

# Factors causing dune ephemeral wetlands to be vulnerable to weed invasion

P.D. Champion and P.N. Reeves

DOC RESEARCH & DEVELOPMENT SERIES 310

Published by  
Publishing Team  
Department of Conservation  
PO Box 10420, The Terrace  
Wellington 6143, New Zealand

*DOC Research & Development Series* is a published record of scientific research carried out, or advice given, by Department of Conservation staff or external contractors funded by DOC. It comprises reports and short communications that are peer-reviewed.

Individual contributions to the series are first released on the departmental website in pdf form.

Hardcopy is printed, bound, and distributed at regular intervals. Titles are also listed in our catalogue on the website, refer [www.doc.govt.nz](http://www.doc.govt.nz) under *Publications*, then *Science & technical*.

© Copyright May 2009, New Zealand Department of Conservation

ISSN 1176-8886 (hardcopy)

ISSN 1177-9306 (web PDF)

ISBN 978-0-478-14598-4 (hardcopy)

ISBN 978-0-478-14599-1 (web PDF)

This report was prepared for publication by the Publishing Team; editing and layout by Lynette Clelland. Publication was approved by the General Manager, Research and Development Group, Department of Conservation, Wellington, New Zealand.

In the interest of forest conservation, we support paperless electronic publishing. When printing, recycled paper is used wherever possible.

## CONTENTS

Abstract	5
<hr/>	
1. Introduction	6
<hr/>	
2. Background	6
<hr/>	
3. Objectives	7
<hr/>	
4. Study locations	8
<hr/>	
4.1 Pouto Peninsula	8
4.2 Hawkens Lagoon	9
4.3 Whitiāu Scientific Reserve	12
5. Methods	13
<hr/>	
5.1 Determining soil fertility and plant tissue nutrients	13
5.1.1 Field sampling	13
5.1.2 Treatment of data	14
5.2 Temporal change in hydrology and vegetation	15
5.2.1 Hydrology	15
5.2.2 Vegetation	15
6. Results	16
<hr/>	
6.1 Soil fertility	16
6.2 Temporal change in hydrology and vegetation	18
6.2.1 Hydrology	18
6.2.2 Vegetation sampled in 2002	23
6.2.3 Change in vegetation transects between 2002 and 2005	29
7. Discussion	32
<hr/>	
7.1 Soil fertility and nutrient assimilation	32
7.2 Hydrology and changes in topography	33
7.3 Temporal changes in vegetation at transects	34
7.4 Invasive alien species in dune ephemeral wetlands	35
7.5 Suggested management initiatives	36
8. Acknowledgements	38
<hr/>	
9. References	39
<hr/>	
Appendix 1	
<hr/>	
List of species recorded at the Pouto, Hawkens Lagoon and Whitiāu study sites	41

Appendix 2	
Pouto Transect 1 monitoring data	44
Appendix 3	
Pouto Transect 2 monitoring data	46
Appendix 4	
Hawkens Lagoon Transect monitoring data	48
Appendix 5	
Whitiau Transect monitoring data	51

# Factors causing dune ephemeral wetlands to be vulnerable to weed invasion

P.D. Champion and P.N. Reeves

NIWA, PO Box 11115, Hillcrest, Hamilton 3251, New Zealand

Email: [p.champion@niwa.co.nz](mailto:p.champion@niwa.co.nz)

## ABSTRACT

Ephemeral wetlands are characterised by seasonal fluctuations in water level, with alternating wet and dry periods. The resulting indigenous vegetation is low in stature, making these wetlands vulnerable to alien weed invasion, and many ephemeral wetland plants are now uncommon or endangered. This study investigated soil nutrients and hydrology as potential influences on the susceptibility of dune ephemeral wetlands to weed invasion. Study sites were selected in dune systems on the Pouto Peninsula, Northland, and at Hawkens Lagoon and Whitiāu near Wanganui, North Island, New Zealand. At these sites, soils and vegetation were sampled and water tables measured to establish water level fluctuation patterns. Transects were established and vegetation type and percentage weed cover on them were measured on three occasions from 2002 to 2005. Soil nutrient levels did not appear to influence the distribution of alien weed species. The cover of alien species did not increase at Pouto sites over the three monitoring years. However, the Wanganui sites progressively became weedier, and taller indigenous vegetation displaced low-stature turf communities. Weed invasion appears to be promoted by a combination of altered hydrology reducing both the water level and the extremes of wet-dry fluctuations, along with stabilised dunes that restrict the dynamic sand movement that creates and destroys these ephemeral wetland areas. Management options include maintaining natural dune processes which ensure that the conditions for creating new ephemeral wetland areas continue, surveillance for and removal of invasive weed species and, at sites where dunes have been stabilised, removal of taller alien and indigenous vegetation by mechanical methods, grazing or selective herbicides.

Keywords: ephemeral, wetland, weed invasion, soil and plant nutrient concentrations, hydrology, endangered plants, sand dune, management options

© May 2009, New Zealand Department of Conservation. This paper may be cited as:  
Champion, P.D.; Reeves, P.N. 2009: Factors causing dune ephemeral wetlands to be vulnerable to weed invasion. *DOC Research & Development Series 310*. Department of Conservation, Wellington. 53 p.

# 1. Introduction

Ephemeral wetlands are low-lying areas generally defined as being periodically wet. Johnson & Gerbeaux (2004) recognise them as a distinctive wetland class in New Zealand. They are found mainly in closed depressions where seasonal variation in rainfall and evaporation can lead to ponding. They have water level fluctuations so pronounced that they become completely dry for months and sometimes years at a time. The vegetation in ephemeral wetlands is characterised by tiny turf plants, although other plant growth forms (e.g. rushes, shrubs) are also common.

Ephemeral wetlands are under-represented in the Department of Conservation (DOC) network of protected natural areas. They are particularly hard to manage, as they are dynamic, altering seasonally in response to inundation by water, and their low-stature vegetation has very specific habitat requirements. Recently, it has become clear that a particular threat to ephemeral wetlands is weed invasion. This study addresses the impacts of weeds on dune ephemeral wetlands (a subset of the wider range of ephemeral wetland types), to provide a basis for determining realistic conservation objectives and guidance on what management is needed to maintain their native turf communities.

Endangered species mentioned in this report are classified using the most recent classification, available on the New Zealand Plant Conservation Network (NZPCN) website ([www.nzpcn.org.nz/](http://www.nzpcn.org.nz/), accessed August 2007).

# 2. Background

A number of authors (Champion 1998; Ogle 1998; Dopson et al. 1999; Johnson & Rogers 2003) have noted the vulnerability of ephemeral wetlands, and the endangered plants they contain, to weed invasion. Ogle (1998) noted that the endangered turf species *Sebaea ovata* is highly impacted by the invasion of alien plants. The small stature of indigenous ephemeral wetland species predisposes them to be out-competed and displaced by taller and/or faster-growing alien species (Champion 1998). Dopson et al. (1999) listed weed invasion as a severe threat to many of the endangered species that are found in ephemeral turf habitats.

Johnson & Rogers (2003) stated that although some alien plants present in ephemeral turfs appear to co-exist with indigenous species, they could become threats following disturbance, nutrient enrichment or changes in climate. Weed species that replace the natural dominant vegetation, grow taller, and/or alter processes such as nutrient cycling and drainage are the major species of concern. Johnson & Rogers (2003) mention 51 species in this category, including perennial grasses, sedges and rushes, with the largest group comprising dicotyledonous herbs.

The invasion of the Sedgemere Ephemeral Tarn in South Marlborough by the alien sedge *Carex ovalis* is a current example of weed invasion impacts (Jones 2007). Five species considered to be nationally endangered occur in Sedgemere Tarn, including one unnamed taxon (*Craspedia* “tarn”) that is apparently endemic to this small tarn. All these plants are threatened by an encroaching dense turf of the alien sedge.

The decision to focus on dune ephemeral wetlands was made following discussions in 2001 with a number of people with ephemeral wetlands expertise. Many of these people described an urgent need to address weeds in dune ephemeral wetlands and lake turfs. Johnson & Rogers (2003) stated that the most pressing research need for ephemeral wetlands is to understand how they function, with improved knowledge of their edaphic (soil) and hydrological processes the most critical requirement.

Dune ephemeral wetlands develop on coasts which are advancing seaward and have a good supply of wind-blown sand. Several different types of dune ephemeral wetlands are recognised, such as dune hollows, deflation hollows, dune slacks, swales and sandplains. The depressions where ephemeral wetlands occur are created when wind erodes sand to the level of the water table. At this level, the sand becomes moist and is no longer prone to removal by wind action (Johnson & Rogers 2003). The substrate in dune ephemeral wetlands is mostly sand, which has a low nutrient content. However, substrate fertility may increase over time as a result of nitrogen-fixing algae (e.g. *Nostoc* and *Anabaena* species) and the accumulation wind-blown silt and organic matter (Singers 1998). Water is predominantly sourced from groundwater and rainfall, so that these are freshwater systems despite their close proximity to the sea (Johnson & Rogers 2003).

### 3. Objectives

This study had the following objectives:

- Determine whether soil fertility is a factor in weed invasion in dune ephemeral wetlands.
- Determine whether the range and periodicity of water level fluctuations in dune ephemeral wetlands are a factor in weed invasion.
- Monitor weed invasion in selected dune ephemeral wetland sites over 5 years.
- Identify management initiatives that will maintain and enhance native dune ephemeral wetland vegetation communities.

## 4. Study locations

Dune ephemeral wetlands were studied at three locations (Fig. 1): the broad, low-fertility sand plains of Pouto Peninsula (Northland Conservancy) and two similar areas adjacent to river mouths in the vicinity of Wanganui (Wanganui Conservancy).

### 4.1 POUTO PENINSULA

The southwestern end of the Pouto Peninsula is composed of mobile, low, sparsely vegetated sand dunes. The area comprises Crown Land, Maori Land and private land (Cromarty 1996).

Dominant indigenous dune plants on the mobile dunes of the Pouto Peninsula are spinifex (*Spinifex sericeus*) and pingao (*Desmoschoenus spiralis*). These dunes are interspersed with seasonally flooded slacks (depressions) and lakes with swamp fringes and inter-connecting swampy arms with oioi (*Apodasmia similis*), *Baumea articulata*, raupo (*Typha orientalis*), *Schoenoplectus tabernaemontani* and kuta (*Eleocharis sphacelata*) (Cromarty 1996).

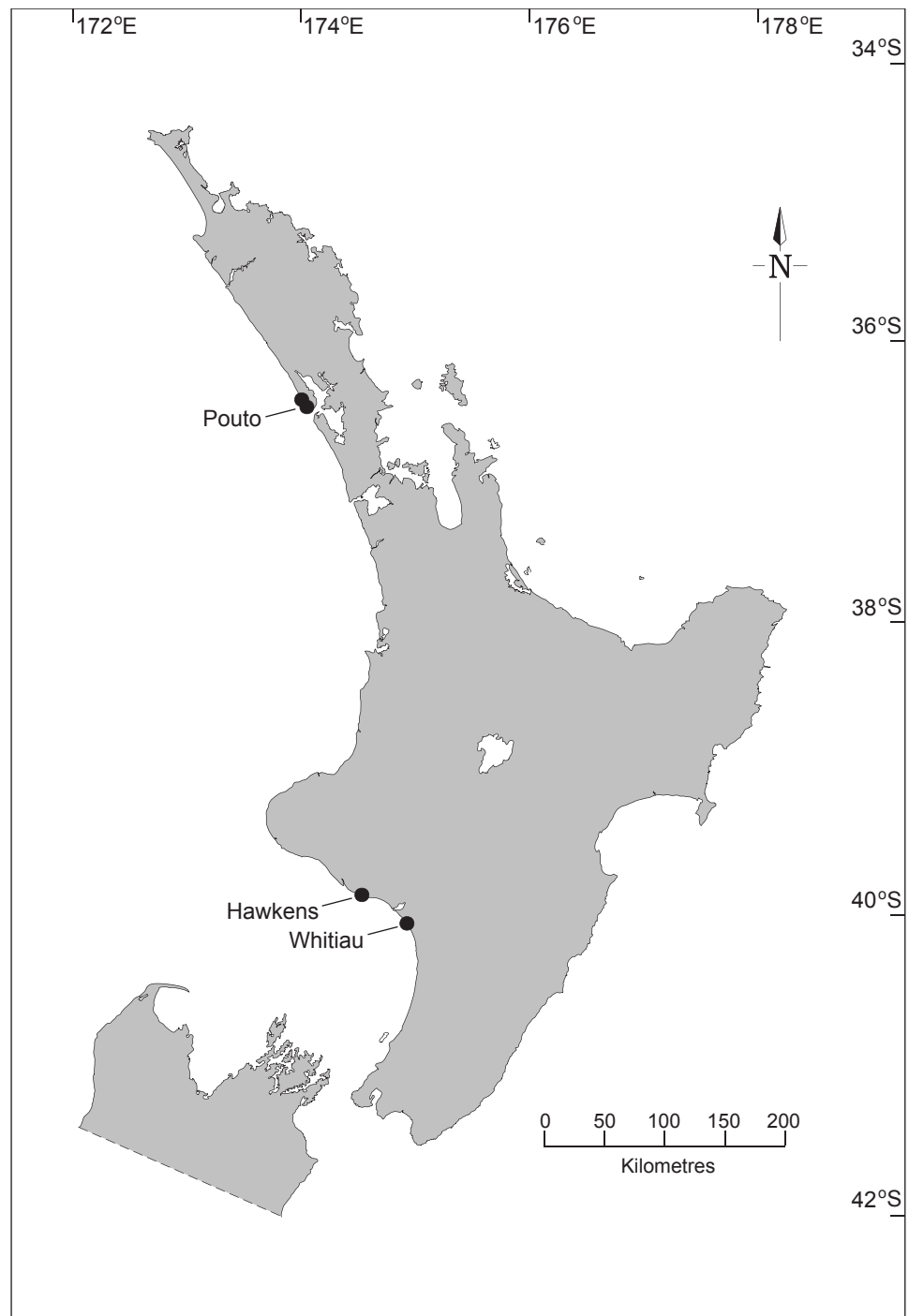
This list was extended by Cameron et al. (2001), who recorded the following plants (alien species are denoted by an asterisk): *Cortaderia splendens*, \*pampas (*Cortaderia selloana* and *C. jubata*), club sedge (*Ficinia nodosa*), tauhinu (*Ozothamnus leptophyllus*), *Lachnagrostis billardierei* and sand carex (*Carex pumila*).

The ephemeral wetland vegetation occurs in the seasonally flooded areas. The open ephemeral wetland areas of the Pouto Peninsula contain the largest population of the chronically threatened sedge *Eleocharis neozelandica* (Gradual Decline) (Forester & Townsend 2004). Cameron et al. (2001) also listed the turf species *Gunnera dentata*, *Spiranthes novae-zelandiae*, *Triglochin striatum*, *Isolepis cernua*, *Lilaeopsis novae-zelandiae*, *Limosella lineata* and *Myriophyllum votschii* in these areas. The acutely threatened *Sebaea ovata* (Critically Endangered) was translocated to two ephemeral wetland areas in 2003 (Forester & Townsend 2004), sourced from the known New Zealand populations of this plant in Wanganui (see sections 4.2 and 4.3). *Sebaea ovata* was historically known from Northland, but these populations are extinct (and all others, with the exception of Whitiāu and Waitōtara). These translocations were an attempt to establish additional populations of this species in similar habitat to those Wanganui sites. Unfortunately, although germination of *S. ovata* occurred in the following year (Forester & Townsend 2004), these populations have not persisted.

Sites initially investigated in this study were the 'Causeway' linking the west coast with Lake Mokeno and 'Stick Lake' just east of North Head on the south coast (Fig. 2).



Figure 1. Map of North Island showing dune ephemeral wetland study locations.



#### 4.2 HAWKENS LAGOON

Hawkens Lagoon Conservation Area is located at the mouth of the Waitotara River (Fig. 3), near the settlement of Waitotara, northwest of Wanganui. It is managed by DOC as a Stewardship Area under the Conservation Act 1987. The area is 100% fenced; however, a grazing license covers 18 ha of the area and cattle have been observed grazing in the study area on several occasions. Other threats to the vegetation communities include possum browsing and weeds. Surrounding land use is predominantly stock grazing.