Eradication programme for four noxious weeds in New Zealand

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Abstract The Ministry for Primary Industries (MPI) has targeted Salvinia molesta (salvinia), Eichhornia crassipes (water hyacinth), Sorghum halepense (Johnson grass) and Moraea flaccida (cape tulip) for eradication under the national interest pest response (NIPR) programme. These weeds are both notifiable and unwanted organisms under the Biosecurity Act 1993. The NIPR eradication programme consists of educational campaigns; enforcement of the Biosecurity Act, which prohibits propagation, planting, sowing, sale and distribution of the weeds; removal and destruction of the weeds from known infested sites; and monitoring those sites for regrowth. Assessment over the past two decades shows that Johnson grass and cape tulip have responded well to management. As at 2013, the number of active Johnson grass sites has reduced by 100% and cape tulip by 74%. The number of active sites for water hyacinth and salvinia, however, keeps rising and falling, thus prolonging eradication.

Keywords Eichhornia crassipes, Salvinia molesta, Sorghum halepense, Moraea flaccida, weeds, NIPR.

INTRODUCTION
Water hyacinth (Eichhornia crassipes), salvinia (Salvinia molesta), cape tulip (Moraea flaccida) and Johnson grass (Sorghum halepense) are noxious invasive weeds introduced to New Zealand several decades ago. Water hyacinth and salvinia are considered to be among the most invasive aquatic plants worldwide (Global Invasive Species Database). Water hyacinth reproduces both asexually and sexually. The seeds are capable of remaining viable for up to 20 years (Randall 2000). Reproduction in salvinia is entirely asexual. Both aquatic species can form large dense floating mats on freshwater bodies, reducing water quality, and thus endangering fish and native aquatic plants. By clogging waterways, the floating mats hamper boating, fishing, irrigation and hydro-electricity generation, and pose flooding and drowning risks to humans and livestock (Malik 2007). Reports indicate that they cause significant economic impacts in countries where they have established (De Groote et al. 2003; Global Invasive Species Programme 2007).

Cape tulip is poisonous to both humans and livestock. Poisoning and death of livestock has been reported (Roberts et al. 1988; Connor 1992) and ingestion by humans can cause vomiting, diarrhoea and paralysis (Johnson & Johnson 2006).

Johnson grass forms dense spreading clumps that often smother and out-compete arable crops. Apart from its competitiveness, it is a major overwintering host for dwarf mosaic

virus, which affects both maize and sweet corn (Buchen-Osmond et al. 1988). When exposed to drought or frost, Johnson grass produces hydrocyanic acid, which can be fatal to livestock feeding on it (Connor 1992).

The objective of the NIPR programme is to eradicate all naturalised and cultivated populations of these weeds from New Zealand. This paper examines the effectiveness of the NIPR programme in managing these four noxious weeds and the progress made over the past two decades.

THE NEW ZEALAND SITUATION

The potential of these four species to impact significantly on New Zealand's environment, economy and human health has long been recognised, and they had been managed previously under the Noxious Plants Act. With the introduction of the Biosecurity Act 1993 these plants became both unwanted and notifiable organisms.

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Biosecurity Act 1993

The Biosecurity Act gives MPI statutory power to manage these weeds, and also places obligations on the public. Section 46 of the Act requires that every person, without unreasonable delay, must report the presence of any notifiable organism to a chief technical officer (CTO). It is prohibited under section 52 of the Act to release any unwanted organism or knowingly communicate them without CTO permission. Section 53 of the Act imposes restrictions on the sale and propagation of unwanted organisms. The penalties for individuals who fail to comply with any of sections 46, 52 and 53 of the Act are serious and include large fines and/or imprisonment.

Education campaigns

The majority of water hyacinth and salvinia detections are in home and farm ponds. Small populations of these plants are easy to manage. But as they grow and multiply rapidly they can cover entire ponds within a few months and become more difficult to manage. To educate the general public about the biology and risks posed by the weeds, and their obligations under the Biosecurity Act, media releases in local newspapers, radio reports, factsheet distribution and meetings with local iwi are organised annually. The campaigns for each weed species are targeted to regions where the weeds are present and encourages the public to report them to the MPI hotline (0800 80 99 66).

Weed management programmes

The weed management programmes consist of site surveys, tracing, weed control and site monitoring. If a suspected new site is reported, a field officer is dispatched to inspect the site. Photos and samples are taken during the inspection for identification and the extent of the infestation is determined. If an NIPR weed is confirmed, a unique site code is assigned and the site is declared an active site. The property owner is informed of their obligations under the Act and the suitable management options for local elimination of the weed. A site map, identifying the locations of the weeds and other relevant features is developed and neighbouring properties are also inspected. In order to prevent further distribution, the property owner is interviewed to trace the source of the infestation and to whom they may also have given samples. Arrangements are then made for the weeds to be removed or sprayed and disposed of.

Johnson grass is controlled by removing seedheads and incinerating them and the plants are sprayed with glyphosate. For small site detections, the rhizomes are dug out and incinerated. Cape tulip is controlled by spraying using either glyphosate or 2,4-D amine and Pulse® surfactant before lowering. Aerial spraying is used for inaccessible areas. Small sites of water hyacinth and salvinia are
Biosecurity

controlled by removing the plants, drying and incinerating them or disposal by deep burial. Large waterways are treated by spraying using diquat after consultation with Regional Councils. All herbicides are applied at rates recommended by the proprietor.

Following the treatment or removal of any of these weeds, the site is inspected within 30 days and monitored for a specified period (Table 1). If no further detections are made, the site is placed under surveillance for a further period to ensure any regrowth is detected early and controlled. If at any time during the surveillance phase, new detections are made or regrowth occurs, the site reverts to an active site. If no further detections are made, local elimination is declared at the end of the surveillance period. National eradication can be declared when the species has been eliminated from all known sites throughout New Zealand.

RESULTS AND DISCUSSION

The NIPR programme has been effective in managing Johnson grass (currently no active sites in New Zealand) and cape tulip (present in Wellington, Hawke’s Bay, Gisborne, Northland, Canterbury and Nelson). These two species are more likely to achieve eradication in the short to medium-term than the aquatic species. All active salvinia and water hyacinth sites are located in the North Island. Both species are sensitive to frost hence they are unlikely to establish in the South Island. Since 2009-10, local elimination has been achieved at 55 salvinia sites, 31 water hyacinth sites and 12 cape tulip sites.

**Johnson grass**
The highest number of active sites for Johnson grass (21 sites) was recorded in 1992-93 at Canterbury, Waikato and Bay of Plenty (Figure 1). This species has been eliminated from Canterbury and Bay of Plenty and the number of active sites has since declined to zero. Two sites at Waikato are under surveillance. If by 2016 no new plants or regrowth are detected, Johnson grass will be declared eradicated from New Zealand, thus illustrating that the management programme is on target to achieve eradication.

**Cape tulip**
Data for cape tulip are available from 1994-95 although several hundred sites existed in the mid 1980s (Randall 2000). The highest number of active sites (92) was recorded in 1994-95 (Figure 2). Since then, both the numbers of active and surveillance sites have declined indicating that the management programme is on target to achieve eradication, approximately by 2025. Currently there are 24 active sites and five surveillance sites. Some of the cape tulip plants at Portland Island (Hawke’s Bay) are located on steep cliffs, inaccessible for ground spraying and are thus controlled by aerial spraying. This makes it difficult for herbicide to reach all plants present. Moreover, the underground corms make eradication from aerial spraying less effective because the corms can remain dormant for several years and germinate when conditions are favourable. Hawkins & Lloyd (2008) advise that persistent control is the key in reducing density

<table>
<thead>
<tr>
<th>Weed species</th>
<th>Active phase</th>
<th>Surveillance phase</th>
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<tbody>
<tr>
<td></td>
<td>Period (years)</td>
<td>Number of inspections/annum</td>
</tr>
<tr>
<td>Johnson grass</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Cape tulip</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Water hyacinth</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Salvinia</td>
<td>0.25</td>
<td>3</td>
</tr>
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1 Weed species growing in impermeable containers, after clearing the content and cleaning the container, local elimination can be declared at 6 months if no weeds are detected during subsequent inspections.  
2 On very large or difficult sites this period may be extended to 5 years.
Biosecurity

of cape tulip infestations. Eradication from Portland Island is therefore expected to take longer than from other parts of New Zealand.

Water hyacinth and salvinia

The numbers of active water hyacinth and salvinia sites over two decades show similar undulating trends (Figure 3). This means eradication of both species is many years away. The extent of their distribution is unknown and it appears there are more active sites than what is currently recorded.

Due to seed longevity, water hyacinth sites require 20 years of surveillance before it can be confirmed that re-infestation has not occurred. For example, regrowth has occurred 7 years after a site had been declared free of the weed (Randall 2000). Currently there are 22 active and 34 surveillance sites. The high number of surveillance sites is partly due to the prolonged period required for surveillance. Management of salvinia requires the shortest monitoring period because unlike the other three species, it does not produce seeds. Moreover the plant dies soon after it has been removed from water. Currently there are 29 active and 22 surveillance sites.

A number of factors contribute to the persistence of the aquatic weeds despite the effort of MPI and Regional councils to eradicate them.

• They are popular aquarium and pond plants. Water hyacinth is admired by some pond enthusiasts for its mauve-blue flowers.

• Both plants are reported to be efficient at removing excess nutrients from ponds and are good for compost.

• Tracing often does not yield good results because some pond owners are unwilling to disclose how they acquired them.

• A few people continue to trade in these plants, thus spreading them further and this threatens to undermine any eradication efforts.

• Rapid vegetative growth rates of these plants can lead to infestations reoccurring from any missed plants following treatment.

Figure 1 The number of active and surveillance sites for Johnson grass since 1990-91.

Figure 2 The number of active and surveillance sites for cape tulip since 1994-95.

Figure 3 The number of active sites for salvinia and water hyacinth since 1990-91.
CONCLUSIONS
Assessment of the four noxious weeds indicates that Johnson grass and cape tulip have responded to management better than water hyacinth and salvinia. However, despite water hyacinth and salvinia being introduced into New Zealand about 100 years ago, neither species has established in any large water body. This indicates that the NIPR programme has helped to slow the spread of these species. To eradicate these aquatic species, public awareness campaigns aimed at changing peoples’ perceptions of these weeds are important. MPI is currently looking at a number of options to increase public awareness of the potential impacts of these weeds on the environment, economy and human health. Surveillance will remain a key tool in determining the distribution of these species. Lastly, prosecuting repeat offenders, especially those who propagate and sell these noxious weeds, remains an option that would act as a deterrent to others and prevent further spread.

ACKNOWLEDGEMENTS
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REFERENCES