially from the west (Australia), carried here by the circulation patterns we now track daily by satellite. On arrival, some of these species underwent spectacular evolutionary radiations, creating many different related species to fill the 'vacant niches' (eg. buttercups in the newly created Southern Alps).

During the last two million years, the earth has gone through a series of climatic fluctuations. Colder 'glacial' periods, lasting sometimes for 100 thousand years, have oscillated with shorter warmer 'inter-glacial' periods, such as that in which we now live, and within which *Homo sapiens* has colonised the earth. Colder periods cause sea level to fall as water evaporated from the sea is locked in terrestrial ice. During inter-glacial periods sea levels rise, flooding former land and creating islands. The main Islands of New Zealand were connected by land at times of lower sea level, and disconnected during inter-glacials. Consequently populations of many organisms in New Zealand have been periodically split in two, and the sub-populations isolated for many thousands of years, allowing the evolution of distinct species from single original ancestors in some cases (eg. kea and kaka), or 'sub-species' in others (eg South Island and North Island robins).

In the case of Great Barrier Island, the last separation from the mainland – Coromandel and the Auckland Isthmus – occurred less than eighteen *thousand* (probably c. 12,000) years ago. As sea-level gradually rose after the last glacial period, the Hauraki Gulf was inundated and the present islands created. Sand-spits and bars enclosed formerly more open estuaries and bays, creating lagoons and coastal wetlands. On Great Barrier Island most of these new land-forms have been created only during the last 6000 years. The most severe impacts of people are now concentrated in this fragile and risky coastal zone.

Thus, as a consequence of its geological and climatic history, New Zealand came to possess a unique suite of birds, reptiles, amphibians, invertebrates and plants. The only terrestrial mammals were three species of bat. Many of the birds evolved a flightless habit, allowing greater body size. The moas (eleven species) are famous giants amongst birds, but there were also giant wekas, geese, penguins, and a parrot (the kakapo). These species and others with reduced power of flight, long life-spans and small clutches were particularly vulnerable to mammalian predators when they finally arrived.

Similarly, the flora had evolved in the total absence of mammalian browsers. There may have been some chemical and structural defences against moa browsing, but these were largely ineffective against deer, goat, pig and possum. These introduced mammals, free of their normal competitors and predators, and provided with a seemingly endless food supply of forest trees and understorey, spread rapidly throughout the country, with devastating effects on indigenous ecosystems, and eventually on the human economy.

Human impacts

The latest survey of the evidence[ii] concludes that Polynesians arrived in New Zealand, with kiore (*rattus exulans*), and dogs, in the thirteenth century (c. 1280 AD). Soon after this, dramatic impacts on the environment can be recognised from pollen and other evidence preserved in lake sediments, peat bogs and cave deposits. Vast areas, especially in the drier eastern sides of both islands, were burned, and forest was replaced by grassland, bracken or scrub. A consequence of forest loss was increased run-off, soil loss, and sedimentation in lowland swamps and estuaries. As the human population increased, pressure on food

resources increased; moa and other large birds were soon eliminated, and populations of some land-nesting sea-birds also declined. In the marine environment, mainland seal and sealion colonies almost disappeared, and accessible fish stocks were depleted. In many areas Maori economy gradually shifted to coastal shell-fish gathering and horticulture based on kumara and bracken fern. Kiore must have played a large role in the extinction of many small ground-dwelling birds and invertebrates.[iii]

The evidence of forest destruction[iv] places the arrival of Maori on Great Barrier Island soon after the Kaharoa eruption (c. 1314±12AD)[v]. Thus, as tradition dictates, these first arrivals could have been on the first canoes to reach Aotearoa/New Zealand from eastern Polynesia. Much of the forest on the Island appears to have been burned, and increased sedimentation in swamps and estuaries dates from this time.[vi]

When Europeans arrived in New Zealand at least 40 bird species, three frogs, a bat and an unknown number of invertebrates were extinct. Many other species were much reduced in numbers. About one third of the forest cover had been destroyed. Coastal resources were severely impacted. In 1835, when Charles Darwin stopped briefly in New Zealand, the European population was less than 2000 but Darwin noted the spread of "very troublesome" weeds which had already "overrun whole districts" and the loss of native flightless birds, "annihilated" (sic) by introduced Norway rats (*Rattus norvegicus*)[vii].

The British brought with them a new suite of plants and animals, and a new technology, designed to create a new England in the Antipodes.[viii] The period from 1840[ix] to c. 1940 was a century of exceptionally rapid and extensive habitat change. It was driven by a widespread belief that man should have dominion over nature, creating individual and collective wealth from the 'uninhabited' waste of forest and swamp. About half the remaining forest was cleared for farming and/or logged for timber and 90% of the wetlands drained. Fires again ravaged the cut-over forest land, creating a new cycle of erosion and flooding. Facing habitat loss and fragmentation, a new suite of competitors, diseases and predators, a further sixteen indigenous bird species went extinct, and many species became restricted to isolated bush remnants or off-shore islands. Now, New Zealand has more than 4 million human inhabitants and 25,000 introduced plant species, with established exotics outnumbering native species[x].

While Great Barrier Island's Maori and Pakeha history has closely mirrored events occurring elsewhere in New Zealand, its isolation has had some benefits for the biota. For example, the survival of populations of brown teal, banded rail, and black petrel may be ascribed – at least in part - to the fact that neither Norway rat nor any of the mustelids reached the Island. But isolation had some negative impacts on the human population and economy, which has remained relatively depressed compared to the nearby Auckland region. Intermarriage between the first farming families, living hard lives on a remote island, created a strong sense of kin-ship, which remains a potent force in Island politics. Lack of easy access to markets, which often changed in ways outside local control, led to relative poverty, and an awareness of difference, which has contributed to the independent spirit of the Island. There is a strong feeling that Great Barrier Islanders should find their own solutions to local environmental problems. However, this requires some knowledge not only of current state of Great Barrier Island's ecology and economy, but also an understanding of the wider political, geographical and historical contexts. Lack of this context may have been at the root of some earlier economic failures.

Biodiversity conservation and the significance of islands in the New Zealand context.
In the 1860's Acclimatisation Societies were set up in most New Zealand towns to facilitate the creation of the 'England of the South Seas'. Introductions were further justified by the then widespread belief that the native fauna was in decline, and that European species would always triumph in the struggle for existence. Many species of plants, animals and birds were introduced, for agriculture, horticulture, and sport, or simply for nostalgic reasons. Some are now mainstays of our economy, but others have become serious environmental pests.

Despite these introductions, and the unsustainable resource exploitation of the early European era, Pakeha New Zealanders soon recognised the importance of conserving tracts of native vegetation, at least in the context of watershed protection and the control of erosion. Maori too, recognised that one way to preserve their Taonga (heritage) in the face of the European land-grabbing was in the creation of reserves[xi].

Now about 30% of New Zealand's land area has some legal protection in reserves, and these mostly come under a single act (The Resource Management Act 1991: RMA) and a single government agency (Department of Conservation) is responsible for most conservation activities. The Department of Conservation was created in 1987, largely as a consequence of public concern over the continued unsustainable logging of native forest. An unfortunate effect of the legislation was to separate 'productive land' (with almost no protection) from 'conservation land' (with almost total protection). The possible conservation role of the matrix of largely private land, within which the conservation estate is set, was not considered. Subsequently, Regional and City Councils were given responsibility (under the RMA) for identifying the areas ecological significance within their boundaries, and providing for the protection of 'significant' habitats for native fauna, and indigenous vegetation cover.

The early conservation initiatives of the Wildlife Service were largely designed to pull individual species back from the verge of extinction. This approach was very successful, gained a high international profile, and is still a strong theme ('Species Recovery Plans') within the Department of Conservation. However a partially successful attempt was also made to set up a national network of reserves representing all the major ecosystems (the 'Protected Natural Areas' scheme). Recently the emphasis has become more holistic, shifting towards the integration of protection and other land-uses, and emphasising ecosystems ('places') rather than iconic species. There is strong support for biodiversity conservation and widespread public participation in local conservation activities. Conservation, pest control and restoration are progressively seen as requiring cooperative efforts, involving Department of Conservation, Local Councils, and community groups. The RMA legislation also requires Maori participation.

New Zealand has approximately 700 off-shore Islands. Some of these are remote and have remained free of most pests, while others are close to the mainland and have gained a varied suite of pests. Island size is approximately related to biodiversity, so that bigger and more isolated islands generally have a higher conservation status than smaller Islands, or those closer to the mainland. At 27,360ha, Great Barrier Island is the largest of our off-shore islands after Stewart Island.

Recognising their importance for the conservation of biodiversity, Department of Conservation commenced a programme of pest eradication on selected islands. After initial ground trapping and baiting experiments, a methodology involving the precise aerial application of poisonous baits was developed. The success of this approach, achieving total

eradication of mammalian pests, allowed the reintroduction of endangered species to many islands. The New Zealand Department of Conservation is now recognised as a world leader in this technology, which has been applied to progressively larger islands, and mirrored on the mainland with the creation of 'mainland islands'. These are areas in which pests are destroyed and their re-invasion resisted (often by the erection of pest-proof fencing and/or marginal zones in which intensive poisonous baiting and monitoring are carried out) to allow the recovery of the indigenous biota.[xii] Local volunteer community groups are involved in the funding, creation and maintenance of many of these areas.

Globalisation trends including international tourism

Globalisation, through television, the internet, and the growth of large corporations operating world-wide, has fuelled consumerism and increased the average size of our 'environmental footprint'. The values and aspirations of the current generation of young New Zealanders differ dramatically from those of their grandfathers: 'saving for retirement' has been replaced by 'living with debt'. This attitudinal shift has probably been a major driver behind environmental pressures in New Zealand. However, there are some very positive consequences of our increased affluence, and our knowledge of events and cultures in other lands. Indeed, it is only through increased communication, cooperation and understanding, that global shifts towards a more sustainable way of life seem possible.

Increased affluence in western society and parts of Asia led to a rapid rise in international tourism in the latter half of the twentieth century, facilitated by the growth in vehicle ownership and the availability of mass air travel. As a consequence, people now regularly travel between continents in large numbers, and other organisms are accidentally transported. While the movement of mammals and birds can be controlled relatively easily, the same cannot be said for seeds, spores, insects and other invertebrates. Despite border security, about 1500 alien insects species are now established in New Zealand, and a dozen new plants become naturalised every year. The introduced flora, including garden plants, far exceeds the native. Concern of course centres on the spread of microbes causing human diseases, but the spread of organisms posing serious environmental and economic risks is just as great.

The economy of Great Barrier Island appears set to become more dependent on tourism. If the Island's natural attractions for 'eco-tourists' are to be maintained or increased, any legislation governing air travel and biosecurity will have local impacts, which may be negative, or positive.

The growing awareness of climate change and the need for carbon sequestration

It is generally accepted that world climate is changing rapidly, mainly as a consequence of carbon-dioxide increase generated by human activities[xiii]. General atmospheric warming is likely to be associated with increased extreme events (eg. droughts and floods), and with global sea-level rise. International attempts to curb $C0_2$ emissions, commenced two decades ago, have been largely ineffective, but New Zealand is committed, through the Kyoto Protocol, to the mitigation of CO_2 output. This will be achieved by 'carbon sequestration'. This term implies the removal of atmospheric CO_2 by its conversion into wood products during the growth of trees. This is seen as a partial or temporary solution while world industry and economy move away from dependence on a fast diminishing supply of relatively cheap oil, gas and coal. The 'Emissions Trading Scheme' will be the instrument through which our international obligations can be met and monitored. As a legacy of its past history of exploitation, Great Barrier Island is now covered largely in regenerating forest ('scrub'),

which sequesters large amounts of $C0_2$ each year, and consequently has potential economic benefit.

The acknowledgement of the link between our local actions and their global consequences, is a profound understanding which is yet to have effect. However, local manifestation can be seen in government-subsidised shifts towards energy efficiency and the increased use of alternative energy sources. On 'off-grid' Great Barrier Island, many of the 'innovations' have been the norm, and in this respect the Island is now well-placed to set an educational example to the remainder of New Zealand.

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i The separation of the land areas which later became Australia and New Zealand, creating the Tasman Sea, occurred about 80 million years ago (for readable discussion see: Gibbs, G 2006. *Ghosts of Gondwana: The history of life in New Zealand.* Craig Potton Publishers, Nelson, New Zealand. Pp232

ii Wilmshurst , J.M. Anderson, A.J. Higham, T.F.G. & Worthy, T.H. 2008. Dating the late prehistoric dispersal of Polynesians to New Zealand using the commensal Pacific Rat. *PNAS* 105 (22): 7676-7680 (www.pnas.org/cgi/diu/10.1073/pnas 0801507105).

iii Wilson , K-J. 2004. *Flight of the Huia: Ecology and conservation of New Zealand's frogs, reptiles, birds and mammals.* Canterbury University Press, Christchurch, New Zealand, Pp 411. Worthy, T.H. & Holdaway, R.N. 2002. T*he lost world of the Moa: Prehistoric life in New Zealand:* Canterbury University Press, Christchurch, New Zealand Pp 718.

iv Horrocks, M., Deng, Y., Ogden, J., Alloway, B.V., Nichols, S.L. & Sutton, D.G. 2001. *High spatial resolution of pollen and charcoal in relation to the c 600 year BP Kaharoa Tephra: Implications for Polynesian settlement of Great Barrier Island, Northern New Zealand. J. Archaeol. Sci. 28: 153* – 168.

v Hogg A.G., et al. 2003 A wiggle-match date for Polynesian settlement of New Zealand. *Antiquity* 77: 116 – 125.

vi Ogden, j., Deng, Y., Horrocks, M., Nichol, S & Anderson, S. 2006. Sequential impacts fo Polynesian and European Settlement on vegetation and environmental processes recorded in sediments at Whangapoua Estuary, Great Barrier Island New Zealand. *Regional Environmental Change* 6: 25 – 40 (DOI 10.1007/s10113-005-0006-5)

vii Darwin, C. 1884. *A Naturalists voyage: Journal of Researches into the Natural History and Geology of the countries visited during* the voyage of H.M.S. Beagle round the world under the command of Capt. Fitzroy, R.N. John Murray. London.

viii Wilson , K-J. 2004. *Flight of the Huia: Ecology and conservation of New Zealand's frogs, reptiles, birds and mammals.* Canterbury University Press, Christchurch, New Zealand, Pp 411. Worthy, T.H. & Holdaway, R.N. 2002. T*he lost world of the Moa: Prehistoric life in New Zealand:* Canterbury University Press, Christchurch, New Zealand Pp 718.

ix 1840 is usually taken as marking the beginning of European settlement, as opposed to more temporary exploitative visits.

x Williams, P.A.; Cameron, E.K. *Creating Gardens: the diversity and progression of European plant introductions,* In: Allen, R.B.; Lee, W.G. 2006: *Biological Invasions in New Zealand.* Ecological Studies Vol.186: 33 - 47

xi In this context Te Huehue Tukino, paramount chief of the Tuwharetoa, gifted the Tongariro volcanos to the government, thus creating the second national park in the world (after Yellowstone, USA) in 1894.

xii The Department of Conservation administers five large 'mainland islands' and there are at least four others administered by private trusts.

xiii Intergovernmental Panel on Climate Change *IPCC Report 2007*