# Transported Fauna and its Effects: New Zealand A Review of the Literature

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**Abstract**

Though they are regarded as pests all over the globe, invasive species have the biggest impact in the island environment. Effects of alien invaders are both swift and devastating, continuing on to native species decimation or extinction as well as landscape desertification and erosion. In New Zealand these examples have been documented repeatedly; and on an island that has evolved in isolation and without mammalian predators – including humans – native species have failed to develop, or have lost the ability to escape or defend themselves in the absence of danger over millions of years. This paper discusses the history of the major biological invasions and their immediate implications, the current conservation efforts and controversies, and possible benefits and further questions raised from species invasion in New Zealand.

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Fauna transported to any new environment can have short and long period effects. These effects are especially punctuated in island environments such as New Zealand, where there are many examples of how alien species alter a fragile landscape and ecosystem. In pre-human New Zealand, species evolved in isolation without mammalian predators or any other type of competition for resources (Harada & Glasby, 2000, p. 80). When the first Polynesians arrived in 1300 A.D., the first wave of biological invasion took place in the form of rats, dogs, and men. The second wave of invasion came by way of European travelers and Captain Cook in 1774; this invasion brought many more alien species to New Zealand. These species, including humans themselves, forever changed the local environment (Veblen & Stewart, 1982, p. 374).

In the big picture of biologic time, changes that occur to an island ecosystem and its endemic flora, fauna and landscape (due to invasive species within a few hundred or thousand years) can seem alarming and tragic. However, these benchmark traits – dispersal, colonization and extinction – have always defined life on Earth. Historically there have been invasions and extinctions of high magnitude that have impacted biota similar to our recent history: our recent, human-facilitated history (Brown & Sax, 2004, p. 531). Current conservation efforts in New Zealand focus on eradication and management of invasive mammals, a task that is costly (Parkes, Robley, Forsyth & Choquenot, 2006, p. 230) and could potentially put the native populations at a risk (Craig et al.., 2000, p. 68). Some would argue that eradication efforts are futile, and more emphasis should be placed on objectivity rather than getting caught up in subjective morality and ethics (Brown & Sax, 2005, p. 483). Regardless of whether the causes or the outcomes of species invasions are good or bad, it is clear that the impact of transported fauna in New Zealand is vast.

New Zealand's biota evolved without terrestrial mammals and remained isolated after it broke away from the mega-continent Gondwanaland about 65-80 million years ago (Craig et al., 2000, 62). This allowed for the native fauna of New Zealand to evolve without predators, and as a result, many bird species became flightless and ground-nesting (Pryde & Cocklin, 1998). When humans arrived (first a predecessor of the Maori around 800 A.D. and then the Maori in 1350 A.D.), they found a land inhabited by large ratites (large, flightless birds) and no terrestrial mammals. With them they brought the Polynesian rat and dog, and within the next 800 years they decimated both the native bird population and the native forests (Glasby & Harada, 2000, p. 85). In example, hunting extinguished all moa species during this time of human inhabitation, along with 21 other native bird species (Veblen & Stewart, 1982, p. 374; Diamond & Veitch, 1981, p. 499). The extermination of the moa resulted in further native species extinctions such as the New Zealand eagle, which was assumed to have relied on the moa for food (Milberg & Tyrberg, 1993, p. 234). The Maoris also eliminated "tuatara, some lizards, and some invertebrates…from the main islands," along with sea lions and seals in up in the North region (Craig et al., 2000, 63). In result of the hunting, the predation by the introduced dog and rat, the massive deforestation and burning of vegetation, it is estimated that "by the time of European contact in the latter half of the eighteenth century, Polynesians had already caused significant changes in New Zealand wildlife and vegetation" (Veblen & Stewart, 1982, p. 374).

The European colonization of New Zealand began in earnest after 1840, and with this came a new wave of biological invaders and habitat destruction (Glasby & Harada, 2000, p. 79, Veblen & Stewart, 1982, p. 374). Feral populations of European domesticated animals (for example pigs, goats, sheep, and cats) wreaked havoc on the native vegetation and fauna. Furthermore, land clearing for pastoral farming and timber claimed almost all that was left from the Maori deforestation (Glasby & Harada, 2000, 86). Europeans also introduced several species of wild animals, such as deer, rabbit and opossum; 138 species of bird were introduced between 1860 and 1880 alone (Veblen & Stewart, 1982 p. 374). The last 200 years has seen the extinction of "16 land birds as well as a bat, a fish, and a number of invertebrates and plants" (Craig et al.., 2000, p. 63). The North Island has seen immense land clearing, which made way for plantations of alien conifers, creating a destructive habitat for the island's native populations (Pryde et al., 1998).

As much as this is true, non-native species do not always cause problems in their alien landscape. For instance, in most gardens growing vegetables and flowers around the globe, one would be hard pressed to find

only natives being tended to. Most can be maintained and run no risk of being so successful that they choke out other species. However, there are a number of negative consequences that can result from transported species, and one is that they can become invasive. Many factors play a role as to whether one species is more successful than another, and if the alien species happens to land in an environment that has favorable climate, an open niche, or lack of predators, it can flourish and potentially become a dominant species. One of the biggest arguments for the eradication of invasive species is that they can lead to the extinction of endemic or unique species.

Extinction of native species can be a catastrophic end result of transported, alien fauna. Asteroid impact, climate change, plate tectonics and other major global events have contributed to mass extinctions in the Earth's past, though the current rate of human-assisted extinctions is unprecedented (Cassey, Blackburn, Duncan, Chown, 2005, p. 476). New Zealand's fauna, having evolved without mammalian predators, was especially vulnerable to human invasion and hunting. Many native birds of New Zealand had evolved to become flightless and quite large, which restricted their ability to escape hunters, making them susceptible to predation (Duncan, 2004, p. 510). There were other native birds that evolved to become flightless, but were too small to be of interest for humans as a food source; they were soon eliminated as well. However, as expressed earlier, humans are not the only invasive species to affect New Zealand and the extinction of endemics; cats, rats and dogs also preyed on these defenseless smaller birds. In the last 700-800 years, New Zealand lost nearly half of its entire vertebrate fauna, in addition to incalculable numbers of invertebrates (Craig, et al.., 2000, p. 63); this coincides with the arrival of man and his animals.

While extinction is detrimental to biodiversity, there are other consequences to introducing alien species. Some of these introduced animals contribute to the loss of habitat by grazing- grazing that eventually leads to erosion. Glasby and Harada points out that:

> The widespread clearance of land for pastoral farming together with the introduction of exotic browsing animals such as deer, rabbits and possums by early Europeans led to large-scale erosion, particularly in the case of the high country and in other erosion-prone areas. (2000, p. 89).

The land in New Zealand is young, brittle and affected by storms that further weaken the fragile landscape (Howard, 1964, p. 423). Grazing mammals exacerbate this natural erosion process, and the domesticated sheep has contributed to more erosion from grazing than introduced wild animals (Howard, 1964, p. 423).

A form of habitat loss other than erosion is known as deforestation (though this can lead to erosion). New Zealand was once a heavily forested place; now, only one quarter of that forest remains. This deforestation began when the Polynesians arrived; carbon dating shows that between 600 and 700 years ago, nearly 40% of New Zealand's forest was burned to make way for agriculture and to ease travel (Harada & Glasby, 2000, p. 85). When the Europeans settled in the 1800s, another 35% of the forest was claimed to facilitate the introduced grazing mammals such as sheep, deer and cattle (p. 86). Glasby and Harada (2000) state that, "it has been estimated that the standing mass of tussock grasslands is approximately 10% of that when Europeans arrived. Parts of these grasslands are now subject to desertification" (p. 86).

With numerous species having gone extinct and there is a great need for protecting the native species that are remaining. Hence, New Zealanders have had to rethink their conservation tactics time and again to ensure the protection of their remaining native species. Once it was thought to be a viable option to introduce even more alien species in order to try and control a predatory invasive one; "European stoats, for example, were introduced to predate on rabbits, but found it far easier to feast on flightless native birds than to chase elusive rabbits" (Pryde, et al.., 1998). Stoats were brought to New Zealand at the end of the 19th century for rabbit population control; they now "are known to kill up to 60% of all North Island kiwi chicks and wreak havoc on other native bird populations, killing far more than they need to survive" ("Media Release," 2001). Unintended, unforeseen and negative consequences to biological controls of invasives make this a questionable tactic. Current conservation strategies include transporting endangered birds to offshore islands from which all (or at the very least, most) mammalian predators have been eradicated – mostly rats and cats (Pryde, et al.., 1998, para. 1), to create and maintain "habitat islands" – man-made recreations of a particular avifauna's natural habitat, also free of predators (Pryde, et al.., 1998, para. 29). Though not all birds in need can be restored via these approaches, and though the maintenance of these habitats can be laborious and costly, in some cases it is very successful and warranted (Pryde, et al.., 1998, para. 42). Poisonous bait is another conservation tactic widely used today in an effort to control mammalian pests (Day, Matthews & Waas, 2002, p. 309). Though it is now widely accepted that wild mammalian pests will never be eradicated (despite the desire to do so), effort is made to control local populations with various poisons such as 1080 or cyanide (Parkes, et al.., 2006, p. 231). Unfortunately, there is collateral damage to this technique; sometimes the poisonous pellets intended for alien invaders are eaten by the species that is being protected (Day, et al.., 2003, p. 309). Craig, et al.. cites, "high costs, accumulation of toxins, nontarget game mammal poisoning, short declines in rare species, and public wariness of poisons are concerns" (2000, p. 68).

There is much evidence to indicate that alien and invasive species are detrimental to the native, endemic

populations. But is it possible that this trend is reversible or, despite the negative immediate consequences, invasive species might actually be neutral or even beneficial in the long run? New Zealand is without any native land mammals (aside from two bat species); of the 50 introduced mammals, it is the impact of the grazing animals on New Zealand's vegetation that is "widely perceived as an ecological disaster involving severe depletion of the plant cover and widespread accelerated erosion" (Velben & Stewart, 1982, p.372). However, it has been pointed out that determining the scope of the impact of introduced browsers and grazers such as the red deer and the Australian brush-tailed opossum are difficult. While detrimental effects of these animals in the forests may be happening, the disproportionate amount of mortality occurring in the native forests might be due to natural changes in the vegetation apart from any introduced animals (Velben & Stewart, 1982, p. 393). It seems that not only are New Zealand's plants and animals unique, but that its landscape processes might be as well, which makes it hard to predict whether the long-term effects of alien species such as the red-tail deer or opossum are truly negative to the native landscape and deserve such attention and resources focused on their eradication. Ewel and Putz feel that:

> Blanket condemnation of alien species in restoration efforts is counterproductive. Where their presence does not unduly threaten surrounding ecosystems, alien species can be tolerated or even used to good advantage, if they provide essential ecological or socioeconomic services. By speeding restoration or making it more effective, non-native species can provide economic and ecological payoffs. Risk is always an issue when alien species are involved, but greater risk taking is warranted where environmental conditions have been severely modified through human activity than where reassembly of a biological community is the sole goal of restoration (2004, p. 354).

Though much is made of the decrease in biodiversity in local environments, it should be noted that species invasion results in an increase in species richness globally and often locally as well. In 2002, Sax, Brown and Gaines found that across all oceanic islands (including New Zealand), "neither plants nor birds have seen a decline in species richness...the richness of plants has increased dramatically, while the richness of birds has remained relatively unchanged" (p. 770). It should also be noted that species richness does not differentiate between indigenous and alien components, and there is concern about this kind of homogenization of biotas across the globe which could diminish "ecological integrity" (Sax et al.., 2002, p. 776). But in 2005 Brown and Sax point out that if an ecosystem continues to function in a healthy way (even though the processes have changed), it is nearly impossible to prove scientifically that true degradation has occurred (2005, p. 482). If the preservation of biodiversity is the main goal of the conservation movement, then it should be recognized that, ultimately, the incidence of exotic species are actually beneficial (Briggs, 2006, p. 197). Brown and Sax argue:

> Is this decrease in global biodiversity a bad thing? Is the net increase in local species richness a good thing? Is high species richness desirable? We do not believe that these are scientific questions. Science can elucidate the causes and consequences of these changes in biodiversity, but ultimately deciding what is good or bad is a moral and social issue (2004, p. 535).

This is a quality point – how far should science and scientists go in determining what species are deserving of life and which are not? Why do humans develop such a sentimental bond with certain creatures, and abject hatred for others? Invasions and extinctions have been happening for millions and millions of years, and Brown and Sax argue that it is irresponsible for scientists to get caught up in subjective reasoning and rather focus on being objective observers to the current large-scale, unintentional experiment on biodiversity - gaining insight into evolution and ecological processes (2004, p. 530). Nature, given enough time, has always managed to sort itself out. There is a pervasive attitude that both scientists and lay-people have about conservation and restoration, being that a return to a natural state is desirable and we must be the ones who dictate what the "natural state" is, along with what aspects of it are favorable. But some fail to realize that this "natural" state is usually not natural at all. At some point in time, everything was transported to where it is now. Where should the line be drawn?

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