

ASSOC. PROF. DAVID A. NORTON



Research approach

The overarching goal of my research is to contribute towards the conservation of New Zealand's indigenous biota, especially its many unique endemic species. However, in undertaking this research, I recognise that biodiversity conservation can not occur in isolation from socio-economic considerations and as a result am increasingly focusing my research on those parts of New Zealand that are not part of the public conservation estate (e.g., in farmland and plantation forests). In the following notes I report on the research being undertaken by myself and my collaborators, including postgraduate students and scientists from a range of institutions.

Research completed 2001-2002

The research that I have been involved in during 2001-02 is best summarized by a selection of papers that have been published or are in press.

(Saunders, A. & Norton, D.A. 2001). While important advances have been made in recovering threatened species and restoring damaged habitats on offshore islands, effective conservation management is also required on the main (North and South) islands if representative elements of New Zealand's remaining biodiversity are to be protected. The recent initiation of Mainland Island projects constitutes an important step in that ecosystem-focused restoration goals are being pursued at mainland sites. The intensity and scope of pest control undertaken at Mainland Islands is greater than has normally been the case previously, as has been monitoring of results and conservation outcomes. Preliminary results suggest that declines in monitored species have been arrested and ecological processes revitalised. In addition to restoring values at individual sites Mainland Islands may be important places where our capacity to manage ecosystems more generally may be developed. Advances in our understanding of ecological processes and of responses to management using sound scientific procedures as part of operational programmes, could lead to improved predictions to underpin management decisions. Refinements to management techniques and the development of appropriate skills, as well as enhancing public support and involvement could also be expected to have major benefits for conservation management more widely.

(Norton, D.A. 2001). By summarising ecological publications over the last 30 years, this paper provides an assessment of the amount and focus of New Zealand ecological research with respect to land tenure. While the number of published articles that deal with private land has increased over the last 30 years, the majority of New Zealand ecological research publications (65%) still focuses on public conservation lands, despite these only accounting for *c.* 30% of the land area. Even with the increasing emphasis in ecological research on

private land there is still a need to better understand both the distribution of indigenous biodiversity and the interactions that occur between land management and indigenous biodiversity on private land. Such research is essential if we are to sustain indigenous biodiversity in lowland New Zealand.

(James, I.L., & Norton, D.A., 2002). The management of indigenous conifer forests in Westland, South Island, New Zealand has focused largely on harvest of the Podocarpaceae tree rimu. Today, key management objectives are to maintain the pre-harvested state of the forest in terms of biomass, tree size ranges (especially old trees), natural spatial patterns, relative proportions of the major tree species, and forest timber quality. This approach to natural forest management is based on utilizing heavy-lift helicopters, pre-empting mortality by harvest of a proportion of single unthrifty rimu trees, and an auditable GPS based forest record system. A transition matrix model is used to determine the expected natural mortality rate and the sustainable harvest is based on pre-empting a proportion of the mortality over a 15 year felling cycle. Trees with significant wildlife features (e.g., cavities and large epiphyte loads) are not harvested. Even natural forest management can impact ecological processes through loss of senile trees, pre-empting forest tree windfall, altering spatial patterns of forest structure and facilitating pest and weed spread. However, because of the dynamic nature of these forest environments, the impact of forestry should be insignificant over major natural disturbance events. The best way to ensure that key management objectives are realized is to adopt an adaptive management approach that involves regularly monitor of key forest attributes and frequent recalculation of the sustainable harvest model.

(Norton, D.A., Ladley, J.J., & Sparrow, A.D., 2002). The influence of host genotypes (provenances) on mistletoe establishment, or the susceptibility of different host provenances to mistletoe infection, has not previously been documented. We quantified the germination and establishment of two New Zealand mistletoes (*Alepis flavida* and *Peraxilla tetrapetala*) on different provenances of their main host *Nothofagus solandri* in a 'common garden' host experiment. Germination was high for both species (96.9% for *A. flavida* and 97.4% for *P. tetrapetala*) but establishment was much lower (13.2% and 2.3% respectively). Deviance explained in statistical models of germination with respect to light, branch growth rate, host tree provenance and tree effects was lower than that explained in models of establishment (20.3 cf. 33.2% for *A. flavida* and 35.9 cf. 73.7% for *P. tetrapetala*). While branch growth rate and host tree provenance were significant variables in the *P. tetrapetala* establishment model, the most significant effect for both species was due to individual trees within provenances (24.9 and 42.8 % of total deviance respectively for *A. flavida* and *P. tetrapetala*). Even when a range of factors are accounted for (e.g., branch growth rate and host tree provenance), there is still a large degree of

unpredictability in mistletoe establishment that reflects either inherent or environmental conditions associated with individual trees.

(Norton, D.A., & de Lange, P.J., 2003). Fire plays an important role in structuring wetland ecosystems, but previous New Zealand wetland studies have lacked adequate experimental controls. In this study we investigated the effects of fire on the vegetation of a New Zealand peat bog through analysis of microclimate patterns, vegetation change, and peat stratigraphy. We focused on the role of fire in sustaining threatened plant species such as the critically endangered orchid *Corybas carsei*. Experimental fire significantly increased the surface radiation and daytime soil temperature, with these differences persisting 53 months after burning. Immediately after fire no living plant material remained in the burn plots, but within 2 months many of the rhizomatous species were resprouting and returned to prefire abundance 50 months later. Obligate-seeding species did not recover their former abundance but several species not observed in the plots prior to the burns established after fire. Species richness, diversity, and evenness increased following fire but declined in the control plots. Species dominance decreased after fire but increased in the control plots. *C. carsei*, which was killed during the fire, reappeared in the burn plots 1 year later at a higher density than prior to burning and was still present 4 years after fire. *C. carsei* flowering was also enhanced following the fire. We found evidence of historical fires, which was supported by radiocarbon dates from a much older adjacent wetland. We suggest that disturbances such as fire are important for maintaining a diversity of plant communities, including the presence of nationally threatened and declining plant species, in peat bogs. Without such disturbances, species such as *C. carsei* are likely to become locally extinct.

Current research

Funding from the Public Good Science Fund (through Landcare Research) is enabling us to continue assessing the importance of dispersal for various aspects of the ecology and conservation of indigenous woody plants. We are presently writing up a study that assessed the distribution of large-fruited species in New Zealand forests and commented on the potential effects of the loss of their only disperser (kereru), and are planning a new study on the dispersal of indigenous species through Canterbury Plain's plantation forests. Department of Conservation funding is enabling us to continue working on the factors threatening coastal cress (*Lepidium*) species, furthering research we started during the 1990s (e.g., Norton et al. 1997, Biodiversity and Conservation 6: 765-785). We are also undertaking research for Solid Energy on the effects of subsidence resulting from underground coal mining on West Coast beech-podocarp forest.

In addition to the currently funded research, I am also developing our research programme investigating options for enhancing the conservation of indigenous biodiversity on private land, including current work conservation

covenants and significance assessment. We hope to instigate new studies in both agricultural and plantation forest environments over the next two years, although the extent and nature of this research will be dependent on the funding obtained. I am also involved in an international initiative exploring the concept of “emerging ecosystems”, ecosystems that have a novel composition and structure as a result of human activities.

Postgraduate activities

Stephanie Enright (M.Env.Sc. thesis), Sarah McElrea (M.For.Sc. thesis) and Craig Miller (Ph.D.) completed in the 2001-02 period and the abstracts of their theses are shown in another section of this publication.

Amy Leighton (M.Env.Sc. thesis) is looking at options for conserving biodiversity on private land. Hilary Phipps and Nerida Theinhardt (both M.For.Sc. theses) are assessing the success of restoration plantings at two West Coast mine sites. Robin Mitchell (Ph.D.) is studying methods for assessing restoration success. Ingrid Gruner (Ph.D.) is looking at the ecology and conservation of South Island threatened brooms (*Carmichaelia* species), while Sina Hustedt (M.For.Sc. thesis) is undertaking a similar study with the threatened endemic shrub *Hebe armstrongii*. Eykolina de Zwart (M.For.Sc. thesis) and Erik van Eyndhoven (Ph.D.) are studying habitat use and diet of possums in a forest-shrubland-grassland mosaic and a mixed beech forest respectively. Brendon Christensen (M.For.Sc. thesis) is assessing the effectiveness of mainland island monitoring programmes. Steve Pawson (Ph.D.) is quantifying the effect of different sized plantation clear cuts on invertebrate diversity.

Collaboration

My research has benefited immensely from interactions with a range of collaborators including both postgraduate students and fellow scientists. I would particularly like to acknowledge the input of Peter de Lange (Department of Conservation), Craig Miller (Department of Conservation and now Macquarie University), Jenny Ladley and Hamish Cochrane (University of Canterbury), Brian Molloy and Rob Allen (Landcare Research), Nick Reid (University of New England), and Richard Hobbs (Murdoch University).

Potential fate of rimu trees over a management time period of 15 years for one 10cm diameter size-class group (James & Norton 2001).

Forest growth for a given time period (15 years)

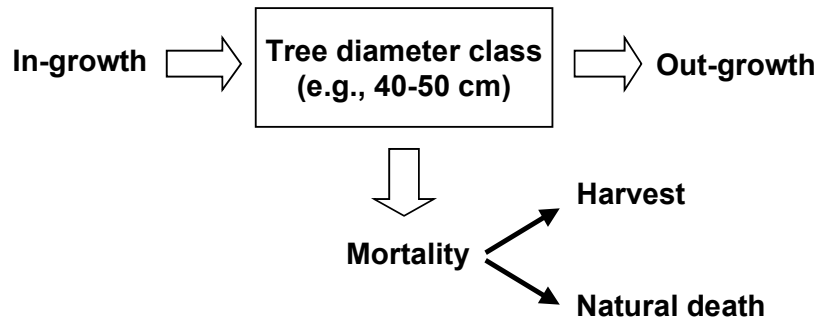


Photo sequence from one burn plot showing the changing vegetation pattern 1) immediately after fire, 2) one year after fire and 3) four years after fire (Norton & de Lange 2003).

