The ecological impact and control of an invasive weed *Tradescantia fluminensis* in lowland forest remnants.

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For Kim and Shirley

my first teachers

A passenger's guide to New Zealand trees
(heading south on Highway 1)

Cabbage trees
like slender ladies
dancing on old, worn carpet,
holding pom poms
that have seen better days

Showy pohutukawa
every summer, crowns its
old, mutton-like trunk,
with splashes of mardi-gras red

Pinus radiata
lined up like
candles on a cake
or tourists on the top deck
of the Cook Straight ferry

The forest remnant
like an old photograph left to fade
and tatty about the edges
Among the weary veterans
a pukatea stands proud
draped in a kiekie cloak
Tradescantia about its feet,
ready to receive
the fat pigeons in clean singlets
who are sure to visit.

Tradescantia-affected Monro's Bush, Manawatu.

Abstract

While there is a general awareness of the global march of invasive weeds, there are relatively few studies which measure the ecological impact of these species on the systems they invade. *Tradescantia fluminensis* Vell. is an invasive weed of canopy-depleted native forest remnants in New Zealand where it carpets the ground and prevents regeneration. In three lowland forest remnants in the lower North Island I measured the ecological impact of *Tradescantia* by comparison of affected and non-affected areas of forest. In addition, I evaluated three methods for control of Tradescantia in two heavily infested forest remnants in the lower North Island.

The impact of *Tradescantia* on native forest regeneration is evident by the decreasing native forest seedling species richness and abundance with increasing *Tradescantia* biomass. Forest regeneration was prevented because of decreasing light levels beneath *Tradescantia.* The compositions of the extant vegetation, seed rain and seed bank are consistent with this interpretation. Seedlings of some native species were more tolerant of *Tradescantia* than others, though the growth to emergence of even the most tolerant species was compromised in dense *Tradescantia.*

While shading of native plants by invasive weeds is a well-studied phenomenon, comparatively little is known about the effects of weeds on ecosystem processes. Tradescantia increases litter decomposition and alters nutrient cycling by modifying the litter quality and microclimate within these forest remnants. The annual uptake of nutrients by *Tradescantia* was a significant amount of the nutrient inputs via litterfall, which (with the exception of Ca) exceeded the amounts of these nutrients held within the forest litter layer, but was only a small amount of these nutrients held within the topsoil.

It is likely that the microclimate within *Tradescantia* that promotes increased litter decomposition also affects invertebrate communities. Epigaeic invertebrates were sampled using pitfall traps. RTU richness was lower in *Tradescantia* plots compared with non-*Tradescantia* plots, though not statistically significant. Two-way indicator species and

detrended correspondence analyses separated *Tradescantia* and non-*Tradescantia* plots within sites. Overall, impacts of *Tradescantia* were apparent despite large differences in invertebrate assemblages among sites. The possible biological consequences of the community and ecosystem impacts outlined in this and the preceding two paragraphs are discussed.

A reduction of *Tradescantia* biomass to ~80 gm^{-2} (~40% cover) is compatible with native forest regeneration. Chemical and manual control methods had limited success in controlling *Tradescantia*, whereas artificial shading significantly reduced its biomass after 17 months. Native sub-canopy trees were planted into *Tradescantia* to achieve natural shading over large areas of forest, but were too young to assess whether or not they will overshade the *Tradescantia*. My research supports the theory that management needs to target the attributes of these forest systems that make them invasible rather than *Tradescantia*, otherwise they remain invasible to other weeds. Therefore, an integration of targeted control and tree planting to improve canopy cover is suggested as a means to arrest the decline of *Tradescantia*-affected forest remnants.

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Arrangement of this thesis

The data chapters of this thesis have been written as stand-alone manuscripts for publication in refereed journals. Inevitably this has led to some repetition of the material and variation in the format among chapters. Each manuscript is set in the style required by the target journal. Where appropriate, manuscripts are co-authored. Alastair Robertson and Peter Williams contributed significant intellectual input and practical input regarding data capture to Chapters 1 & 2. Alastair also made a substantial contribution to the data analysis, including the suggestion of the statistical techniques employed in Chapter 1. Neal Scott contributed 'ecosystems expertise' to Chapter 2. Specifically, he suggested the resin bag study and provided a technician to do the nutrient assays required. Duncan Hedderley is the Statistician who helped design and analyse the litter decomposition study (Chapter 2). Ian Stringer co-supervised and played a significant role in obtaining funding for some of the research. However, in all cases I am senior author, which indicates the major scientific contribution to the study, and the primary role in writing the manuscript.

Chapter 1. Standish, R.J., Robertson, A.W. and Williams, P.A. 2001. The impact of an invasive weed *Tradescantia fluminensis* on native forest regeneration. Journal of Applied Ecology 38 (6): 1253–1263.

Chapter 2. Standish, R.J., Williams, P.A., Robertson, A.W., Scott, N.A. and Hedderley, D.I. (submitted) Invasion by *Tradescantia fluminensis* increases decomposition rate and alters nutrient cycling in New Zealand lowland forest remnants. Biological Invasions.

Chapter 3. Standish, R.J. (submitted) Impact of an invasive clonal herb on epigaeic invertebrates in forest remnants in New Zealand. Biological Conservation.

Chapter 4. Standish, R.J. (accepted) Experimenting with methods to control *Tradescantia fluminensis*. New Zealand Journal of Ecology.

Appendix 1 is a report I prepared on behalf of Landcare Research for the Department of Conservation.

Appendix 1. Standish, R.J., 2001. Prospects for biological control of *Tradescantia fluminensis* Vell. (Commelinaceae). DOC Science Internal Series #9. Department of Conservation, Wellington, 25p.