

Bruce D. Clarkson

Reversing Biodiversity Decline in Aotearoa New Zealand

Abstract

Reflections on the history of and prognosis for reversing biodiversity in Aotearoa New Zealand are provided from the perspective of a 40-year involvement in terrestrial ecology and its interface with central and local government policy development and implementation. The emerging favourable policy framework, continuing growth of iwi- and community-led conservation, and a shift to regional-scale restoration give cause for optimism. But reversal of biodiversity decline over still greater areas is required, alongside an in-perpetuity commitment to management that enhances indigenous biodiversity.

Keywords biodiversity, pests, weeds, conservation, restoration, policy, strategy

The wicked problem of biodiversity decline

Biodiversity – the diversity within species, between species and of ecosystems – is declining globally faster than at any time in human history, according to the most recent (2019) Intergovernmental Science-Policy Panel on Biodiversity and Ecosystem Services (IPBES) report on the state of biodiversity and ecosystem services. Further,

the negative trends in biodiversity and ecosystem functions are projected to worsen in most future scenarios in response to rapid human population growth, unsustainable production and consumption, and associated technological development. The world is on track to miss the targets of the Paris Agreement, the Aichi biodiversity targets, and 80% of the United Nations Sustainable

Development Goals (food, water and energy security) because of our poor stewardship of the natural world. Following a brief flurry of media attention, these shocking predictions have generally evaporated from public discussion, leaving only a Google trail and the unanswered question, how does this apply to Aotearoa New Zealand? This article reflects on the history of and prognosis for reversing biodiversity decline in Aotearoa New Zealand.

How does Aotearoa New Zealand fit within this global crisis scenario? How representative of our situation is this gloomy outlook of widespread biodiversity loss? Recent assessments show that New Zealand biodiversity is following and perhaps even exceeding global trends, partly reflecting the insular origin of many ecosystems and species. And what are the key causes of our biodiversity decline? Again, our unique global context is significant. New Zealand shares the main contributors of decline reported internationally. But our unique history sets us apart. Our flora and fauna have high levels of endemism and are poorly adapted to impacts of invasive alien species, but they can be preserved only in Aotearoa New Zealand.

Nationally our main ecological drivers of biodiversity loss are:

- *Habitat loss and fragmentation*

The majority of habitat loss and fragmentation occurred prior to the 1920s, but it was still significant up to the 1970s, was government funded, and has transformed our landscapes later and

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more rapidly than elsewhere in the world. More than one-third of New Zealand forests were cleared for agriculture and 90% of wetlands have been drained. While the rate of loss is comparatively low this century, indigenous habitats, including wetlands, continue to be destroyed, and the cumulative impact on depleted or threatened ecosystems remains significant. Further, legacy effects continue in residual indigenous vegetation patches many years after fragmentation or drainage occurs.

- *Pest predation of fauna and browsing and grazing of vegetation*

A wide range of environmental pests was introduced by successive settlers deliberately or inadvertently. Our flora and fauna are highly vulnerable to competition and displacement from these alien invaders. Recognition of the impacts on indigenous fauna, and in particular on avifauna, is comparatively recent. Herbivore impacts were recognised earlier, but their significance may have been overlooked in recent years due to a focus on mammalian predators.

- *Weed competition and altered ecosystem processes*

More than 1,800 exotic vascular plants survive in the wild in New Zealand without human assistance and about 20 new species escape from gardens every year from a reservoir of more than 25,000 introduced plant species. Many naturalised plant species have traits which give them the ability to alter ecosystem processes, changing the rate and trajectory of vegetation succession in ways which, sometimes irreversibly, reduce the richness and diversity of native species.

- *Disease*

Arrival of new diseases can also reduce population viability and change vegetation composition and structure. Kauri dieback caused by fungus-like *Phytophthora agathidicida* is currently causing significant damage to kauri forest and individual trees, while the recently arrived fungus *Austropuccinnia psidii* is affecting members of the myrtle family, including ramarama, rāta and pōhutukawa.

- *Land use change and intensification*

For indigenous biodiversity, the initial transformation from a natural ecosystem, either for agriculture, cropping or plantation forestry, causes the most degradation and decline. Land use changes and intensification exacerbate

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the initial modifications, but can be part of sustainability goals to conserve and enhance biodiversity values.

- *Climate change*

The potential impacts are still unclear, but most ecologists agree that our flora and fauna will be disadvantaged directly and indirectly by the impacts of climate change, resulting in at least local extinctions, strengthened competition from alien species, and biotic migrations tracking suitable climates.

But more important are the underlying causes of biodiversity decline, summarised by Brown et al. (2015), based on the results of the Root Causes project (Wood, Stedman-Edwards and Mang, 2000). They attribute biodiversity decline to the imbalance between human growth and consumption and sustainable development (including biodiversity protection). The loss of biodiversity and ecosystem services, in their framework, is fundamentally caused by market failure, exacerbated by the unequal power of private development interests and public conservation interests, and the lack of recognition of how many key commodities rely on biodiversity (Brown et al., 2015). Ecologists understand the ecological impacts and drivers of biodiversity decline and largely know how to fix degraded ecosystems and increase threatened species populations, but are sometimes naïve about these 'root causes' of decline. Unfortunately, continually repeating the ecological narrative has not led to a reversal of biodiversity decline. But working alongside iwi and communities, and councils and the Department of Conservation (DOC) can make a local and even regional difference.

Background history

Forty years ago in Aotearoa New Zealand environmental management was a hotly contested topic and major changes were initiated. In 1982 a nature conservancy for the management of natural lands of the Crown, and a Ministry for the Environment with its own Act, were called for by a consortium of environmental and recreation non-governmental organisations. The Environment Act 1986 created the Ministry for the Environment and the Office of the Parliamentary Commissioner for the Environment. One year later (in 1987), DOC was established by 'joining the green dots of conservation' between the New Zealand Forest Service, the Department of Lands and Survey and the Wildlife Service. The conservation estate was extensive, comprising national parks and scenic and allied reserves. Sizeable forest parks and their ecological areas were soon added to the Crown conservation estate, following the controversial decision to cease logging of native forests on Crown-owned land. This protected natural area network covered one-third of New Zealand's land area. But it was concentrated in the uplands and unrepresentative (in the words of the Reserves Act 1977) for

ensuring, as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character. (s3(1)(b))

The early 1980s saw the advent of the Protected Natural Areas Programme (PNAP), an attempt to rapidly identify the 'best of the rest' areas (recommended areas for protection) for protection on private lands, especially in regions undergoing rapid development: for example, scrub clearance for establishment of pine plantations or expansion of dairying and cropping.

Coincidentally my own career as an ecologist began around this time, and indeed my role as a Department of Scientific and Industrial Research (DSIR) regional botanist appears to have resulted from the need to place staff close to where some of the controversial land use decisions were occurring at the time. Now, having been a keen observer of landscapes and native flora for even longer, it is timely to reflect on the

state, condition and trend of Aotearoa New Zealand's biodiversity under a changing policy framework and consider the prognosis for reversing biodiversity decline. My starting point is the 1980s and my emphasis is on specialist-interest native vascular plants and terrestrial vegetation.

The New Zealand Protected Natural Areas Programme

David Thom, chair of the National Parks and Reserves Authority, considered the PNAP survey the most important conservation initiative of the 1980s (Kelly and Park, 1986). Started in 1981, five years later the programme had achieved wide support, with 26 of New Zealand's 268 ecological districts having been surveyed. The four pilot studies, focusing on ten districts, identified some 200 areas for protection. I was privileged to be involved in one of these pilot studies (Motu ecological district) and a further ten PNAP surveys undertaken between 1984 and 2009 across a large portion of the western and eastern central North Island. They provided essential training for a new generation of ecologists and remain for some ecological districts the most comprehensive publication available on indigenous ecosystems. While the coverage was far from comprehensive, the PNAP surveys were the best available information to address the state of biodiversity on private land, and the adequacy of protection (Bellingham, 2001). The recommended establishment of a permanent PNAP survey unit (Kelly and Park, 1986), with a staff of at least 15 operating on an initial ten-year time frame (to match the rate of transformation evident in the New Zealand landscape), never eventuated.

Nevertheless, by 2001 at least 83 ecological districts had been surveyed and 43 reports had been published (Bellingham, 2001) by various consortia of DOC and its precursors, councils, universities, the Crown research institute Landcare Research and its DSIR precursors, and environmental consultancies. Wildland Consultants Ltd (2004) identified 51 published reports and 17 unpublished reports, and new surveys were still being undertaken. I am unaware of any more recent reviews of the PNAP and it is unlikely many additional surveys were undertaken; the most recently published PNAP survey appears to be the one covering the Kaipara ecological region (Smale et al., 2009). PNAP surveys suffered from lack of accessibility of both the published and unpublished documents and the underlying data layers (Bellingham, 2001; Wildland

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Consultants Ltd, 2004). However, they have been widely used by councils in delineating and scheduling significant natural areas under the Resource Management Act 1991 (RMA).

The advent of the RMA, a new statutory context, was partly responsible for the demise of the PNAP, but it was unfortunate that the programme was never completed. At this time a national approach was debated, with no consensus from ecologists (Walker et al., 2008) or across all territorial local authorities on criteria for assessing significance, and conflicts arose with private landowners about the use of PNAP data by authorities. One of the strongest legacies of the PNAP is evident in the Mt Taranaki (Egmont) ecological district (Clarkson, 2011), where most of the small ring plain patches identified as recommended areas for protection remain and are now QEII covenants, or in case of the 142-ha Mahood-Lowe Reserve, opened in 2020, a Native Forest Restoration Trust reserve purchased following a public fundraising appeal.

The Resource Management Act 1991

The RMA can be viewed as a legislative response aligned with the restructuring of environmental management in New Zealand and designed to move beyond the adversarial and politicised debates of the 1980s. In consolidating disparate environmental planning statutes, the RMA fostered a system of plans and policy statements at the territorial and regional level (Davies, 2008). Initially heralded as innovative and novel internationally (Memon and Gleeson 1995), reflection on its limitations soon emerged (Davies, 2008) and continue to this day.

Soon after the inception of the RMA, a critique by Murray and Swaffield (1994) noted that it was based on policy myths, including the focus on tradeable natural and physical resources and the assumption that these resources could be managed sustainably. The RMA also assumed that sustainable management should integrate conservation and development, achieved through rational planning of the environmental outcomes in resource use. From an ecologist's perspective, the first is most problematic, as the Act takes a reductionist approach to trading and managing resources, including biodiversity, across complex interdependent and interconnected systems (ecosystems). The main impact of the Act on biodiversity was through section 6 matters of national importance, in particular sections 6(a), 6(b) and 6(c) relating to:

- (a) the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
- (b) the protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:
- (c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.

From my perspective, most debates over consent applications quickly descended into overly adversarial conflicts in which the emphasis was on specific patches of habitat, as if they were static entities in time and space. Key concepts such as cumulative loss or the need to maintain metapopulations at regional scale were overshadowed, despite often being inherent in the significance criteria being utilised. The risks associated with climate change were rarely, if ever, considered. On several occasions I witnessed

procedures appearing to favour those with greater resources to employ expert witnesses or those with the capacity to take the financial risk of challenging decisions, a finding supported by Chapple (1995) and Gunder and Mouat (2002).

In district plan reviews, definitions of significance were continually debated, there was an over-reliance on desktop surveys and incomplete schedules of significant natural areas appeared to result from pushback by politically motivated vested interests. This over-regionalisation of approach or lack of will to undertake the process of recognising and providing for biodiversity also seemed to result from inadequate resourcing in smaller councils and a lack of central government policy and leadership. Despite these limitations, the RMA slowed loss of biodiversity on private land, and in some areas of New Zealand notable successes have been achieved, often associated with national campaigns. From an ecological perspective, retention of indigenous habitat on landscapes is the first step, followed by statutory protection. But both are only holding patterns (for the lifespan, in the case of native forests, of the main trees) if the fundamental drivers of decline persist and there is little or no active management to reverse the decline.

Compliance and monitoring of resource consents is another area where the RMA has been problematic. Countless resource consents have been issued by regulatory agencies since the inception of the RMA: 34,000 by regional and district councils and the Environmental Protection Authority in 2012–13 alone (Brown et al., 2015). The decision-making process, requirements for mitigation actions, compliance and monitoring are all important dimensions for protecting biodiversity. As outlined by Brown et al. (2015), the requirements are typically stated in a side agreement or, more commonly, as a condition of consent. Consent conditions for these positive conservation actions are important to lessen the impacts of development on biodiversity. However, compliance must be enforced. Brown et al. (2013) documented that councils do not rigorously enforce either their plans or the conditions of consent. Monitoring of consents is typically under-resourced, penalties are modest and political interference seems common. A possible solution is the separation of consenting from compliance and monitoring (Brown et al., 2015). Finally, there is the issue of local authorities using extensive powers for non-notification and with developers apparently able to buy off

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objections in order to avoid conflict (Gunder and Mouat, 2002).

All of the constraints outlined have the potential to contribute to biodiversity decline, and in my experience often do. While I am aware that a review of the RMA is currently in progress, my focus here is on the specific biodiversity-focused policies.

The first New Zealand Biodiversity Strategy Under DOC leadership, and involving many government agencies, including the Ministry for the Environment, the first New Zealand Biodiversity Strategy (Department of Conservation and Ministry for the Environment, 2000) was developed and ratified. Public participation in the development of the strategy was strong and the draft subtitle ‘Our chance to turn the tide’, and primary goal of ‘halting the decline’ seemed to resonate widely. The sub-goals of goal three (halt the decline) of the strategy were:

Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and to do what else is necessary to Maintain and restore viable populations of all indigenous species and sub species across their natural range and maintain their genetic diversity.

The strategy was, in large part, a response to commitments made under the United Nations Convention of Biological Diversity, signed in 1992 and ratified in 1993.

The New Zealand Biodiversity Strategy specified 147 actions in ten priority action areas, most falling to central government agencies and territorial authorities and regional councils. Territorial authorities and regional councils carried out their statutory functions under the RMA, and most regional councils and unitary authorities invested in operational programmes (mostly through pest management under the Biosecurity Act). In 2000 government had recognised that ‘to turn the tide’ on biodiversity losses would require more resources and initiatives on a wider number of fronts to achieve. A review of progress in the first five years (Green and Clarkson, 2005) showed that the funding (\$184 million) provided through the Biodiversity Package made important contributions in a number of areas. In summary, one-third (35%) of the priority actions were scored as having made ‘substantial’ progress in the first five years of the strategy, while two-thirds (67%) scored as ‘high priority’ for contributing to the future outcome of the strategy. Green and Clarkson also noted that several objectives were achieved despite government agency priority shifts, while iwi- and community-led conservation and restoration initiatives continued to grow.

Without further systematic reviews it is difficult to assess progress over the remaining 15 years. However, Willis (2017) did highlight further important initiatives aimed at lifting performance in achieving reversal of decline, including: amendment to the RMA to provide local authorities with the express function of ‘maintaining biodiversity’; and a major policy and consultation process looking at biodiversity and private land, and the value of a national policy statement on biodiversity to guide and direct decision making under the RMA. In my view, several government agencies listed as leads on specific actions progressively disengaged and the strategy was seen as a DOC strategy, rather than one embraced nationally. Despite a promising start, the fact remains that the strategy did not meet the primary goal of halting the decline and, in the words of Willis (2017), was an ‘intervention failure’.

In an attempt to learn from the first strategy’s shortcomings, a 2020 DOC review, ‘Lessons learnt from the 2000 New Zealand Biodiversity Strategy’ (Department of

Conservation, 2020b), drew on consultation discussions, comments received in response to the discussion document (*Te Koiroa o te Koiroa*) published in August 2019, and on other published reviews, including the two already covered above. Apart from noting that the strategy was viewed as belonging to DOC, the most significant issue identified centred around implementation. Aspects of accountability and responsibilities, prioritisation, monitoring and review all contributed to a lack of progress of implementation.

The current state of biodiversity

Since the landmark 1997 *State of New Zealand's Environment report* (Ministry for the Environment, 1997), which identified biodiversity loss or decline as New Zealand's most pervasive environmental issue, a plethora of reports and updates (e.g., the Environment Aotearoa series, the OECD performance review series and reports by the parliamentary commissioner for the environment) have consistently reported on an ongoing decline. Perhaps the most robust analysis to date is found in Brown et al. (2015), because it not only analyses the drivers of biodiversity decline but provides a solutions framework and a range of strategic, tactical and practical solutions (Clarkson, 2015). However, as Willis has correctly identified, 'the reality is that whether things have got better or worse depends on what you are measuring where, and compared to what baseline' (Willis, 2017, p.17). All of the accounts have their limitations, but in recent years there has been greater availability of suitable data and indicators.

Most recently, the DOC report *Biodiversity in Aotearoa: an overview of state, trends and pressures* (Department of Conservation, 2020a), companion to the strategy, sought to objectively present the data and information that describes the extent of the biodiversity crisis in Aotearoa New Zealand. In doing so it set the scene and supported the strategy 'by providing the evidence base for the action needed to respond to this crisis'. As discussed below, these strong words are generally backed by a more quantitative approach than seen in earlier assessments.

In terms of terrestrial ecosystems and species, the focus of this account, decline, is clearly documented, but the question remains, is it of crisis proportions? For vascular plants, the best-known group of plants and with 84% endemism, some 62% of species have shown declines in conservation status between the

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last two New Zealand Threat Classification System (NZTCS) assessment years (2012–17). However, the NZTCS assessment uses a Delphi methodology and no rigorous quantitative population viability analyses appear to have been undertaken. Some 107 species are now listed as data deficient (de Lange et al., 2018) and many members of Myrtaceae have been reclassified to higher threat status because of the presumed impacts of myrtle rust. However, there can be little doubt that 213 plant species in the highest threat class (nationally critical) – for example, kōwhai ngutu-kākā (*Clianthus maximus* and *C. puniceus*) – are at serious risk of extinction in the wild.

Continuing clearance of indigenous vegetation is quantified from the New Zealand Land Cover Database (2020). For indigenous forests, scrub and shrubland, the net loss from 1996 to 2018 was 40,800 ha, and for indigenous grasslands it was 44,800 ha. Despite some gains from habitats reverting to native cover naturally or through restoration, the net loss of native forest, scrub, shrubland and grassland (2012–18) amounted to 12,900 ha. The latest threatened environments analysis demonstrated that 32% of New Zealand's 500 land environments had less than 10% cover of

native vegetation remaining, while a further 14% had 10–20% native vegetation cover (Cieraad et al., 2015). Collectively, these two categories represent around 33% of New Zealand's total land area, with the most depleted parts of Aotearoa in coastal and lowland areas of low relief, particularly high-fertility alluvial plains, terraces and flats. While the spatial extent of vegetation and its reduction is adequately assessed, there was insufficient information to document the state and trend of ecological integrity of indigenous ecosystems across the country.

Data collection of indicators of ecosystem integrity is limited, as is coordinated curation of existing information. However, researchers have developed a basis upon which to advance this area. This includes standard regional government biodiversity indicators (Lee, McGlone and Wright, 2005; Bellingham et al., 2016). DOC has used the outcome monitoring framework originally set out by Lee, McGlone and Wright (2005) and revised and updated by McGlone et al. (2020) to support the development of a quantitative, field-based monitoring programme for ecological integrity: data elements combine to form a measure, and multiple measures are combined to provide information about an indicator.

The most comprehensive and extensive systematic long-term monitoring programme presently operating in Aotearoa to report on state and trend in terrestrial biodiversity is Tier 1, undertaken by DOC across all public conservation land. The Tier 1 network measures condition and builds on and extends the Ministry for the Environment's land-use carbon analysis system (LUCAS), in place since 2002 for reporting on carbon stock and change in Aotearoa New Zealand's forests and shrubland.

Trends from Tier 1 monitoring on public conservation land indicate no change in the overall balance of indigenous and exotic plants in forests between the first (2002–07) and second (2009–13) measurements (Bellingham et al., 2014). However, many of these forests are in remote uplands, well buffered from infestation from the weeds that inhabit smaller forest remnants in lowland and coastal zones. Environmental weeds detected by Tier 1 monitoring were more frequent in non-forest plots, with the most common being mouse-eared hawkweed (Bellingham et al., 2013).

There are some positive trends in statutory protection on private land. The extent of private land protected through Queen Elizabeth II National Trust covenants rose from 10,000 ha

in 1990 to 184,210.8 ha in 2018 (qeiinationaltrust.org.nz). Most QEII covenants occur in the two most threatened environments and their contribution to biodiversity representativeness far exceeds their generally small patch size (median 5.6 ha). However, limited information is available on the condition and trend of covenants nationally.

While no national-scale direct assessments of the condition and trend of indigenous ecosystems appear to be available, recent research focused on the extent of conservation lands under intensive and extensive pest management via ecosanctuaries, offshore islands and mainland reserves can be used to indirectly gauge the extent of pest control, a major aspect of reversal of biodiversity decline. Green and Clarkson (2005) noted that it was clear that the funds or capacity will never be available to manage indigenous biodiversity at the level of DOC's current investment in its intensively managed areas. These represented just 2–3% of the total lands administered by the department. The auditor-general (2012) suggested that DOC was able to actively manage only a small proportion (about one-eighth) of New Zealand's conservation land and about 200 of the 2,800 threatened species. Russell et al. (2015) estimated that some 45% of mainland New Zealand was under some form of predator management (possum control, mustelid control and rodent control), that 10% of island area was predator free in 2014 and that 50% of island area could be predator free within a decade. Focusing on ecosanctuaries, Innes et al. (2019) showed that while comprising only 0.2% of New Zealand's land area, they have achieved significant biodiversity gains, in particular returning some very pest-sensitive species to the New Zealand mainland after decades of absence. Spill-over of biodiversity into the wider landscape is a further benefit of ecosanctuaries (Tanentzap and Lloyd, 2017). Ecosanctuaries are the strongest practical attempts on mainland New Zealand to meet legislative requirements to eradicate diverse, harmful introduced species and thereby reverse biodiversity decline (Innes et al., 2019). They also represent a shift in management leadership, with some 50% managed by DOC and the remainder by community trusts or similar.

My own recent observations on the current state of biodiversity

Not long after the Covid-19 pandemic began to constrain my work programme,

While a national policy statement is not a silver bullet, it could be expected to assist in providing a more coherent and strengthened approach to solving the biodiversity crisis, particularly in relation to ongoing loss of biodiversity on private land.

I determined to spend more time in the outdoors (nature) to reacquaint myself with some of the field sites I worked on as the DSIR Botany Division regional botanist and to relearn the New Zealand vascular flora. The results of this effort are publicly available on the citizen science platform iNaturalistNZ (under the user name brucedc). As of 14 March 2022, some 9,711 plant observations (1,195 species) were posted over a period of almost two years. While my re-examination has been essentially qualitative, my baseline is long experience and many unpublished and published reports on the natural areas produced between 1980 and 2000. I have used my observations of the vegetation condition and the presence and abundance of palatable vascular plant species to assess whether natural areas or specific sites have declined or improved or remain in a similar condition to when visited mostly more than 30 years previously. As to be expected, I have noted a wide range of vegetation condition changes, from serious decline to marked improvement, but a majority of sites appear to be in poor condition, most of these over the duration of my observations.

Unsurprisingly, the amount of active management of introduced herbivores and

invasive weeds seems to explain the differences. Waikato's Maungatautari Ecological Island sanctuary has shown the greatest improvement, a result of intensive pest control implemented since the installation of the predator-proof fence and the extermination of mammalian herbivores, including goats and possums. In places, the once uncommon shrub epiphyte kohurangi (*Brachyglottis kirikii*) is becoming prominent as a ground dweller again and the vegetation on old slip faces or rocky ridges is thickening and impenetrable in places. Palatable ground species, such as toropapa (*Alseuosmia macrophylla*) and hen and chicken fern, are abundant and king fern (*Psitana salicina*) is regenerating. Te Papakura o Taranaki (Egmont National Park) is showing similar recovery since the implementation of Project Mouna, with goats most likely fully eradicated and possum numbers as low as they have ever been. The only damage noted came from intensive human impact on a confined area on the crest of Pouakai, and hare damage more widely on the Pouakai Range tops and fringe of Ahukawakawa mire. While birds were not a focus, the range of species seen and the bird song intensity in both natural areas is remarkable compared to my visits in the 1980s and 1990s. The same situation is evident at Rotokare Reserve in east Taranaki, where bird translocations and extermination of pests have been undertaken inside the predator-proof fence since 2009. A different style of recovery is evident in Paengaroa Reserve, where intensive weed control alongside pest control has helped protect a rich assemblage of divaricating plants. On mounts Tarawera and Tauhara wilding conifers have been greatly reduced, but the benefits of pest control were not as evident.

The worst examples of decline are mainly in scenic and allied reserves or former state forest lands: for example, Karamu Scenic Reserve, Paiaka Domain Recreation Reserve, Awakino Conservation Area and Pureora Mountain Ecological Area (Pureora Forest Park). In these places, introduced herbivores remain a problem. Goats have modified the Awakino reserve since my first visits and show no signs of abating. Over more than 50 years of observation, the scenically and ecologically important Awakino Gorge flora and native vegetation has continued to decline in extent and condition due to goat and possum browsing and weed invasion, particularly of the roadside fringes. In the Awakino Conservation Area extensive areas of the

understorey and ground cover exhibit major depletion and a cessation of normal forest regeneration, with toropapa all but locally extinct. At Karamu Scenic Reserve goats are progressively removing the palatable limestone flora and the ground cover is heavily depleted, as it is at Paiaka Domain Recreation Reserve. Goat control was recommended for Karamu Scenic Reserve as early as 1984, but it is uncertain if this has ever been undertaken. On Mount Pureora deer numbers are likely higher than they were in the 1980s, because the submontane flora remains obviously impacted. Within Tongariro National Park, deer are damaging an important mire with uncommon plant species on the flanks of Hauhungatahi. Many sites show a complex mix of improvement and decline, depending on the range of management undertaken. For example, in Tukainuka Scenic Reserve, where pest control is good, domestic stock have continuing access because of inadequate boundary fencing.

Overall, from the sites revisited, the picture emerges of ongoing decline at different rates depending on management. Notable exceptions are the highest-status conservation sites, such as national parks or ecosanctuaries. Sites intensively managed, such as Maungatautari, give us an insight into what the vegetation was like before the invasion of mammalian herbivores, although lacking pre-human large avifauna herbivory. With kohurangi growing in the ground layer at Maungatautari, reinforcing the descriptions of early European explorers, the emerging vegetation composition cautions each generation of ecologists about the shifting baselines for interpreting vegetation condition. These sites also represent a new approach, where the local iwi and/or community or private landowners have taken full responsibility for active management. Some small patches in the rural landscape – e.g., the Te Aroha Station, Pehiri, Miller Bush and Waingarō QEII covenants – have shown good recovery. The most important ingredients are kaitiaki who care and have the resources to actively manage the degradation caused by introduced pests and weeds.

Waiting for a national policy statement on indigenous biodiversity

It is now more than 20 years since I was invited to early discussions on development of a national policy statement on indigenous biodiversity. Previous iterations appear to have been halted because of disagreements

The nature and style of council consultation, the lack of clarity around constraints on use and development, and the lack of clear economic incentives to retain and protect biodiversity on private and Māori lands all come into play.

among stakeholders and lack of political will. A useful interim document, a statement of national priorities for protecting rare and threatened native biodiversity on private land, emerged from the earlier discussions and was published by the Ministry for the Environment in 2007, after the failure to finalise a draft national policy statement. Those priorities were:

- national priority 1: to protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand (LENZ) at Level IV) that have 20% or less remaining in indigenous cover;
- national priority 2: to protect indigenous vegetation associated with sand dunes and wetlands, ecosystem types that have become uncommon due to human activity;
- national priority 3: to protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2;
- national priority 4: to protect habitats of acutely and chronically threatened indigenous species.

While a national policy statement is not a silver bullet, it could be expected to assist in providing a more coherent and strengthened approach to solving the biodiversity crisis, particularly in relation to ongoing loss of biodiversity on private land. The latest attempt to formulate a national policy statement began in 2016, with the formation of a Biodiversity Collaborative Group consisting of industry representatives, environmental groups, and an iwi advisor to the Iwi Chairs' Forum. Perhaps the most significant report commissioned by the group (Walker et al., 2018) discusses the critical factors to maintain biodiversity, in particular what effects must be avoided, remediated or mitigated to halt biodiversity loss. This provides tables and a decision tree to assist policymakers and stakeholders to interpret and understand how to assess the effects of development applications. In essence, the group recommended that it is most sensible, efficient and cost-effective to maintain existing indigenous biodiversity resources. They also noted that there are inherent difficulties and risks in seeking to recreate or reconstruct indigenous habitat in order to mitigate for continuing removal of indigenous habitat for development projects, and that mitigation may not result in an ecosystem of equivalent richness or function. I agree. From my observations of many RMA decisions, biodiversity has been the loser, particularly in landscapes where biodiversity has already suffered serious depletion. The remedy or mitigation offered often has little chance to result in a medium- to long-term biodiversity gain, and in any case will often not be monitored to determine compliance with consent conditions.

My interest and contribution to these discussions focused on the urgent need to restore or reconstruct indigenous habitat in New Zealand's most depleted environments, including the urban and peri-urban zone (Clarkson, Kirby and Wallace, 2018). There the goal should be to build, expand and reconnect indigenous habitats to ensure that they persist near where the majority of New Zealanders live. The MfE's draft national policy statement released in November 2019 following a consultation process found 92% support among submitters.

The draft statement is well grounded in ecological science, and, most importantly, has implementation requirements which, if adhered to, could make a significant difference to protecting and restoring indigenous biodiversity on private land.

There is also recognition that existing significant natural areas may not capture all areas of significance, and provision needs to be made for new sites to be managed, reflecting their natural values. Highly mobile species, such as bats, and their habitats and iwi taonga species and ecosystems are also catered for. Modern restoration ecology principles feature strongly in the draft, with recognition that territorial local authorities need to promote restoration and enhancement (including through reconstruction) of wetlands, degraded significant natural areas and areas providing connectivity or buffering functions. Native vegetation cover of a minimum of 10% is expected in urban and rural zones. Local authorities are encouraged to adopt a precautionary approach to development where the effects on biodiversity are uncertain, and when changing or making policy statements or plans to promote the resilience of indigenous biodiversity to climate change. The requirement for regional councils to prepare a regional biodiversity strategy in collaboration with territorial authorities, tangata whenua, communities and other identified stakeholders could be the process that finally delivers a coordinated approach to reversing biodiversity decline at the regional scale.

The Aotearoa New Zealand Biodiversity Strategy

Led by DOC (2020c), a revised *Te Mana o te Taiao: Aotearoa New Zealand Biodiversity Strategy 2020* was completed and launched on 10 August 2020. The new strategy takes a broader approach to solving biodiversity decline than the previous attempts. Importantly, it encompasses a more progressive bicultural (Treaty of Waitangi-based) approach. It confirms the priority focus on indigenous flora, fauna and ecosystems. It seeks to address the systemic structural and funding issues that constrained the previous strategy and has ambitious goals, including restoration of ecosystems running from the mountains to the sea. It recognises the importance of influencing and meeting commitments to international agreements and conventions. Finally, it has an increased emphasis on urban and peri-urban nature and the centrality of people's relationships with nature. Unfortunately, some impetus appears to have been lost during the 2020 election process. Following the installation of the sixth Labour government in 2020, work on an implementation plan was revived and

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an interim oversight group established to advise the new minister of conservation on aspects of the strategy, including governance.

Progress on the draft national policy statement on indigenous biodiversity, inextricably linked to the strategy, appears to have slowed. Ironically and predictably, the same issue that prevented ratification of earlier iterations of the national policy statement has reappeared. In the late 1990s, attempts to identify significant natural areas on private land in the Far North District led to discord and withdrawal of plan provisions. Similar reactions have occurred in other districts and regions over the years, and most recently in the Far North again following a council communication to 8,000 landowners regarding significant natural areas. Māori land is disproportionately affected, as Māori landholdings are often remaining biodiversity

strongholds, reflecting a history of confiscation or loss of their most productive land. The nature and style of council consultation, the lack of clarity around constraints on use and development, and the lack of clear economic incentives to retain and protect biodiversity on private and Māori lands all come into play. Efforts are currently underway to determine appropriate incentives to reduce this roadblock. As is often the case, previous research (Clough, 2000) probably identifies most of the potential solutions. However, new approaches in the form of bio-banking and payment for retention of ecosystem services are emerging internationally.

An optimistic future?

The IPBES report concluded optimistically, observing that it is not too late to turn this crisis around and that there are many practical actions available to get back on the right trajectory and improve the scale and pace of change: 'Nature can be conserved, restored and used sustainably while other global societal goals are simultaneously met through urgent and concerted efforts fostering transformative change' (IPBES, 2019, p.20). It identified five main interventions to generate transformative change by tackling the underlying indirect drivers of the deterioration of nature: (1) incentives and capacity building; (2) cross-sectoral cooperation; (3) pre-emptive action; (4) decision making in the context of resilience and uncertainty; and (5) environmental law and implementation. Many elements of these interventions can be identified in our attempts to reverse biodiversity over the last 40 years discussed above. Moreover, Brown et al. (2015) have canvassed them all in detail.

My November 2020 address to the Royal Society of New Zealand branch in Napier outlined many reasons for taking an optimistic view on progress towards reversing biodiversity decline. In brief, increased funding for DOC and the Ministry for Primary Industries and philanthropic funding of the style of Project Janzoon and Project Mouna, as well as recent initiatives such as Predator Free 2050, Jobs for Nature and the One Billion Trees programme, were providing the opportunity to restore at scale. The emerging favourable policy framework, continuing growth of iwi- and community-led conservation, and a shift to regional-scale restoration involving new collaborative and collective impact models were also improving performance. Finally, increasing recognition

of the seriousness of climate change and its coupling with biodiversity decline, alongside growing awareness of the human wellbeing and health benefits of high-quality greenspace and nature, were driving an appreciation of the need for a greater response. Countering these positive influences are the realities of the dominant economic model, inadequate funding to adequately mitigate past and present biodiversity loss, and continuing habitat losses and species range contractions. Then there is ongoing failure to recognise the full scale of the response needed to achieve a one-ecosystem approach (Daugherty and Towns, 2019), in which every transaction with nature leaves nature no worse off and preferably provides a net biodiversity gain. At the time of writing, the likelihood of a ratified national policy statement on indigenous biodiversity seems to be hanging in the

balance. In addition, while the total funding package has improved, the security and term of funding and the over-reliance on voluntary support is a continuing concern. Many of the gains from Jobs for Nature, or any other conservation initiative for that matter, can be quickly lost as the nature of reversing the decline in Aotearoa New Zealand requires an in-perpetuity commitment and any cessation in management will result in rapid loss. The transformational shift required would see extermination of the pests targeted by Predator Free 2050 and some more besides, and similar success with control of the most problematic weeds, over even more extensive areas of Aotearoa than currently.

While the IPES report and the United Nations Decade of Ecosystem Restoration, which began in 2021, provide us with added motivation for the transformational change

needed, in the end it will be the people of Aotearoa New Zealand who will determine the fate of our unique biodiversity. That is the main reason I remain optimistic, as I observe so many New Zealanders prepared to commit their time and energy to working for the highest practicable extent of improvement and a rebalancing of the results of 200 years of sometimes systematic removal of indigenous biodiversity over much of lowland and coastal Aotearoa. Our indigenous biota just needs to be given the chance to reassert itself on our landscapes. Tipping that balance at regional and national scale remains an elusive yet feasible goal.

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