Rangitikei River phragmites (*Phragmites australis*) investigation

NIWA Client Report: HAM2006-136
October 2006

NIWA Project: ELF07201/HZRC24

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Prepared for

Horizons Regional Council

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1. Introduction

Horizons Regional Council successfully sought Envirolink funding (Advice No. HZLC24) to engage NIWA to compile the published scientific data on Phragmites (*Phragmites australis* (Cav.) Trin. ex Steud.) management, and the development of a management plan for eradication of this plant from the lower Rangitikei River.

This report outlines the steps taken to determine if the problem species was phragmites, a review of relevant literature and recommendations for management of the site.

2. Correspondence

Hilary Webb of Horizons Regional Council contacted me by email on 9th August 2006 about a recent find of phragmites on the lower reaches of the Rangitikei River and queried about management options for this species.

Samples of a tall grass were collected in May 2006 by Colin Ogle at Tangimoana Boating Club (see the collection label in Figure 1). He described the grass as looking like a dwarfed form of the bamboo, *Pseudosasa japonica*, stating that the Boating Club folk called it bamboo, and use cut stems of it to mark the tidal channels (C. Ogle pers. comm. 17th August 2006). Colin's identification of this plant was based on the vegetative characters in Flora 5 (Edgar and Connor 2000) and Hubbard (1968). This identification was confirmed by Kerry Ford of Landcare Research in August (Figure 1).

After contacting both Hilary and Colin I questioned the identity of these specimens and Hilary collected material from several sites in the vicinity of Tangimoana and from the Rangitikei River further upstream to the vicinity of the stream flowing from Flock House and sent material to me on the 14th and 24th August. Material wasn't typical of either phragmites or the related giant reed (*Aundo donax* L.) and I suggested a field inspection was warranted both to hopefully determine the identity of the plant and decide on an appropriate management strategy if it was phragmites.

CHR 585551A **Allan Herbarium, Landcare Research, New Zealand**
Gramineae
Phragmites australis

Country: New Zealand **LD:** [Wellington Land District]
Loc: Rangitikei; Rangitikei R. estuary, Tangimoana

NZMS 260: S24 007 983 **Alt.:** 1 m

Hab: Old tidal river bed of Rangitikei (diverted in 1960s), now swamp with tidal channel.
Locally the dominant plant - with Typha orientalis/Bolboschoenus caldwellii
Hab. Keywords: Flat, Estuary, Silt, Unconsolidated
Abundance: Local
Coll: C.C. Ogle 4996 **Date:** 25 May 06
Det.: C.C. Ogle **Date:** 25 May 06
Det. Note: confirm. Kerry Ford 11/8/06
Remarks: Plant Register ID: 2006/049
Common
No flowers or seed heads seen. (Not recorded here in Flora of NZ Vol 5). Patches to 20 cm diameter. Culms woody, hollow. Leaves flat, dull green, smooth except for fine scabrid tip; borne in 2 rows up culms. Ligule a dense row of hairs, deciduous long hairs at sheath mouth. No inflorescences seen.

Sheets A to B.

Dom/Ass spp: Typha orientalis; Bolboschoenus caldwellii

Figure 1: Allan Herbarium (CHR) specimen label for grass collection at Tangimoana.

3. Review of phragmites biology, ecology and weed potential

Phragmites is a robust emergent perennial rhizomatous grass producing annual cane like stems up to 3 m tall. Rhizomes are far-reaching and can extend down to 2 m vertically and much greater distances horizontally. Leaves are cauline, alternate and sheath around the stem, with the lamina up to 70 cm long and 5 cm wide. The inflorescence is a showy silky purple or white panicle up to 40 cm long. Although all New Zealand populations of this species flower, seed production has not been found.

Phragmites has a very limited distribution in New Zealand with recent collections made from Napier, Murchison and Christchurch, with historical collections from Nelson and the Grey River in Westland.

Phragmites is possibly the most cosmopolitan plant species (Holm et al. 1977), being indigenous to all major continents except Antarctica. It is not indigenous to New Zealand, however Connor et al. (1998) discuss this possibility based on the von Haast collection in 1860. Subsequently Edgar and Connor (2000) regard the species as introduced. It has latitudinal amplitude from 70ºN to 43ºS (Esler et al. 1993), but is not widespread in the tropics.

Phragmites is a highly variable species, with a number of intra-specific varieties described (Clevering and Lissner 1999). This variation has been used to explain the large ecological amplitude of the species, with different varieties tolerant to different ranges in water depth, salinity etc. In New Zealand there appear to be two introductions, one (4x) from Murchison, postulated to originate from Europe and the others (8x) most likely Australian (Connor et al. 1998).

Some clones of phragmites are saline tolerant, aggressively invading saltmarsh vegetation in the USA (Marks et al. 1994; Saltonstall 2002 & 2003).

Phragmites tolerates water quality ranging from mesotrophic to eutrophic status, colonises mud and organic substrates, occasionally sand, grows to water depths of approximately 0.5 m and can also form floating sudds that can raft over much deeper water (Hocking et al. 1983; Esler et al. 1993). The margins of all types of waterbodies and many wetland types appear to provide suitable habitat for this species.

Stems are produced annually with subsequent senescence each autumn/winter (Hocking et al. 1983).

There are waterbodies and wetlands that provide suitable habitat for phragmites throughout New Zealand in all but alpine and subalpine zones.

Seed production of phragmites is apparently rare within its native range. The New Zealand populations are all clonally reproducing, presumably from one initial introduction to each area and these are geographically isolated from each other (apart from the sites where they are cultivated together). Water movement can disperse vegetative mats of phragmites, particularly where the sudd (floating rafts) growth form occurs.

Phragmites is more competitive than Manchurian wild rice, the wild rice displaced to areas with more stressful conditions. NIWA have rated phragmites as the worst potential aquatic weed (Champion and Clayton 2001), partially based on its ability to displace other vegetation including the next worse aquatic grass weed Manchurian wild rice (*Zizania latifolia* - Yamasaki and Tange 1981).

Phragmites invades drainage systems, obstructing water flow and promoting flooding. It invades low-lying agricultural land and is problematic in many countries (Holm et al. 1977).

It is likely that the rhizome system of phragmites could penetrate into and through stop-banks and may cause them to saturate and slump during winter, requiring maintenance. The sharp rhizome tips enable the plant to penetrate compacted road construction material, a metalled trotting track, butyl rubber liners of artificial ponds and the species even escaped from cultivation in a glasshouse growing through a crack in a concrete floor! Its ability to damage such structures illustrates its potential to damage roads and other structures.

A European clone of phragmites has been introduced into North America and is heavily impacting natural wetlands there. Marks et al. (1994) include the displacement of indigenous wetland vegetation and the impact of change in wetland structure and function on wetland fauna and increased fire risk impacting on wetland habitat as detrimental impacts of this species. Chambers et al. (1999) note a reduction of plant biodiversity and a consequent reduction in insect, bird and mammalian species as well as disturbance of hydrological cycles and nutrient regimes.

Phragmites is currently managed by regional councils or territorial land authorities under respective Regional Pest Management Strategies where it occurs (Hawkes Bay, Tasman and Canterbury Regions). All sites are targeted for eradication. Phragmites is an Unwanted Organism under the Biosecurity Act (1993) and is currently on the National Pest Plant Accord (NPPA) list.

4. Field visit and collection of plant material

Field sites of this grass in vicinity of the lower Rangitikei River were visited on 5th September 2006, accessed by helicopter. The grass was sporadically distributed along ~ 7 km of the lower river (Figure 2), landing at sites in the vicinity of Tangimoana (Figures 3 and 4) and the river near Flock House (Figures 5 and 6).

Plants at the site in the vicinity of Tangimoana were similar to C. Ogle's description of the material he collected, being bamboo-like. Most shoots comprised several lateral culms arising from the main culm and the diameter of lateral culms around 5 mm. Leaves were in the vicinity of 10 mm across. Plants were around 1 to 2 m tall. However, young shoots typical of *Arundo donax* were seen arising from the patch investigated and dead culms exceeding 20 mm in diameter were also seen. Material was collected for accession into the Allen Herbarium.

Figure 2: *Arundo donax* (mid-right on river edge, see arrows) – near Rangitikei River NZMS S26 026984, 5th Sept 2006.

Figure 3: *Arundo donax* – near Tangimoana NZMS S26 004986, 5th Sept 2006.

Figure 4: Scattered shoots of *Arundo donax* – near Tangimoana. Also note clumps of the same species indicated by red arrow NZMS S26 004986, 5th Sept 2006.

Figure 5: *Arundo donax* with Don Clark (Horizons Regional Council) – near Rangitikei River NZMS S26 049004, 5th Sept 2006.

Figure 6: *Arundo donax* – near Rangitikei River NZMS S26 049004, 5th Sept 2006.

Material on the banks of the Rangitikei River were typical of *Arundo donax*, being around 4 m tall, with leaves around 50 mm across and culms in excess of 20 mm across. Material was collected for accession into the Allen Herbarium.

I was visiting aquatic weed sites in the vicinity of Brisbane on 21st August and examined phragmites plants there. New shoots were around 1 m tall, with dead culms of the plant almost double that height.

Plant material of phragmites was collected from the Ruakura Research Station in Hamilton on 18th September and also from the Christchurch Botanical Gardens on 20th September. New shoots, around 40 cm long had only just begun to emerge from Murchison-sourced plants, whereas Napier-sourced plants had only just started to emerge from dormancy. No new shoots were seen in Christchurch, but senesced culms were collected attached to living rhizomes. Giant reed plants were sampled from the Waikato River bank, Hamilton on 18th September. Some of the giant reed had been slashed and regrowth very similar in habit to the Tangimoana plants were also collected.

5. Determination of Rangitikei grass plants

I took collected plant material to Landcare Research at Lincoln where I discussed the identification features with Kerry Ford and Ines Schonberger.

Vegetatively phragmites and giant reed are very similar (Figure 7). Both species have short membranous ligules with hairy ends and with hairs on the collar (leaf blade/sheath margin). In phragmites, the ligule is long-ciliolate (hairy) (Figure 8) whereas this is short-ciliolate in giant reed (Edgar and Connor 2000). Unfortunately hairs are deciduous and only new growth can be used to distinguish these species.

Figure 7: Young shoots of *Phragmites australis* (left) and *Arundo donax* (right).

Figure 8: Young shoots of *Phragmites australis* showing long ligule hairs.

Typically giant reed plants are much larger than phragmites, with leaves typically 30 to 60 cm long and 25 to 50 mm wide (cf. 40 to 60 cm long and 10 to 30 mm wide), with culms 20 to 30 mm diameter (cf. up to 10 mm diameter) (Edgar and Connor 2000). The atypical plants growing at Tangimoana fitted the characters of phragmites.

If flowering material were present the two species could be determined by a hairy (giant reed) or hairless (phragmites) lemma and a hairless or sparse tufted hairy (giant reed) or dense long silky hairy (phragmites) callus. Unfortunately no flowering material was seen.

I confidently determine all the Rangitikei River plants as giant reed (*Arundo donax*) based on the lack of senescence (die-back to underground parts overwinter), lack of flowering, typical giant reed regrowth and the observation of similar growth habit of giant reed plants mechanically damaged in Hamilton. The atypical growth form is likely to be a consequence of its habitat, being exposed to frequent flood events and salt-laden westerly winds.

6. Management implications and recommendations

Giant reed has been included on the 2006 revised list of NPPA plants. This species is much more common than phragmites, recorded as an occasional escape from both North and South Islands by Edgar and Connor (2000). It is typically found in wasteland, especially sandy soils. It is common in Northland and Auckland, is locally common in other parts of the Manawatu/Wanganui Region (C. Ogle, H. Webb, D Clark, N. Procter pers. comm.) and I have seen it as far south as Haast. This species is not considered to be a major problem in New Zealand (Champion 1995; Environment Bay of Plenty 2006), but is a major weed of riparian areas in California (Bell 2002).

The Rangitikei sites appear to have been present for decades (N. Procter, Horizons Regional Council pers. comm.) and therefore do not appear to be an immediate threat to the system. Erosion of riverbanks by flood events are likely to disperse viable rhizome fragments down the river, with the original plants potentially being planted for bank stabilisation.

Giant reed is commonly controlled in California using high rates of glyphosate (Bell 2002) but imazapyr, recently registered for aquatic use in the USA (BASF 2006) also is labelled to control it.

I would recommend annual surveillance of known sites to determine the rate of spread of this species. If it is actively invading and displacing valuable indigenous riparian vegetation, causing economic harm or obstructing recreational activities it would be worth considering for inclusion on the next Regional Pest Management Strategy. However, this would require information on its current distribution and cost benefit analysis.

7. Acknowledgements

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8. References

BASF (2006). Habitat herbicide: top weeds controlled (http://www.vmanswers.com/lib/PDF/2545054_convcard.pdf accessed October 2006).

Bell, P.B. (2002). Ecology and management of *Arundo donax*, and approaches to riparian habitat restoration in southern California. (http://tncweeds.ucdavis.edu/esadocs/arundona.html accessed October 2006). Environment BOP weed index http://www.envbop.govt.nz/weeds/weed270.asp

Chambers, R.M.; Meyerson, L.A.; Saltonstall, K. (1999). Expansion of *Phragmites australis* into tidal wetlands of North America. *Aquatic Botany 64*: 261-274.

Champion, P.D. (1995). Assessment of plant pests proposed for inclusion in Auckland Regional Council's Pest Management Strategies. NIWA Client Report ARC315.

Champion, P.D.; Clayton, J.S. (2001). A risk assessment model for aquatic weeds in New Zealand. In; R.H. Groves, F.D. Panetta, J.G. Virtue Ed. Weed Risk Assessment. Pg 194-202.

Clevering, O.A.; Lissner, J. (1999). Taxonomy, chromosome number, clonal diversity and population dynamics of *Phragmites australis. Aquatic Botany 64*: 185-208.

Connor, H.E.; Dawson, M.I. (1998). Chromosome numbers of *Phragmites australis* in New Zealand. *New Zealand Journal of Botany 36*: 465-469.

Edgar, E.; Connor, H.E. (2000). Flora of New Zealand Volume 5: Grasses. Manaaki Whenua Press, Lincoln, Canterbury.

Esler, A.E.; Leifting, L.W.; Champion, P.D. (1993). Biological success and weediness of the noxious plants of New Zealand. MAF Quality Management, Lynfield.

Hubbard, C.E. (1968). Grasses. A guide to their structure, identification, uses, and distribution in the British Isles. Penguin Books, Hannondsworth, UK.

Hocking, P.J.; Finlayson, C.M.; Chick, A.J. (1983). The biology of Australian weeds. 12. *Phragmites australis* (Cav.) Trin. ex Steud. *Journal of the Australian Institute of Agricultural Science* 123-132.

Holm, L.G.; Plucknett, D.L.; Pancho, J.V. & Herberger, J.P. (1977). The World's Worst Weeds. University Press of Hawaii, Honolulu.

Marks, M.; Lapin, B.; Randall, J. (1994). *Phragmites australis*: threats, management and monitoring. *Natural Areas Journal 14*: 285-294.

Saltonstall, K. (2002). Cryptic invasion by a non-native genotype of the common reed *Phragmites australis* into North America. *Proceedings of the National Academy of Sciences of the United States of America 99*: 2445-2449.

Saltonstall, K. (2003). Recent Research on *Phragmites australis* in North America: Implications for Management. *Proceedings of the Aquatic Invaders of the Delaware Estuary Symposium*, Malvern, Pennsylvania. 12-15.

Yamasaki, S.; Tange, I. (1981). Growth responses of *Zizania latifolia*, *Phragmites australis* and *Miscanthus sacchariflorus* to varying inundation. *Aquatic Botany 10*: 229-239.