Biological Success and Weediness of Existing Terrestrial Pest Plants and Aquatic Weeds in Northland

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Contents

1 Introduction

Information on the threats to Northland posed by terrestrial and aquatic pest plants that are currently in Northland Regional Council's Regional Pest Management Strategy, together with a few new aquatic weeds that not in the strategy, was summarised by Landcare Research for the council in February 2008, and funded by Envirolink Medium Advice Grant NLRC61.

Northland Regional Council's Regional Pest Plant Management Strategy (RPMS) became operative in 2005 and is due for review in 2009. Prior to that review the council requires further information on the weeds currently in the RPMS so they can be appropriate classified in the next RPMS. This information will feed into the pest plant strategy review process and help Northland Regional Council to ensure its pest plant management strategy has objectives that are able to deliver maximum benefits to the region. The council also requires information on new and emerging weed issues. New terrestrial weeds are dealt with in a separate report (Williams 2008), but for convenience all aquatic weeds are dealt with in this document.

2 Objective

To describe the potential 'weediness' of the current pest plants in Northland that threaten agricultural, biodiversity, and other values.

3 Methods and Data Sources

The primary data sources used were:

Species listed in the 2005 Northland RPMS
Weediness scores from the DOC Weeds database (Clayson Howell, DOC, September 2006)
List of species found in all other RPMS in New Zealand
Plants on the National Pest Plant Accord
No. of overseas weed lists the species is on overseas derived from scanning Randall (2002)
Previous summaries of the weediness of noxious plants in New Zealand (Esler et al. 1993)
Online web databases

One of us (PAW) inspected weed infestations in Northland during 2 days in November 2007 and in the course of other fieldwork in Northland in November 2007 and February 2008.

The data sheets were prepared and updated following the format of Esler et al. (1993) and the reader is referred to that document for the details of the scoring system. In essence, the scoring system has 15 categories that summarise the performance of a plant for characteristics that determine either its biological success (maximum 21) or harmful impacts, i.e. its weediness (maximum 24). Many of the comments regarding distribution and impact especially are applicable to other areas apart from Northland.

The terrestrial weeds were compiled by PAW and the aquatic weeds were compiled by PDC, with the exception of monkey musk and yellow flag iris. In the reports of Esler et al. (1993), most species scores are accompanied by a reference to the material in the text. This is extremely time consuming so

we have just put a list of the major sources at the end. However, in a few cases, where particular scientific papers or other reports were uncovered, these are included following the scores for the relevant species.

A summary of the potential for biological control of many of these weeds is given in Williams & Hayes (2007).

4 Species Summaries

Table 1 Summary of Biological Success ratings and Esler's Index of Weediness listed in order of common name and their page number within the text.

Page	Name		Biological Success rating (max 21)	Esler's Index of Weediness (max 24)
	Terrestrial plants			
8	African feather grass	*Pennisetum macrourum*	21	14
9	Bathhurst burr	*Xanthium spinosum*	10	8
10	Broom	*Cytisus scoparius*	12	12
11	Californian thistle	*Cirsium arvense*	15	11
12	Chinese privet	*Ligustrum sinense*	11	13
13	Gorse	*Ulex europaeus*	14	19
15	Houttuynia	*Houttuynia chordata*	17	10
16	Kahili ginger	*Hedychium gardnerianum*	18	14
17	Lantana	*Lantana camara*	12	13
18	Moth plant	*Araujia sericifera*	15	13
19	Nassella tussock	*Nassella trichotoma*	16	14
20	Nodding thistle	*Carduus nutans*	13	11
21	Old man's beard	*Clematis vitalba*	18	15
22	Pampas	*Cortaderia selloana*	16	17
23	Ragwort	*Senecio jacobaea*	15	14
24	Rhamnus	*Rhamnus alaternus*	12	11
25	Skeleton weed	*Chondrilla juncea*	18	12
26	Tree privet	*Ligustrum lucidum*	12	13
27	White-edged nightshade	*Solanum marginatum*	10	13
28	Woolly nightshade	*Solanum mauritianum*	13	12
29	Yellow ginger	*Hedychium flavescens*	15	12
	Aquatic plants			
30	Alligator weed	*Alternanthera philoxeroides*	17	20
32	Bladderwort	*Utricularia gibba*	17	14
33	Californian bulrush	*Schoenoplectus californicus*	15	11
34	Eel grass	*Vallisneria gigantea and V. spiralis*	15	17
35	Egeria	*Egeria densa*	17	20
37	Fringed waterlily	*Nymphoides peltata*	19	17
38	Hydrilla	*Hydrilla verticillata*	17	18
40	Manchurian wild rice	*Zizania latifolia*	19	18
42	Marshwort	*Nymphoides geminata*	16	17
43	Monkey musk	*Mimulus guttatus*	16	13
44	Nardoo	*Marsilea mutica*	12	9
45	Parrot's feather	*Myriophyllum aquaticum*	17	16
47	Pickerelweed	*Pontederia cordata*	8	8
48	Senegal tea	*Gymnocoronis spilanthoides*	17	15
49	Spartina	*Spartina alterniflora, S. Anglica and S. ×townsendii*	16	17
51	Water poppy	*Hydrocleys nymphoides*	15	16
52	Yellow flag iris	*Iris pseudacorus*	15	13

4.1 Terrestrial species

Species

African feather grass (*Pennisetum macrourum*)

Family
Poaceae
Origin
South Africa
Weed
Widespread weeds in Australia.
Uses
An ornamental plant.
Form
A large tufted, rhizomatous perennial to 2 m tall with dense, bristly, pale green, cylindrical inflorescences.
Ecology
Mainly in damp soil, of a wide range of types, from sand to light clay.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerates a range of soil conditions including partly saline. Established plants are drought resistant. High optimum temperature required for germination.

3 **Maturation rate** Seeds germinate in autumn, but these tend to be rather weak. Rhizomes begin developing after 7 months and this is the main method of spread.

3 **Seeding ability** High seed production recorded, but this is variable from year to year. High germination rate (88%) has been recorded. Most seeds not long lived, but some remain viable for long periods in the soil. It cannot emerge from a depth greater than 8 cm.

3 **Dispersal and establishment** Barbed seeds are spread by a very wide range of vectors and pathways, from natural means such as water and wind, to contaminants. Rhizomes spread by machinery and cultivation. Also has potential for spread by dumping.

3 **Cloning** Naturally it spreads from the rhizomes, up to 10 cm thick, which are up to 30 cm deep. Young tussocks arise from offshoots from these rhizomes.

3 **Recovery** New colonies can be established from rhizome fragments having only one node**.** Recovers rapidly from damage and from fire. Seed bank is also a source of new plants.

3 **Competitive ability** Aggressive plant forming dense clumps excluding most other plants. Seedling establishment is poor other than in open situations. Because it can resist grazing, it persists in pastures.

21 **Biological Success and Environmental Impact Rating**

Weed status assessment (0–3)

3 **Obstruction** Forms thickets to the exclusion of all else, including light machinery. Blocks drains.

3 **Suppression** Threats to lower-growing plants and seedling establishment of all other species. Can even suppress blackberry.

0 **Health impairment**

0 **Quality impairment**

2 **Damage to natural areas** Little at present, but potential to invade open areas, forest margins, coastal cliffs and headlands, track-sides.

0 **Other** None

Opportunity

3 **Extent of suitable habitat** Large areas of Northland are vulnerable, especially open situations of all kinds.

3 **Resistance to management practices** Resistant to grubbing and other mechanical means. Can be controlled by chemicals if patches small enough. Recovers from bare ground following spraying.

14 **Esler's Index of Weediness**

Species

Bathhurst burr (*Xanthium spinosum*)

Family
Asteraceae
Origin
South **America**
Weed
Common as a weed in many countries with Mediterranean to warm-temperate climates.
Uses
None
Form
Spiny, erect, multi-branched annual herb 10–100 cm tall. Narrow leaves with seed capsules in the axils. Woody oval burrs with spikes 2–3 mm long that cling to clothing and wool.
Ecology
Grows in a range of marginal habitats, pasture, arable land, coastal places and waste land. Most common from Auckland to Hawkes Bay. Roots can extend to great depths to gain water. Has quite high water requirements.

Ratings
Biological Success and Environmental Impact (0–3)

1 **Versatility** Requires moist warm soils for germination. Has tolerance of flooding. Intolerant of shading and cannot establish in rank growth.
3 **Maturation rate** Germinates in spring and early summer and can produce seeds in its first year. Lifespan unknown.
2 **Seeding ability** Seeds produced in abundance. Seed density is dependent on plant density, with isolated plants producing greater seed. Germination has been noted as 45–80%. Seeds have staggered germination times, some entering the seed bank for more than 3 years.
2 **Dispersal and establishment** Seeds can be dispersed several metres if plant knocked, but most dispersed passively. Hooked seeds then carried by water, or by attachment to a wide range of carriers.
0 **Cloning**
1 **Recovery** Disturbance will cause germination of seeds. Adult plants recover from cut shoots.
1 **Competitive ability** Strongly competitive with field crops overseas, but not with closed-canopy communities.

10 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Forms dense thickets on margins but in NZ is not in high abundance to do this.
1 **Suppression** Not sufficiently dense to shade other plants except in field crops (not in NZ).
1 **Health impairment** None known.
1 **Quality impairment** Not a noticeable detraction visually.
0 **Damage to natural areas** Potential to invade bush margins, regenerating scrub and native shrublands, banks, cliffs where it out competes early-successional native species such as māhoe. In stable situations it is overtaken by further native species.
1 **Other** Host to fungal diseases of horticultural plants.

Opportunity

1 **Extent of suitable habitat** Not limited by climate in the lowlands. Probably dispersal is limited in NZ at the moment.
2 **Resistance to management practices** Grubbing/manual treatment is effective only before burrs form. Management in NZ keeps the plant at very low levels.

8 **Esler's Index of Weediness**

Species

Broom (Cytisus scoparius)

Family
Fabaceae
Origin
Europe
Weed
Weed in Australia and many temperate areas including North and South America.
Uses
None in NZ that cannot be substituted by other plants, e.g. pollen for bees.
Form
A vigorous and fast-growing perennial shrub to 5 m forming dense thickets.
Ecology
Grows in a wide range of marginal habitats, regenerating scrub, forest margins, cliffs, banks, and even wetland margins. Frost tolerant. Prefers well-drained soils and does not grow on the most infertile soils. Fixes nitrogen.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Highly variable growth habit dependent on level of shade. Photosynthetic stems an adaptation to drought. Tolerates a range of soil conditions. Seeds can withstand submergence for long periods.

2 **Maturation rate** Can produce a few seeds in the second year, with maximum seed production after 4–5 years.

3 **Seeding ability** Produces up to 18 000 seeds per bush and maintains this for its life of c. 15 years. A few seeds germinate in first year, but others enter the seed bank and can survive for up to 16 years.

1 **Dispersal and establishment** Seeds explosively dehisced, but the main dispersal mechanism is transportation by a range of means, either by water, gravity, contaminated soil, earthworks, and stock (e.g. sheep's backs).

0 **Cloning.**

2 **Recovery** Regrows after grazing and damage and cut stumps, but less capacity in this regard than gorse.

2 **Competitive ability** Seedlings are highly palatable. Cannot establish in shade and so requires open areas, or spaces between other plants such as rank grass. Crowds out other plants once established. Collapses after about 10–15 years though, giving way to other plants. Self-perpetuating stands form in open habitats such as riverbeds.

12 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Forms dense thickets obstructing tracks, grazing access.

2 **Suppression** Suppresses grass growth and early growth of pine plantations**.**

1 **Health impairment** Foliage thought to cause digestive disorders in horses but this is not considered a problem in NZ.

0 **Quality impairment**

2 **Damage to natural areas** Smothers very early native regeneration but then gives way as it matures. Because it is a successional plant in forest habitats its damage to native species is primarily where it occupies open areas such as riverbeds and cliffs where it can persist.

1 **Other** Some increase of fire risk.

Opportunity

2 **Extent of suitable habitat** Large areas of open habitats are present in Northland that are suitable.

2 **Resistance to management practices** Grubbing or spraying is effective. Because eaten by stock, not a threat to pastures except in very slack grazing land. For summary of biocontrol see Williams & Hayes (2007). Broom twigminer (*Leucoptera spartifoliella*) and broom seed beetle (*Bruchidius villosus*) are established in Northland.

12 **Esler's Index of Weediness**

Species

Californian thistle (*Cirsium arvense*)

Family
Asteraceae
Origin
Eurasia
Weed
Widespread weed on several continents.
Uses
None in NZ.
Form
An erect perennial herb up to 150 cm spreading by extensive creeping roots to form dense patches that may be hectares in extent.
Ecology
Grows in a wide range of marginal habitats, light pasture, cropping systems, open land waste places. Invades wetland margins.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions and drainage regimes but seedlings emerge only from bare ground.
3 **Maturation rate** Produces seeds in the first year after germination and once tap root formed, lateral roots soon follow. Plant dies down in autumn after first frosts.
2 **Seeding ability** Abundant seeds produced in late summer. Some may germinate almost immediately whereas others enter the soil seed bank and may remain viable for up to 20 years.
2 **Dispersal and establishment** Widely dispersed by wind and as a contaminant. Germination is best in open sites and seedlings are light demanding.
2 **Cloning** Establishes very readily from even small pieces of root and this can emerge from a great depth.
2 **Recovery** Regrows when damaged.
2 **Competitive ability** Withstands only moderate competition in establishment phase, but adult plants are more highly competitive with other herbaceous species and crops.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Forms dense patches but even sheep can get through these.
2 **Suppression** Reduces pasture production and some crops considerably. Allelopathic.
1 **Health impairment** Young stock can damage their mouths.
1 **Quality impairment** Contaminant of seed crops, hay, and other produce.
1 **Damage to natural areas** Primarily a weed of agriculture but some impact on wetland margins.
0 **Other None**

Opportunity

2 **Extent of suitable habitat** Large areas of Northland suitable but limited by good farm management.
3 **Resistance to management practices** Difficult to control. Cultivation is generally ineffective**.** Not a management problem on good farmland. For summary of biocontrol see Williams & Hayes (2007). No biocontrol agents for this thistle are established in Northland.

11 **Esler's Index of Weediness**

Species

Chinese privet (*Ligustrum sinense*)

Family
Oleaceae
Origin
Japan-Asia
Weed
Widespread weed on several continents and in the Pacific.
Uses
Once widely used as a hedge plant but now less popular.
Form
Broadleaved shrub to c. 5 m. Evergreen except in coldest areas.
Ecology
Grows in a wide range of marginal habitats, regenerating scrub, forest margins, plantation edges.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions but is inclined to be intolerant of very light soils and calcareous soils. Prefers soils of medium acidity and drainage. Tolerant of frosts. Not as shade tolerant as many native shrubs it grows with.
2 **Maturation rate** Takes several years before first fruits produced.
2 **Seeding ability** Abundant small dark seed produced in NZ. Some suggestion of a seed bank.
2 **Dispersal and establishment** Seeds spread by birds, primarily exotic species (blackbirds, starlings and mynahs) and silvereyes. Also spread by dumping and soil movement. Often seedlings germinate en masse, smothering out competition. Seedlings have been seen on treefall mounds well inside forests.
0 **Cloning**
1 **Recovery** Regrows after cutting and can resprout from root suckers.
2 **Competitive ability** Once beyond the seedling stage is a highly competitive plant in a range of open habitats and moderate subcanopy shade. But does not compete with a dense cover of native species and seldom forms the canopy unless the site was fairly open to start with.

11 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Forms dense thickets but no worse than other shrubby vegetation.
2 **Suppression** Suppresses all shorter-growing native species.
3 **Health impairment** There has been debate about how and why privet is reputed to cause allergies in humans. There is evidence that a sharp reaction to the perfume of the flowers causes a great discomfort, but more recently it has been shown that the pollen is the likely cause of the problems.
0 **Quality impairment**
2 **Damage to natural areas** Potential to invade bush margins, regenerating scrub and native shrublands. Generally overtopped by taller native species if left undisturbed. Most abundant in highly disturbed areas and on alluvial soil. According to the Northland Regional Council website, it is not invasive in Northland.
0 **Other**

Opportunity

2 **Extent of suitable habitat** Potentially large areas of land available in marginal habitats in Northland.
2 **Resistance to management practices** Can be cut and susceptible to a range of herbicides. Can resprout if cut and also regrows from the seed bank. In Australia, seeds were found to last only a short time, but this seems to conflict with the New Zealand experience.

13 **Esler's Index of Weediness**

McGregor PG 2000. Prospects for biological control of privet (*Ligustrum* spp.) (Oleaceae). Landcare Research Contract Report LC9900/127.

Species

Gorse (*Ulex europaeus*)

Family
Fabaceae
Origin
Eurasia
Weed
Widespread weed on several continents.
Uses
None in NZ that cannot be substituted by other plants, e.g. pollen for bees.
Form
Much branched spiny perennial shrub up to 4 m tall that lives for up to 30 years. Commonly found as a very dense scrub.
Ecology
Grows in a wide range of marginal habitats and waste land over a wide altitude and rainfall range, but particularly on poor soils. Optimum growth is on acid soils of pH 4.5–5.0 under 500–1500 mm per year. Lives longer and flowers most profusely in cooler districts. Is considered useful source of pollen for bees.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions but prefers acidic soils with low nutrient supply. Fixes nitrogen which helps here. Can form a 'seedling bank' in shady conditions but only for a limited time. Not especially tolerant of very harsh climates or salt spray.

3 **Maturation rate** Can produce fruit in its second year.

3 **Seeding ability** Produces abundant small seeds that can persist in the ground for several decades. Others germinate soon after release. Viability is high, commonly >90%. Hard seed coat also enables transport by abrasive means such as water.

2 **Dispersal and establishment** Explosive dehiscence, but most fall close to the parent plant**.** Spread by a very wide range of vectors, from being carried in the hooves and on the backs of sheep, to spread in gravel and by machinery.

0 **Cloning**

2 **Recovery** Recovers rapidly after damage and seedlings germinate after fire. These have low competitive ability if a sward or other cover is present.

2 **Competitive ability** A highly competitive plant only in the presence of grazing, high light or very low nutrient situations. Unable to establish in a dense sward. In woody vegetation it is shaded out.

14 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Forms dense thickets that are impenetrable.

3 **Suppression** Threats to pasture on marginal land and to short native vegetation. Can completely dominate in these circumstances.

1 **Health impairment** Spines are a nuisance and can become infected in hands etc.

1 **Quality impairment** Spiny twigs lower the value of wool.

2 **Damage to natural areas** Potential to invade a wide range of short native communities. Suppresses early woody vegetation successions. On the other hand, it fosters native regeneration in the long run because it 'retires' land from grazing. After 20 or so years it is suppressed by the native woody species if not disturbed. Latest evidence from central regions of New Zealand suggests these pathways will not lead in the same direction as native successions in the immediate future.

3 **Other** The large litter build-up and the flammable nature of the crowns means gorse is a major fire hazard near urban areas especially. Can also carry fires into native communities.

Opportunity

3 **Extent of suitable habitat** Large areas of Northland suitable.

3 **Resistance to management practices** The large persistent seed bank makes it difficult to control in any situation where there is bare ground remaining after treatment. Can be grubbed in small amounts, or smashed, sprayed or burnt over larger areas. These all require either oversowing to prevent seedling growth or else respraying to kill seedlings. For summary of biocontrol see Williams & Hayes (2007). Gorse seed weevil (*Exapion utilis*), gorse pod moth (*Cydia succedana*), gorse spider mite (*Tetranychus lintearius*), gorse thrips (*Sericothrips staphylinus*) and gorse soft shoot moth (*Agonopterix umbellana*

previously *ulicetella*) are established in Northland, but only the seed weevil and spider mite are widespread.

19 Esler's Index of Weediness

Species

Houttuynia (*Houttuynia chordata*)

Family
Saururaceae
Origin
Asia
Weed
On several global weed lists. A weed in its native range. Also in USA and Australia.
Uses
Used as a horticultural plant but not widely grown.
Form
Is a perennial ground cover herb with rosette base, large multi-coloured leaves and upstanding seed heads to 120 cm height. Normally deciduous, dying back to the rootstock over winter, although it can be semi-evergreen in warm areas.
Ecology
Found in shaded places in lowlands and forested banks. Its natural habitat is shallow water and low-light situations. It thrives along the margins of ponds and waterways. Grows in a wide range of open sites in Australia but in NZ is confined to the Auckland Region.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Wide range of substrates but probably frost sensitive.
3 **Maturation rate** Very easily propagated by division or cuttings, plant fragments can easily take root and form new infestations. Once established it can cover large areas assisted by creeping rhizomes and an extensive root system.
2 **Seeding ability** Will set viable seed parthenogenetically. Male plants are all sterile.
2 **Dispersal and establishment** Dispersed primarily by humans and garden dumping, then lateral growth**.** Rhizome fragments have the potential to be dispersed.
3 **Cloning** Stems creep and spread from slender, couch-like rhizomes.
3 **Recovery** Regrows from rhizomes.
2 **Competitive ability** Highly successful only in open moist sites. Has yet to demonstrate its full capacity in NZ.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Has the potential to block drains.
2 **Suppression** Covers other low-growing plants.
0 **Health impairment**
0 **Quality impairment**
2 **Damage to natural areas** Potential to be highly disruptive to moist habitats and waterways.
0 **Other** None

Opportunity

2 **Extent of suitable habitat** Large areas of lowland Northland are probably suitable.
2 **Resistance to management practices** Need to be very careful when removing rhizomes. Can be killed with herbicides but difficulties with collateral damage in garden situations.

10 **Esler's Index of Weediness**

Species

Kahili ginger (*Hedychium gardnerianum*)

Family
Zingiberaceae
Origin
India
Weed
Widespread weed in Australia, the Azores, and several other countries. Widespread in Northern New Zealand.
Uses
An ornamental plant.
Form
A large tufted, rhizomatous perennial to 2 m tall with dense, large green leaves and conspicuous flower heads over a layer of massive rhizomes.
Ecology
Widespread on a range of sites especially damp soil.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions and tolerant of drought. Established plants are drought resistant. Grows under a range of shade but flowers best in full sun.
3 **Maturation rate** Grows rapidly from seed and rhizomes. Aerial stems are annual.
2 **Seeding ability** High seed production recorded, up to 900 seeds per flower head.
3 **Dispersal and establishment** Seeds spread by a wide range of birds**.** Rhizomes spread by dumping and water, also by machinery.
3 **Cloning** Naturally it spreads from the rhizomes, which are up to 1 m deep. Young plants arise from offshoots and from pieces of detached rhizomes.
3 **Recovery** Recovers rapidly from damage and from fire. Seed bank is also a source of new plants. Can root from excavated pieces of rhizome.
3 **Competitive ability** Aggressive plant forming dense clumps excluding most other plants.

18 **Biological Success and Environmental Impact Rating**

Weed status assessment (0–3)

3 **Obstruction** Forms thickets to the exclusion of all else, including light machinery. Blocks drains and obstructs tracks.
3 **Suppression** Threats to established light forest and all lower-growing plants and seedling establishment of all other species.
0 **Health impairment**
0 **Quality impairment**
3 **Damage to natural areas** Wide spread damage to native forest and regenerating scrub which effects vegetation succession, margins, coastal cliffs and headlands, track-sides.
0 **Other None**

Opportunity

2 **Extent of suitable habitat** Large areas of Northland are vulnerable, especially open situations of all kinds.
3 **Resistance to management practices** Resprouts from damaged plants which limits manual control other than in very small areas. Can be effectively controlled by chemicals applied to the cut rhizomes.

14 **Esler's Index of Weediness**

Species

Lantana (*Lantana camara*) (note: there are many colour forms and these notes apply to *sensu stricto*)

Family
Verbenaceae
Origin
Central America
Weed
Widespread weed globally.
Uses
Various forms are widely cultivated for the flowers.
Form
Aromatic shrub up to 3 m tall.
Ecology
Wide range of shrubby habitats in regenerating scrub and forest margins as well as more open areas such as road cuttings. Mainly in northern NZ. Widely planted as a horticultural plant. . Some marginal spread by suckering. Only a minor agricultural shrub weed in NZ, blocks passage.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a wide range of soil conditions, but is frost sensitive. Grows best on rich soils with no period of real drought stress.
2 **Maturation rate** Rapid growth rate and can produce seeds within 2–3 years. Bushes can live for many years.
2 **Seeding ability** Produces abundant seed, numbering several thousand per square metre per year, with up to 48% viable.
2 **Dispersal and establishment** Seeds dispersed by a range of birds. Some marginal spread by suckering.
1 **Cloning** Plants expand by suckering and if these become detached, new bushes can form.
1 **Recovery** Can withstand some damage, even if broken off at ground level.
2 **Competitive ability** Highly competitive with smaller native species in high-ight situations. Shades out native biota. Can also suppress tall grass.

12 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Shrubs can block access and obscure tracks etc. because of the dense twiggy growth.
2 **Suppression** Suppresses pasture in some situations, but this is very localised in NZ.
3 **Health impairment** Causes photosensitivity and children have been poisoned by the fruits.
1 **Quality impairment** Pieces of twig and leaves are sticky and can become attached to wool.
2 **Damage to natural areas** Suppresses native plant regeneration, especially in open habitats but also tolerant of some shade so can occupy understoreys where there is canopy damage.
0 **Other**

Opportunity

2 **Extent of suitable habitat** There is a lot of suitable habitat in Northland, especially in coastal situations and on offshore islands.
1 **Resistance to management practices.** Difficult to kill by mechanical means and needs a lot of spray to cover. Biocontrol agents are likely to be introduced in the future.

13 **Esler's Index of Weediness**

Swarbrick JT, Willson BW, Hannan-Jones MA 1998. *Lantana camara.* L. In: Panetta FD, Groves RH, Shepard RCH eds The biology of Australian weeds. Melbourne, RG & FJ Richardson. Pp .119–140.

Species

Moth plant (*Araujia sericifera*)

Family
Asclepiadaceae
Origin
South America
Weed
Weedy in Australia, California, Israel, Italy, and Spain, and naturalised in Africa and North America.
Uses
Was commonly grown as an ornamental.
Form
Fast-growing evergreen vine with a woody stem up to 40 mm in diameter.
Ecology
Prefers loose, fertile soils in warmer climates in areas of moderate to high rainfall.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** It establishes most freely in semi-shade but will tolerate exposure to full light once it reaches the canopy of shrubs, hedges, or trees. Intolerant of severe cold, which probably determines its southern limits as a problem plant in NZ. Grows best on deep moist soils but will grow in gravel and sand dunes.

2 **Maturation rate** Fruits within 2 years of establishment under good conditions. Seedlings can remain suppressed until an opening arrives.

2 **Seeding ability** Possibly only 1% of flowers bear fruit and this may be because of a lack of suitable pollinators in New Zealand. The establishment of an efficient pollinator in New Zealand could further increase its weediness (A. E. Esler, pers. comm.). The choko-like fruits contain about 400 seeds.

3 **Dispersal and establishment** Spread of the plant is by wind-borne seeds, which can travel at least several hundred metres on parachutes of fine silky tufts. It is suspected that seeds have blown from the mainland to offshore islands in the Hauraki Gulf (Esler 1988). The majority of seeds are viable and most germinate fairly soon after landing, provided they have moist warm conditions (in Queensland). But seeds can germinate freely more than 5 years from the time of being shed. Seeds can remain floating for up to 33 days.

1 **Cloning** Can grow from damaged plants but does not clone.

2 **Recovery** Shows recovery from spraying and totally resistant to cutting.

3 **Competitive ability** Can completely smother other plants.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Some obstruction of tracks and the like.

1 **Suppression** Not an agricultural weed but potential for being a forestry weed.

2 **Health impairment** Plant is poisonous and causes skin complaints.

0 **Quality impairment**

3 **Damage to natural areas** Has the potential to cause substantial environmental damage in NZ by scrambling over trees and shrubs to a height of about 6 m, smothering and replacing native species in disturbed or low-canopy forest, and in open lands such as coastal areas or offshore islands. It is also a problem in urban reserves and gardens where it can become the dominant species. It is expected that it will spread to become a serious weed in open forest and on forest margins.

0 **Other** None

Opportunity

3 **Extent of suitable habitat** Large areas of Northland are vulnerable, including offshore islands.

3 **Resistance to management practices** Resistant to physical treatments because has a well-developed root system that is hard to pull out. Often recovers from chemical control. Biocontrol agents are likely to be introduced in the future.

13 **Esler's Index of Weediness**

Esler AE 1988.

Species

Nassella tussock (*Nassella trichotoma*)

Family
Poaceae
Origin
South America
Weed
Widespread weed in Australia, South Africa and Europe.
Uses
None
Form
Dense tussock to 70 cm with narrow fine harsh leaves overtopped by slender seed heads.
Ecology
A temperate plant but tolerant of a wide range of temperatures and heavy frosts. Climatically it is best suited to eastern NZ and drier parts of northern NZ. Tolerant of a wide range of soil conditions but not swampy areas.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of climate and soil conditions, up to 900 m. Seedlings are partially shade tolerant.

1 **Maturation rate** Begins to flower in second to thrid year.

3 **Seeding ability** Produces extremely abundant seeds on the ends of long trailing culms that become detached with each bearing about 50 seeds. Total production per square metre is in the order of 100 000. Seeds become dormant for up to 15 years and germinate when exposed to the light.

3 **Dispersal and establishment** Seeds are spread by wind and a wide variety of contaminated goods such as sheep's backs and machinery.

0 **Cloning** Does not clone.

2 **Recovery** Recovers rapidly following the occasional fire. Unless plants are grubbed completely they will re-establish. Most recovery is from the seed bank.

3 **Competitive ability** Extremely competitive in a pasture situation and also in light scrub or even lightly wooded forest. Causes major reduction in pasture because it is unpalatable.

16 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Being short, it does not obstruct major works, nor fill drains etc., but is difficult to grub out.

2 **Suppression** Suppresses shorter or equal-height pastures and native species. Not palatable to stock or rabbits.

1 **Health impairment** Causes damage to sheep's mouths and irritates lambs skins where it penetrates the wool.

2 **Quality impairment** Spoils fleeces and where it is harvested amongst seed crops these are made worthless by the contamination.

2 **Damage to natural areas** Its principal effect in NZ would be invasion of low plant communities including sand dune hollows and cliff communities. Potential to invade such areas on offshore islands because of wind dispersal.

0 **Other** None

Opportunity

3 **Extent of suitable habitat** Large areas of eastern NZ vulnerable and climate match very close with northern Northland, where it would do best on light soil.

3 **Resistance to management practices** While individual tussocks can be removed by grubbing, the re-emergence from the seed bank and reinfestation from adjacent areas makes it very difficult to control. Tussocks can be hard to distinguish from other species. Eradication is effectively impossible.

14 **Esler's Index of Weediness**

Species

Nodding thistle (*Carduus nutans*)

Family
Asteraceae
Origin
Eurasia and North Africa.
Weed
Widespread weed on several continents.
Uses
None in NZ.
Form
Annual, biennial, or perennial herb forming a prostrate rosette and erect flowering stems up to 1.5 m. Deep fleshy taproot up to 40 cm. Numerous large heads weigh down the stems causing them to droop.
Ecology
Grows in a wide range of crops with open space and light soil, pasture, lucerne, waste places, roadsides, marginal habitats.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Genetically diverse in New Zealand. Withstands frosts and severe drought. Not tolerant of waterlogging and absent from high rainfall areas of NZ. Requires vernalisation for production of flower stems.

2 **Maturation rate** Seeds germinated in autumn rapidly produce overwintering rosettes occupying space in droughty pastures. Flowers are produced 1 or 2 years following. Seeds ripen very quickly, only about 2 weeks after flowering.

3 **Seeding ability** Produces 10 000 seeds/plant with 60–80% viability. Dormancy is for 8–9 years at 5 cm depth and > 20 years for 20 cm depth.

2 **Dispersal and establishment** Seeds are heavy and most become detached from pappus to fall near parent plant. Spread is primarily by water, animals, contaminant of farm machinery etc.

0 **Cloning**

2 **Recovery** Grows from damaged plant which persists as vegetative state until able to flower. Requires at least 5 cm of tap root to be removed to kill it. Multiple stems produced by mowing. Seeds on cut stems able to mature and is therefore very resistant to manual weed control.

2 **Competitive ability** Not a highly competitive plant in a farming sense, because it can be suppressed in the seedling stage by good pasture growth. This also delays flowering. But exploits gaps in pasture in autumn.

13 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Forms dense thickets that are difficult to push through, reducing access.

2 **Suppression** Inhibits germination and growth of pasture plants and reduces pasture production over summer by up to 8%.

1 **Health impairment** Pieces of plant with spines may injure stock.

1 **Quality impairment** Pieces of plant in wool are a contaminant.

0 **Damage to natural areas** No record of damage to natural areas.

0 **Other** None

Opportunity

2 **Extent of suitable habitat** Large areas of light soil in Northland are probably suitable.

2 **Resistance to management practices** Can be excluded by good pasture management. Grubbing effective if 10 cm of root removed. Herbicides effective especially on young plants. See notes on biocontrol in Williams & Hayes (2007). Nodding thistle receptacle weevil (*Rhinocyllus conicus*), nodding thistle gall fly (*Urophora solstitialis*) and nodding thistle crown weevil (*Trichosirocalus horridus*) are all known to have established in Northland but their distribution and abundance are not known at this time.

11 **Esler's Index of Weediness**

Species

Old man's beard (*Clematis vitalba*)

Family Ranunculaceae
Origin Eurasia
Weed Weed mainly in Australia and NZ.
Uses
Once grown as an ornamental.
Form
Very vigorous woody vine with stems commonly to 10-cm diameter that climbs to over 20 m, covering the supporting vegetation. Deciduous, with masses of persistent seed heads over winter.
Ecology
Grows in a wide range of marginal habitats, regenerating scrub, forest margins, plantation edges, banks. Grows best on fertile soils, especially alluvial soils.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Seedlings are stress tolerant (grows in footpaths) and relatively shade tolerant (light compensation point is 1%) compared with some other vines. Needs light levels above 5%. Can withstand severe frosts. Tolerates a range of soil conditions and not particularly sensitive to soil acidity.

2 **Maturation rate** Seeds can germinate throughout the year if sufficient moisture. Flowers in mid to late summer and seeds produced the same autumn (March–December). Growth is rapid and in high light will be multistemmed from the base. Can grow up to 5 m in a season. Flowers in 4–5 years. Can probably live for at least 20 years.

3 **Seeding ability** Abundant **s**eeds produced, >10 000 per square metre. These can be dispersed immediately or overwinter on the vines. High germination rates in order of 80% but increases with chilling, nitrates, and low light. Seeds are hygroscoptic which buries them in the soil by twisting the awn.

3 **Dispersal and establishment** Long-distance dispersal by wind and water (plants often on river margins**).** Also a contaminant on river gravel and as attachments.

2 **Cloning** New plants are produced at the nodes every 15 cm from stems in contact with the ground.

3 **Recovery** Grows from any stem fragments in contact with the ground. Fragments can live for months if left hanging and later come in contact with moist ground. In large disturbed areas, will regenerate from seed.

3 **Competitive ability** Highly competitive with all associated vegetation. Climbs and shades out its supporting canopy so it becomes extremely dark underneath and prevents germination of other species (and its own seedlings).

18 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Forms dense thickets that are almost impossible for humans and stock to get through, especially when in vegetation 2–5 m tall.

3 **Suppression** A single plant can cover 180 square metres.

0 **Health impairment**

0 **Quality impairment**

3 **Damage to natural areas** Covers secondary vegetation and damaged forest. Prevents regeneration of native species. Smothers existing understorey shrubs, including threatened species. Particularly bad because occupies already threatened ecosystems on flood plains.

0 **Other** None

Opportunity

3 **Extent of suitable habitat** Very large areas of Northland are suitable. Chilling requirement may limit germination in Northland, but this needs testing.

2 **Resistance to management practices** Grubbing is not effective unless stems kept off the ground. Cutting and spraying stumps is effective. Can also be controlled by helicopter spraying. Greatest difficulty is finding isolated stems before they emerge above the canopy and seed. Old man's beard leaf miner (*Phytomyza vitalba*) is widely established in NZ, but it is not known if it is present in Northland.

15 **Esler's Index of Weediness**

Species

Pampas (*Cortaderia selloana*)

Family
Gramineae
Origin
South America
Weed
Widespread weed on several continents.
Uses
Grown as a stock food and for shelter.
Form
Large broadleaved tussock up to 4 m with tall conspicuous seed heads.
Ecology
Grows in a wide range of marginal habitats, regenerating scrub, forest margins, plantation edges, up to 600 m. Especially common on disturbed ground and open areas such as sand dunes.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions but is inclined to be intolerant of cold clay soils. Relatively more frost tolerant than *C. jubata.* Studies comparing *C. selloana* with *C. jubata,* a similar species, found that *C. selloana* is genetically more diverse and could be one of the reasons of its success (Lambrinos 2002).These results are consistent with the hypothesis that genetic variability enables better utilization of heterogeneous habitats as well as promoting greater competitive abilities. Very tolerant of maritime exposure.

3 **Maturation rate** Reproduces by seed and can do so in the first year. Seeds are primarily wind-dispersed and are capable of dispersal distances up to 20 miles. Is gynodioecius but behaves dioeciously in nature.

3 **Seeding ability** Female plants are capable of producing up to 100 000 seeds per flowerhead and seeds annually.

2 **Dispersal and establishment** Seeds spread up to 25 km by wind. Dispersed also by water, as a product contaminant, and by people for ornament and windbreaks.

0 **Cloning** None

3 **Recovery** Regrows after cutting, grazing, mowing, and burning.

3 **Competitive ability** Once beyond the seedling stage is a highly competitive plant in a range of open habitats.

16 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Forms dense thickets that are difficult to push through.

3 **Suppression** Suppresses all shorter vegetation growing with it. Competes for light and nutrients with forestry plantings.

1 **Health impairment** Causes cuts to workers.

1 **Quality impairment** Seeds blow into products and accumulate in buildings.

2 **Damage to natural areas** Potential to invade bush margins, regenerating scrub and native shrublands. Particularly damaging on low coastal communities where it outcompetes native species.

3 **Other** Severe fire hazard.

Opportunity

2 **Extent of suitable habitat** Very large areas of Northland are suitable, particularly light coastal areas and forestry blocks.

2 **Resistance to management practices** Excluded from pastures by grazing of seedlings but adults very difficult to control. Requires large quantities of herbicide but these are effective.

17 **Esler's Index of Weediness**

Lambrinos JG. 2002.The variable invasive success of *Cortaderia* species in a complex landscape. Ecology 83: 518–529.

Species
Ragwort (*Senecio jacobaea*)

Family
Asteraceae
Origin
Eurasia and North Africa.
Weed
Widespread weed on several continents.
Uses
None
Form
Annual, biennial, or perennial herb forming a prostrate rosette and erect flowering stems up to 1.2 m.
Ecology
Grows in a wide range of open sites, pasture, waste places, roadsides, marginal habitats, swamps.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Withstands frosts and moderate drought, but prefers wetter areas. Wide range of substrates tolerated, including poor drainage.

2 **Maturation rate** Seeds germinate in autumn producing rosettes up to 30 cm wide the following spring. Flowers are produced 1 or 2 years following germination depending on the size of the rosette. Seeds ripen very quickly, only about 2 weeks after pollination.

3 **Seeding ability** Produces extremely variable amount of seed, up to 50 000–150 000 seeds per plant with 80–90% viable. Dormancy is for at least 8–9 years.

2 **Dispersal and establishment** Seeds are wind dispersed although the majority fall within a few metres of the adult. Also spread is by water, animals, contaminant of farm machinery etc.

1 **Cloning** Can recover from fragments of root when cut but not strictly clones.

3 **Recovery** Grows from damaged plant which persists as vegetative state. Very resistant to manual weed control and ineffective herbicides. Recovered damaged plants can persist for years.

2 **Competitive ability** Not a highly competitive plant in a farming sense, because can be suppressed in the seedling stage by good pasture growth. But grazed only by sheep, so in cattle paddocks it comes to dominance. However, can compete with grasses in poor pasture, particularly in autumn, and once occupies the site can persist.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Forms dense stands that are difficult for sheep to push through.

2 **Suppression** Suppresses pasture growth considerably, more or less in proportion to the area occupied. An economic pest overseas.

3 **Health impairment** Accumulates alkaloids that are poisonous to stock.

2 **Quality impairment** Taints milk and honey.

1 **Damage to natural areas** Grows on forest margins but its main effect is probably the exclusion of native species on river berms.

0 **Other** None

Opportunity

2 **Extent of suitable habitat** Large areas of Northland are probably suitable.

2 **Resistance to management practices** Can be excluded by good pasture management. Grubbing effective only if the whole root removed. Herbicides effective especially on young plants. Largely controlled now in NZ and Northland by the ragwort flea beetle (*Longitarsus jacobaeae*). Additional biocontrol agents are now available if needed.

14 **Esler's Index of Weediness**

Species
Rhamnus (*Rhamnus alaternus*)

Family
Asteraceae
Origin
Mediterranean region.
Weed
Widespread weed on several continents.
Uses
Formerly grown mainly as a hedge plant.
Form
Rhamnus is a dioecious tree that grows up to 10 m in height, but usually shorter in exposed sites.
Ecology
Grows in a wide range of open sites, waste places, roadsides, marginal habitats, coastal sites, hedges, also in wet areas. In NZ, it is a weed of coastal areas and especially exposed cliff faces on offshore islands.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Withstands frosts and moderate drought, more so than many native species. Wide range of substrates tolerated, including poor drainage, but grows best on very well drained soils. Able to establish under light shade or in full sun.

2 **Maturation rate** Reaches reproductive age in 2-3 years. Flowers during early winter and early spring and produces fruits that ripen in late spring and early summer. Female plants can produce fruit every other year. Germination of seeds was unaffected when seeds were exposed to temperatures as low as 5°C on the island of Mallorca, which is within its native range.

2 **Seeding ability** Produces large amounts of seed.

2 **Dispersal and establishment** Seeds are dispersed by birds. Starlings are particularly important because they feed on the mainland and roost on offshore islands. Also spread by possums and humans for cultivation.

0 **Cloning** Can recover from cutting, but not strictly cloning.

2 **Recovery** Regrows from damaged plants.

2 **Competitive ability** Highly competitive only in open sites although it is quite shade tolerant.

12 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Forms dense stands that are difficult for sheep to push through.

2 **Suppression** Suppresses smaller native species.

0 **Health impairment**

0 **Quality impairment**

3 **Damage to natural areas** Because its growth rate is faster, and the patches are denser, than most native shrub and tree species, rhamnus quickly dominates and extends islands of young vegetation, outcompeting subcanopy species in forest, particularly lighter drier forest on stony soils. Able to suppress many kinds of shrubby native vegetation. Impacts on pōhutukawa regeneration.

0 **Other**

Opportunity

3 **Extent of suitable habitat** Large areas of Northland are probably suitable, especially coastal areas and offshore islands.

2 **Resistance to management practices** Can be treated by the usual combination of cutting and poisoning. Dense seedlings can be sprayed.

11 **Esler's Index of Weediness**

Species

Skeleton weed (*Chondrilla juncea*)

Family
Asteraceae
Origin
Eurasia and Mediterranean region.
Weed
Widespread weed on several continents.
Uses
None
Form
Perennial herb with rosette base and upstanding seed heads to 120 cm height.
Ecology
Grows in a wide range of open sites in Australia but in NZ is confined to the Auckland Region.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Wide range of climates and soils in Australia centred on Mediterranean climates. Requires high summer temperatures to flower. Genetically variable in Australia but NZ populations limited anyway.

3 **Maturation rate** Rapid growth to maturity, from germination in autumn to flowering the next spring.

3 **Seeding ability** Produces large amounts of seed, up to 1500 per plant, to 70 000 per square metre. Germinates immediately, with high viability. Rapid loss of viability over a few months. No persistent seed bank.

3 **Dispersal and establishment** Wind dispersed long distances and also by contamination. Root fragments can be dispersed by machinery.

3 **Cloning** Regenerates from subsurface and surface roots.

3 **Recovery** Regrows from damaged plants

1 **Competitive ability** Highly successful only in open sites and cannot compete with cover of crops.

18 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Makes grain harvesting difficult because it clogs machinery**.**

1 **Suppression** Not usually severe in crops.

0 **Health impairment**

3 **Quality impairment** Contaminant of grain and seed crops.

1 **Damage to natural areas** In open situations in Australia, impacts on native species but NZ situation unknown. If it established in a wide range of open sites it may compete with small native plants.

0 **Other** None

Opportunity

2 **Extent of suitable habitat** Large areas of lowland Northland are probably suitable, especially dry waste places, open places in orchards etc. Open coastal areas and offshore islands are vulnerable.

2 **Resistance to management practices** Difficult to manage where not heavily cultivated or grazed. Some difficulties with herbicides.

12 **Esler's Index of Weediness**

Species

Tree privet (*Ligustrum lucidum*)

Family
Oleaceae
Origin
China
Weed
Widespread weed on several continents and in the Pacific.
Uses
Formerly grown as a hedge, or specimen tree.
Form
Broadleaved tree to 10 m. Evergreen except in coldest areas.
Ecology
Grows in regenerating scrub, forest margins, plantation edges, coastal cliffs.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions but is inclined to be intolerant of very light soils and calcareous soils. Prefers soils of medium acidity and drainage. Tolerant of frosts. Young plants are quite frost tolerant. More shade tolerant than Chinese privet.

2 **Maturation rate** Takes several years before first fruits.

3 **Seeding ability** Very abundant small dark seeds produced in NZ. Some suggestion of a seed bank. Germination has been reported as from 7% to 28%.

2 **Dispersal and establishment** Seeds spread by birds, primarily exotic species (blackbirds, mynahs, and starlings) and silvereyes in Northland. Also spread by dumping and soil movement.

0 **Cloning** None

1 **Recovery** Regrows after cutting.

2 **Competitive ability** Once beyond the seedling stage is a highly competitive plant in a range of open habitats and also in understorey situations. Forms a tall dense canopy if not in great competition from taller native species. High density of adults results from high density of seedling establishment.

12 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Forms dense thickets but no worse than other shrubby vegetation.

2 **Suppression** Suppresses all shorter- growing native species.

3 **Health impairment** There has been debate about how and why privet is reputed to cause allergies in humans. There is evidence that a sharp reaction to the perfume of the flowers causes a great discomfort, but more recently it has been shown that the pollen is the likely cause of the problems.

0 **Quality impairment**

2 **Damage to natural areas** Potential to invade bush margins, regenerating scrub and native shrublands. Most abundant in highly disturbed areas and on alluvial soil. Has the potential to pre-empt sites and occupy them for a long time (maybe >100 years).

0 **Other**

Opportunity

2 **Extent of suitable habitat** Potentially large areas of land available in marginal habitats in Northland.

2 **Resistance to management practices** Can be cut and susceptible to a range of herbicides. Can resprout if cut and also regrow from the seed bank. In Australia, seeds were found to last only a short time, but this seems to conflict with the NZ study where tree privet seeds lived for 2.5 years.

13 **Esler's Index of Weediness**

Species

White-edged nightshade (*Solanum marginatum*)

Family
Solanaceae
Origin
South America
Weed
Widespread weed on several continents.
Uses
None
Form
Much branched perennial shrub to small tree with prickles up to 1.5 cm long and hairs on stems and leaves.
Ecology
Grows in a wide range of marginal habitats and waste land over a wide altitude and rainfall range.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions but prefers coastal areas of lighter soil.
2 **Maturation rate** Can produce fruit in its second year.
2 **Seeding ability** Seeds produced in fleshy fruit.
2 **Dispersal and establishment** Fruit does not appear to be favoured by either birds or animals and dispersal by seed is probably rather limited. The fruit tend to be round and they can also be dispersed in water. Seedlings are light demanding.
0 **Cloning** None
1 **Recovery** Minimal recovery from damage and no great resurgence from seed banks.
1 **Competitive ability** Not a highly competitive plant in a farming sense, but shades out small native species in places such as sand dunes.

10 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Forms dense prickly thickets in pastures.
2 **Suppression** Threats to pasture on marginal land.
1 **Health impairment** Very sharp spines on leaves and stems.
0 **Quality impairment**
2 **Damage to natural areas** Potential to invade bush margins, sand dunes, open areas.
0 **Other**

Opportunity

3 **Extent of suitable habitat** Large areas of Northland are suitable.
2 **Resistance to management practices** Grubbing or spraying are effective. Hairy leaves means paying special attention to herbicide mixture.

13 **Esler's Index of Weediness**

Species

Woolly nightshade (*Solanum mauritianum*)

Family
Solanaceae
Origin
South America
Weed
Widespread weed on several continents.
Uses
Sometimes grown as an ornamental.
Form
Small, open branched shrub or tree up to 10 m, with large pale leaves that make it very conspicuous.
Ecology
Grows in a wide range of marginal habitats, regenerating scrub, forest margins, plantation edges in the lowlands.

Ratings
Biological Success and Environmental Impact (0–3)

1 **Versatility** Tolerates a range of soil conditions.
3 **Maturation rate** Produces fruit a few months after germination and can live for up to 20 years.
3 **Seeding ability** Abundant seeds produced in fleshy fruit, >20 000 per plant in South Africa. Most have a field half-life of about 12 months in South Africa, but secondary dormancy can be induced in the field and seeds can then last for several years in the seed bank.
2 **Dispersal and establishment** Fruit eaten by a wide variety of birds. Seedlings are relatively shade tolerant.
0 **Cloning** None
2 **Recovery** Grows from stumps and recovers from seed bank.
2 **Competitive ability** Not a highly competitive plant in a farming sense, but can dominate early successional vegetation. Grows more rapidly than many native species in early-successional situations.

13 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

1 **Obstruction** Forms dense thickets initially that are difficult to push through but as it ages, becomes more open and is not difficult to push through.
2 **Suppression** Threatens regenerating scrub by initially suppressing the native woody species.
2 **Health impairment** Possibly poisonous to stock and causes nausea and skin irritation in people.
1 **Quality impairment** The pale leaves, in marked contrast to native vegetation, are very conspicuous and unattractive to some.
2 **Damage to natural areas** Potential to invade bush margins, regenerating scrub and native shrublands where it outcompetes native species such as māhoe. However, in time it is likely to be overtaken by further native species.
0 **Other** None

Opportunity

2 **Extent of suitable habitat** Very large areas of Northland are suitable.
2 **Resistance to management practices** Grubbing or spraying is effective. Not a management problem on good farmland. More difficult to control when in dense scrub such as gorse scrub. Biocontrol agents are likely to be introduced in the near future.

12 **Esler's Index of Weediness**

Species

Yellow ginger (*Hedychium flavescens*)

Family
Zingiberaceae
Origin
India
Weed
Widespread weed in the tropical Pacific, Australia, North America. Widespread in Northern New Zealand.
Uses
An ornamental plant.
Form
A large tufted, rhizomatous perennial to 2 m tall with dense, large green leaves and conspicuous flowerheads over a massive layer of rhizomes.
Ecology
Widespread on a range of sites especially damp soil.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates a range of soil conditions and tolerant of drought. Established plants are drought resistant.
3 **Maturation rate** Grows rapidly from rhizomes. Aerial stems are annual.
0 **Seeding ability**
1 **Dispersal and establishment** Rhizomes spread by dumping and water, also by machinery.
3 **Cloning** Naturally it spreads from the rhizomes, which are up to 1 m deep. Young plants arise from offshoots and from pieces of detached rhizomes.
3 **Recovery** Recovers rapidly from damage and from fire. Can root from excavated pieces of rhizome.
3 **Competitive ability** Aggressive plant forming dense clumps excluding most other plants.

15 **Biological Success and Environmental Impact Rating**

Weed status assessment (0–3)

3 **Obstruction** Forms thickets to the exclusion of all else, including light machinery. Blocks drains and obstructs tracks.
3 **Suppression** Threats to established light forest and all lower-growing plants and seedling establishment of all other species.
0 **Health impairment**
0 **Quality impairment**
1 **Damage to natural areas** Damage to native forest and regenerating scrub less widespread because it is not spread by birds.
0 **Other None**

Opportunity

2 **Extent of suitable habitat** Large areas of Northland are vulnerable, especially open situations of all kinds.
3 **Resistance to management practices** Resprouts from damaged plants which limits manual control other than in very small areas. Can be effectively controlled by chemicals applied to the cut rhizomes.

12 **Esler's Index of Weediness**

4.2 Aquatic plants

Species

Alligator weed (*Alternanthera philoxeroides*)

Family
Amaranthaceae
Origin
Native of S. America.
Weed
Weedy in California, SE USA, Puerto Rico, Burma, Thailand, Indonesia, India, Australia (since 1946), China and NZ. Accidentally introduced to NZ in ships ballast.
Uses
Utilised as a food plant by some ethnic groups (Sri Lankan and Somalian). Also rarely cultivated as an aquarium/pond plant. Unwanted organism in NZ.
Form
Perennial aquatic herb with floating stolons to 10 m forming rafts or growing on banks. Stems hollow, prostrate (stolons), decumbent or ascending to 1.5 m. In pasture has closely matted stems and roots, thickened nodes, taproot to 0.5 m.
Ecology
Invasive in nutrient-rich water bodies and wetlands; troublesome in drainage ditches. Tolerant of salinity. Also a terrestrial weed invading pasture, cropping land and urban areas. Abundant in the Kaipara, where it was first recorded in 1906. Locally abundant elsewhere in Northland, but absent from some areas. Also widespread on west coast of Auckland, scattered elsewhere, also local in Waikato, Bay of Plenty and Manawatu-Wanganui regions. A few cultivated sites in Canterbury and Westland.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerates frost, some salinity, non-aquatic soil. Wide substrate range.
3 **Maturation rate** Rapid, no seedling stage.
0 **Seeding ability** Produces flowers, but seeds not viable.
2 **Dispersal and establishment** Water, machinery, animals and birds.
3 **Cloning** Produces two buds in all leaf axils to form mats up to 60 cm deep (able to bear a man's weight). Fragmented and dispersed by cultivation, clearing machinery.
3 **Recovery** Submerged buds revive on surfacing. Disturbance promotes reproduction. Drying, stranded plants revive. Regrows in spring after frosted back to ground level.
3 **Competitive ability** Creeping, floating mats shade out other plants. Biomass doubles in 50 days (Florida).

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Floating mats cover water bodies restricting their use, reducing stock access to water, and reducing water flow, which leads to sedimentation and flooding.
3 **Suppression** Competes with water plants and wetland plants successfully except water hyacinth. Smothers riparian crops and pasture in infestations far from streams.
3 **Health impairment** Associated with photosensitivity, liver damage, skin lesions and death in cattle and lambs. Provides favourable breeding conditions for mosquitoes and other insects. Complete cover of drains and other small water bodies presents drowning risk to stock and humans. Promotes water-borne diseases.
2 **Quality impairment** Causes water stagnation and contaminates pasture and various crops.
3 **Damage to natural areas** Replaces water and riparian vegetation, restricts birds, affects aquatic life. Has completely overtopped wetland vegetation on Waikato Heads.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Could grow in most lowland areas of Auckland Region.
3 **Resistance to management practices** Hard to control using herbicides (several registered for terrestrial use) and cultivation on farmland due to extensive root system. Herbicidal control in waterways and swamps either requires herbicides not registered for aquatic use (requiring a resource consent) or limited control with herbicides currently registered for aquatic use. Fresh summer growth readily grazed by cattle but this stimulates growth of otherwise dormant buds of the weed in pasture.

Biological control with flea beetle *Agasicles hygrophila* and moth *Arcola malloi* occasionally effective in aquatic habitats in warm climates, but swampy and terrestrial habitats are not suitable for their survival. Additional biocontrol agents may be released in the future.

20 Esler's Index of Weediness

Species

Bladderwort (*Utricularia gibba*)

Family
Lentibulariaceae
Origin
Native of the Americas, Africa, Southern Europe, Southern Asia and Australia.
Weed
Weedy in NZ and reported as naturalised in the UK. A common weed of the aquarium trade.
Uses
Utilised as an aquarium/pond plant. Unwanted organism in NZ.
Form
Submerged perennial without roots. It has slender stems that may be floating, submerged or creeping along the substrate or smothering other submerged vegetation. The stem leaves are threadlike either undivided or divided into two at the base. The bladders or 'traps' are 1- or 2-valve-lidded and borne on the leaves.
Ecology
Forms dense floating mats in small dams but also smothers shallow water vegetation in dune lakes growing to around 3 m depth. Widespread, but still spreading throughout Northland, also in South Rodney and Waitakere with a few Waikato sites.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Seems to prefer shallow still water, senescent over winter.
3 **Maturation rate** Flowers in summer to early winter. Fragments grow rapidly in spring.
2 **Seeding ability** Northern populations appear to set viable seed.
3 **Dispersal and establishment** Vegetative fragments spread by stream flow, accidental human introduction, boats, trailers, eel nets. Seed appears to be dispersed by waterfowl, with some sites very isolated from human activities.
3 **Cloning** Stems spread by fragmentation.
2 **Recovery** Produces turions (winter buds) that can re-establish when conditions are favourable.
2 **Competitive ability** Long-term impacts on the species it smothers need further research.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Extremely dense growth below water surface seriously retards water flow, interfering with irrigation projects and other activities requiring pumps. Also interferes with recreational activities such as boating, swimming, fishing.
3 **Suppression** Appears to smother a range of submerged plants including lagarosiphon in Lake Ngatu.
0 **Health impairment**
1 **Quality impairment** Stranded plant material reduces aesthetic appeal.
3 **Damage to natural areas** Requires further investigation, but a decline in the endangered *Utricularia australis* has been noted in the lakes invaded by this species.
0 **Other**

Opportunity

3 **Extent of suitable habitats** It has potential to spread throughout Northland.
2 **Resistance to management practices** Unknown.

14 **Esler's Index of Weediness**

Species

Californian bulrush (*Schoenoplectus californicus*)

Family
Cyperaceae
Origin
Native of North, Central and South America..
Weed
Possibly naturalised in Pacific (Hawaii, Cook Is., Easter Is.), naturalised in New Zealand and Australia (NSW) and an unwanted organism in NZ.
Uses
Rhizomes and pollen used as foodstuffs, culms used for thatching and weaving. Planted for erosion control, wetland restoration and wildlife habitat. Was used in NZ for constructed wetlands to treat effluent.
Form
Tall, perennial emergent sedge up to 2–3 m with long rhizomes and stout rootstocks. Stems are triangular and leafless each with drooping flower heads.
Ecology
Dense, tall vegetation on riverbanks especially in estuarine areas. Probably introduced to the Northern Wairoa River in ballast, but not collected until 1990s. It is now abundant in the vicinity of Dargaville on the Northern Wairoa River and the Lower Waikato River Delta.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Prefers tidal salt-influenced waters.
2 **Maturation rate** Clonal spread with no evidence of seed germination in the field.
2 **Seeding ability** Viable seed is set, but seedlings have not been recorded in the field.
2 **Dispersal and establishment** Rhizome fragments eroded from clumps and spread by water movement. Possibly also spread by machinery and deliberate spread as a constructed wetland plant.
3 **Cloning** Rhizome extension forms dense monocultures.
2 **Recovery** Tolerates moderate exposure/wave action. Not normally exposed to grazing animals, herbicide tolerance unknown.
2 **Competitive ability** It is apparently displaced by Manchurian wild rice, but may displace indigenous sedges such as *Schoenoplectus tabernaemontani, S. pungens* and *Bolboschoenus fluviatilis*, but not adult mangroves (*Avicennia marina*).

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Can blocks drains and encourage siltation.
2 **Suppression** Overtops and suppresses some other marginal species.
0 **Health impairment**
1 **Quality impairment** Apparently spreading into the margins of the North Wairoa River and stabilising sand bars on the Waikato River.
2 **Damage to natural areas** Invasive in tidal estuarine areas.
0 **Other**

Opportunity

1 **Extent of suitable habitat** Appears to be restricted to estuarine areas.
2 **Resistance to management practices** Unknown.

11 **Esler's Index of Weediness**

Spcies

Eel grass (*Vallisneria gigantea* and *V. spiralis*)

Family
Hydrocharitaceae
Origin
Native of Europe, Africa, North America, Asia and Australia.
Weed
Weedy in 23 countries including NZ.
Uses
V. spiralis was utilised as an aquarium/pond plant, but is now an Unwanted organism in NZ. *V. gigantea* is a Notifiable organism, but does not appear to have been distributed in the ornamental plant trade in NZ.
Form
Attached, submerged, stoloniferous, dioecious perennial up to 5.5 m tall with strap-like leaves arising from stout rhizomes and can colonise lake-bed sediments to a depth of 9 m. The taxonomy of this genus has not been satisfactorily resolved and it appears that two species are naturalised in NZ.
Ecology
Lakes, streams and rivers. Colonises sandy to silty sediments and in some situations anchors to bare rock. Maximum growth at 25˚C. *V. spiralis* was first recorded in 1982 from Meola Creek, Auckland and is rarely naturalised from Northland (near Katikati) to Wellington and Masterton in the North Island, and in the Opawa River in Blenheim in the South Island. *V. gigantea* is only known from Lake Pupuke and the adjacent quarry in Auckland, being first recorded there in 1897.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Lot of variation in these species. Occurs in flowing and standing waters. Overwinters in temperatures down to about 5˚C. Grows in wide variety of habitats and temperatures and thrives in low levels of salinity.
3 **Maturation rate** Flowers in summer when it undergoes rapid growth.
0 **Seeding ability** No seeds produced in NZ although both sexes occur here.
1 **Dispersal and establishment** Vegetative spread by intentional plantings. Unlike other members of family fragmentation is not a major method of spread and the restricted distribution of this species compared to the oxygen weeds reflects this.
3 **Cloning** Very rapid stolon extension which produce new shoots and roots at intervals.
3 **Recovery** Rapid regeneration after cutting. In Australia, regrew to original length in 4 weeks after leaves were cut at base.
2 **Competitive ability** Completely dominates the stream vegetation at many sites but egeria is apparently displacing this species in some sites at Meola Creek and Lake Pupuke, with eel grass restricted to fast-flowing sites and rocky substrates respectively.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Obstructive to water flow. Forms dense stands in still water reducing uses for recreation.
2 **Suppression** Suppresses some species but probably only competitive with other Hydrocharitaceae when on rocky substrates, or in fast-flowing waters.
1 **Health impairment** Drownings reported in Lake Pupuke and adjacent quarry due to tangling in this species.
2 **Quality impairment** Piles of severed leaves decomposing on shores of Lake Pupuke are aesthetically unpleasant. Surface-reaching leaves disrupt recreational water activities.
3 **Damage to natural areas** Some displacement of other species. Could completely alter many aquatic communities.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Tolerant of fast-flowing and still waters and could therefore colonise much of Northland.
3 **Resistance to management practices** Mechanical removal and covering with weed mat has been used for control. Cutting checks weed growth for 3–4 months. No consistent herbicide control has been achieved in NZ field sites.

17 **Esler's Index of Weediness**

Species

Egeria (*Egeria densa*)

Family
Hydrocharitaceae
Origin
Native of eastern South America (Argentina, Brazil, Uruguay).
Weed
Weedy in Hawaii, South Africa, Borneo, Japan, USA, England, Australia, NZ, most probably as a result of the aquarium trade.
Uses
Utilised as an aquarium/pond plant. Unwanted organism in NZ.
Form
Submerged, much branched, slightly stoloniferous perennial freshwater aquatic herb with whorled leaves on stems to 6 m long, usually firmly rooted in bottom mud.
Ecology
Thrives in turbid and enriched waters of mild to warm freshwater ponds, lakes, reservoirs and slowly flowing streams of warm-temperate to tropical regions, in which the plant occurs at all depths to 7 m. Optimum temperature for growth is 25°C. First record of naturalised plant in NZ in 1946 in lower Waikato River, where it is still abundant. Scattered and still spreading throughout much of the North Island, including Northland. Well established in Marlborough with several sites in Canterbury and one Westland site.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerates wide range of nutrient levels, but very susceptible to iron deficiency. Has a very low light requirement and is cold tolerant, thriving in lakes with water temperatures close to freezing. Can persist in intermittently flowing streams or those subject to flooding.

3 **Maturation rate** Flowers in summer and early autumn. Stems break into segments in autumn and small buds on these segments produce new plants the following spring. Root crowns survive for several growing seasons and are primary overwintering structure. Maximum growth occurs during early summer and autumn as growth stops at water temperatures <6°C and >30°C.

0 **Seeding ability** No seeds produced as female plants do not occur in NZ, USA, or Australia.

2 **Dispersal and establishment** Vegetative fragments spread by stream flow, accidental human introduction, boats, trailers, eel nets.

3 **Cloning** Specialised nodal regions called double nodes are located every 6–12 nodes along shoot and it is only these regions that produce lateral buds, branches, and adventitious roots. Stem fragments containing a double node region need only be 7.5 mm long to produce new growth.

3 **Recovery** Regrows after cutting. Totally recovers from diquat treatment 9 months after application (Opawa, Blenheim) with much quicker recovery in northern NI.

3 **Competitive ability** Earlier considered to not be as competitive as lagarosiphon but in Lake Rotorua it has almost displaced lagarosiphon. It seems to be dominant over lagarosiphon in eutrophic water bodies. Co-exists with lagarosiphon and *Ceratophyllum* in flowing areas of Waikato River.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Extremely dense growth below water surface seriously retards water flow, interfering with irrigation projects, hydroelectric output and urban water supplies. Also restricts water traffic and interferes with recreational activities such as boating, swimming, fishing. Blocks penstocks in hydroelectric power stations.

3 **Suppression** Very effective up to depths of 8 m because of mass monocultures.

1 **Health impairment** Presents a drowning risk caused by entanglement.

2 **Quality impairment** Surface-reaching beds reduce aesthetic appeal and recreational water use.

3 **Damage to natural areas** Disrupts predator-prey relationships, increases sedimentation rates and causes fluctuations in chemical and physical parameters of a water body. Replaces native communities. Implicated in the collapse of shallow lake vegetation in Northland and Waikato, resulting in toxic cyanobacterial blooms.

0 **Other**

Opportunity

3 **Extent of suitable habitats** It has potential to spread throughout Northland, particularly in nutrient-enriched waters.

3 **Resistance to management practices** Hand pulling, cutting and digging with machines provide only temporary control and are costly and results in dispersal of fragments. Has been controlled by lowering lake water level. Fed on heavily by water birds. Susceptible to diquat (more than lagarosiphon and *Ceratophyllum)* but only gives 6–9 months' control. Chinese grass carp used effectively to eliminate egeria from one lake.

20 **Esler's Index of Weediness**

Species

Fringed waterlily (*Nymphoides peltata*)

Family
Menyanthaceae
Origin
Native of temperate Eurasia.
Weed
Weedy in USA, Canada, Denmark, Sweden, Netherlands, Ireland and NZ.
Uses
Utilised as an ornamental pond plant. Unwanted organism in NZ, thought to be eradicated.
Form
Aquatic bottom-rooted perennial with long branched stolons extending up to 1 m or more and lie just beneath the waters surface. The node on the stolons typically produces a plant and many thread-like roots. The floating heart-shaped to almost circular leaves with a V-shaped sinus are 3–10 cm long on long stalks, and they arise from creeping underwater rhizomes.
Ecology
Slow-moving rivers, lakes, reservoirs, ponds and swamps. It can also grow on damp mud. It grows in water from 0.5 to 3–4 m deep, where it dominates with a thick mat of floating leaves. Only known from a pond on Whangaparaoa Peninsula, Auckland (first record 1988) and some ornamental ponds in Waikato.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Two races occur in Europe, a west European sub-oceanic and a Siberian continental race. Seeds withstand drying for 2–5 years. Does not germinate under anaerobic conditions. Does not tolerate cold winters. Tolerates submersion and dewatering and grows on drying mud.

3 **Maturation rate** Overwinters by short-shoots that form new leaves and long-shoots in spring. Flowers last a single day. Seed capsules mature under water 1–2 months after flowering then burst open at base. Rapid growth from vegetative fragments.

3 **Seeding ability** Forms large areas with many flowers during a long period and produces large amounts of viable, floating-winged seeds 10–40 seeds/capsule and 3117 developed seeds/m2 has been recorded.

2 **Dispersal and establishment** Seeds float and are dispersed over water surface by water currents and water birds. Plant fragments spread by water movement and human activities.

3 **Cloning** Stoloniferous growth, spreading by fragmentation.

2 **Recovery** Possibly regrows after tops removed.

3 **Competitive ability** Likely to exclude *Nymphaea* spp. and cultivars.

19 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Freely branching stems form a tangled mass in water, obstructing boats and preventing fishing and swimming.

3 **Suppression** Blanket of plant material eliminates submerged plants and likely to outcompete other floating leaved species.

0 **Health impairment**

2 **Quality impairment** Spoils aesthetic qualities and restricts uses.

3 **Damage to natural areas** Would suppress submerged plants in littoral zone.

0 **Other**

Opportunity

3 **Extent of suitable habitats** Has potential to spread and colonise a wide range of habitats in Northland.

3 **Resistance to management practices** Some success with herbicides reported internationally. None tried in NZ. The only field site was controlled with weed mat lining, with the waterbody being destroyed and back-filled in 2002.

17 **Esler's Index of Weediness**

Species

Hydrilla (*Hydrilla verticillata*)

Family
Hydrocharitaceae
Origin
Native of Europe, Central Africa, India, SE Asia and Australia.
Weed
Weedy in many countries including USA, Fiji, Panama, South Africa (first recorded in 2006) and NZ. NZ plants probably introduced from Australia.
Uses
Utilised as an aquarium/pond plant in other countries, but never seen in the trade in NZ. Notifiable organism in NZ, targeted for eradication by MAF BNZ.
Form
Submerged, much branched, slightly stoloniferous perennial freshwater aquatic herb with whorled leaves on stems to 8 m long, usually firmly rooted in bottom mud. Produces perennating organs (tubers and turions).
Ecology
Prefers warm freshwater ponds, canals, and slow-moving streams subjected to occasional flooding. Grows from water's margin to 9 m depth but grows best towards surface as it prefers well-lit waters. First record of naturalised plant in NZ in 1963 in Hawke's Bay and restricted to four sites there.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Large genetic and morphological differences occur within the species due to its extremely wide and disjointed geographical range. Monoecious and dioecious strains also exist. Tolerant of cool and brackish waters and can grow in water to 12 m deep. Survives adverse conditions by forming tubers and turions which remain dormant for long periods. Turions and axillary buds are covered with tough scale leaves that enable stem fragments to tolerate considerable drying. Grows well under wide range of nutrient levels, over temperature range of 10°C to 35°C, and tolerates small amounts of salinity.

3 **Maturation rate** Vegetative growth occurs throughout year in tropical areas. In cooler, temperate areas overwinters as reproductive organs that rapidly grow in summer. Flowers in summer and autumn.

0 **Seeding ability** No seeds produced in NZ since only one sex of plant is present.

2 **Dispersal and establishment** Stems break at nodes by mechanical means and strong stream flow and fragments produce new colonies downstream. Spread can be very rapid - small colony in USA expanded to 5 ha in 12 months.

3 **Cloning** Four modes of vegetative reproduction: stolons, tubers, turions, fragmentation. Stem including only one node will readily grow into mature plant. Tuber production is analogous to seed with 605/m2 reported which survive up to 5 years. NZ hydrilla has tubers surviving up to 13 years, but produced in lower densities than in USA. Also short-lived turions > 1000/m2 reported in Florida.

3 **Recovery** Fragments regrow from a single node. Apical and subapical parts survive drying for 16 h at 30°C. Regrows 4-6 months after treatment with diquat. Dormant buds on tubers rapidly regrow after destruction of apical parts.

3 **Competitive ability** Dense canopy shades out other plants and produces allelopathic chemicals that result in pure stands of hydrilla. Competes successfully with other species during regrowth due to low light requirement. Has many growth adaptations that allow it to outcompete other plants. Limits light penetration by > 95% in first 30 cm of water column.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Restricts water movement interfering with hydroelectric output, urban water supplies, irrigation projects, river traffic, and recreational pursuits.

3 **Suppression** Forms a dense canopy with the ability to suppress other plants by shading and allelopathy up to depths of 12 m.

1 **Health impairment** Presents a drowning risk because it masks water bodies.

2 **Quality impairment** In Australia, usually grows as part of a balanced community and will improve water quality and fish production. In NZ displaces all native and introduced species. In USA, excessive growth of hydrilla resulted in 90% loss of revenue from sport fishing.

3 **Damage to natural areas** Replaces native plants important to aquatic ecosystems.

0 **Other**

Opportunity

3 **Extent of suitable habitats** Expected to grow in lakes, rivers and drains throughout NZ, including Northland. Has not spread outside Hawke's Bay region due to isolation of lakes.

3 **Resistance to management practices** In Florida $12 million spent on control between 1981 and 1985. Mechanical control slow and costly and provides only temporary relief and encourages spread. Biocontrol with grass carp shows potential with eradication achieved in one NZ lake 19 years after carp introduced. NZ plants resistant to diquat and fluridone herbicides (used in USA), but susceptible to endothall (registered for use in 2005).

18 **Esler's Index of Weediness**

Species

Manchurian wild rice (*Zizania latifolia*)

Family
Poaceae
Origin
Native of East Asia (China, Japan, Korea, Russia, NE India and Myanmar).
Weed
Introduced and cultivated in Malaysia, also reported from the UK. Weedy in NZ and an unwanted organism. Considered weedy and the one reported site eradicated in the USA due to the fungal pathogen associated with this species (*Ustilago esculenta*) that threatened indigenous *Zizania* species grown for wild rice production.
Uses
Leaves used locally as a vegetable and when older made into mats. Cultivated plants attacked by fungus *U. esculenta* which hinders stem elongation and flowering and causes a thickening of the stem. Infected plants are cooked and eaten like asparagus. Provides shelter for stock during winter. Stock will readily graze young growth of this plant, but soon becomes unpalatable and impenetrable when established.
Form
Very tall, coarse, aquatic, perennial grass up to 3–4 m with far-spreading rhizomes.
Ecology
Dense, tall vegetation on riverbanks and floodplains, lake margins, lagoons, tidal flats, ditches, damp pasture and cropping land. Introduced to Dargaville from Asia probably in ballast, being first recorded as naturalised in 1906. It now occupies 338 ha along 55 km of the Northern Wairoa River, its tributaries and associated drainage systems, with 16 outlier populations in western Northland (Joynt & Newby 1998). Additional sites are found in other parts of Northland (Kauri and Whangarei), Auckland (Lakes Kereta and Karaka on the South Head of the Kaipara, Helensville, Laigholm and Mangere), Waikato (Waihou, Piako and Awaiti Rivers on the Hauraki Plains, Horohoro near Lake Karapiro and Lake Te Kouti, Cambridge) and Wellington (Waikanae).

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Can grow in both fresh and salt water.

3 **Maturation rate** Flowers Nov–Dec. Seeds germinate quickly. Vegetative fragments regenerate rapidly and flowers in first year.

2 **Seeding ability** Irregular seeder with large amounts of seeds being produced in some seasons.

2 **Dispersal and establishment** Seeds by birds and water. Rhizome fragments by machinery (mainly), water and large floating mats which take root to form new infestations.

3 **Cloning** Produces rhizomes several metres long spreading rapidly where tidal flow is minimal.

3 **Recovery** Survives most herbicide treatment, burning and cutting back. Will not stand a lot of stock trampling.

3 **Competitive ability** Its dense growth displaces most other vegetation and unless heavily grazed this species can displace pasture species, forming a tall monoculture.

19 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Blocks drains and access to water, impedes water flow and increases chance of flooding.

3 **Suppression** Overtops and suppresses other marginal species and invades neighbouring pasture.

0 **Health impairment**

3 **Quality impairment** Causes good land to become waterlogged by intensifying the wetness, forming swampy areas. Destroys stopbanks (rhizomes penetrate into and through stopbanks, opening them up).

3 **Damage to natural areas** Extremely invasive in native vegetation and appears to reduce the diversity of vegetation it invades, displacing small-stature species (all other non-woody plants) and enveloping taller vegetation. Examples of endangered species threatened by Manchurian wild rice include the plants *Thelypteris confluens* and *Phylloglossum drummondii* and the fernbird (*Bowdleria punctata vealeae*). Reduced diversity of species due to invasion by Manchurian wild rice was noticed in riparian areas and also kahikatea (*Dacrycarpus dacrydioides*) dominated forest. It is likely that those species enveloped by dense growths of this grass would be unable to reproduce and sustain themselves under those conditions, and in the long-term, monocultures of Manchurian wild rice may result.

0 **Other**

Opportunity

3 **Extent of suitable habitat** Could occupy much land on upper reaches of harbours and on margins of water bodies. The potential range of this species in NZ would not be limited by temperature.

3 **Resistance to management practices** Notoriously difficult to control. Can be restricted on accessible land by regular mowing, crushing and/or burning. Haloxyfop and imazapyr herbicides are showing promise in the management of this species.

18 **Esler's Index of Weediness**

Joynt, P.; Newby, L. 1998. Kaipara District Manchurian rice grass management plan. Northland Regional Council, Dargaville.

Species

Marshwort (*Nymphoides geminata*)

Family
Menyanthaceae
Origin
Native of New South Wales and Victoria, Australia.
Weed
Only known as weed in NZ.
Uses
Utilised as an ornamental pond plant. Unwanted organism in NZ.
Form
Aquatic perennial with branched stolons up to 1 m long usually just below water surface and rounded, floating leaves with V-shaped sinus.
Ecology
Still water of swamps to fast-flowing freshwater streams. In NZ occurs in still water near lake margin in shelter of sedge, sometimes on mud by water's edge, and in small ponds. In Australia common up to high country at altitude of up to 1000 m. Has completely blocked several farm dams. Planted in Lake Okareka (Rotorua) in 1976 and had since spread rapidly (now eradicated). Also occurs between Rakaia and Te Pirita in Canterbury, near Nelson, Wairarapa, Waikato and Auckland.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** In Australia, found in still to strong flowing waters at depths from a few centimetres to 2.5 m. Tolerates fluctuating water levels. Grows on drying mud.
3 **Maturation rate** Flowers from Nov–Apr, and flowers last for only 1 day.
0 **Seeding ability** Seeds have not been reported from NZ. Ovaries appeared to decay before seed set took place in cultured and natural field populations.
1 **Dispersal and establishment** Apparently spread deliberately in NZ, and likely to establish very freely.
3 **Cloning** Stoloniferous growth, spreading by fragmentation. Even leaf fragments have the ability to form new plants.
3 **Recovery** When surface leaves damaged by herbicide, petioles detach from stolons that remain unaffected and new shoots and roots develop from detached petioles.
3 **Competitive ability** Spreads much faster than *Nymphaea alba* and overgrows other water lilies.

16 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** The floating tangle of stolons and leaves can form a complete cover over water bodies.
3 **Suppression** Floating blanket eliminates submerged plants.
0 **Health impairment**
2 **Quality impairment** Spoils aesthetic qualities and restricts water use.
3 **Damage to natural areas** Would suppress submerged species in littoral zone.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Has potential to spread within a given waterbody and to colonise a wide range of habitats throughout Northland.
3 **Resistance to management practices** No suitable herbicide has been found. All sites to date have been eliminated using black polythene or weed mat lining or hand removal.

17 **Esler's Index of Weediness**

Species

Monkey musk (*Mimulus guttatus*)

Family
Scrophulariaceae
Origin
Eurasia and North America.
Weed
Widely reported as a weed of damp places. Webb et al. (1988) describe it as 'widespread throughout', having first naturalised in 1878, but generally uncommon north of the volcanic plateau.
Uses
Not listed as offered for sale in Gaddum's (2000) plant finder. However, the complex as a whole attracts a great deal of scientific interest, because the diversity of pollination syndrome, mating system, and habitat preference found within this section makes it a uniquely amenable model system for studies in ecology, genetics, and evolutionary biology of natural populations. Widely grown overseas but much less so in NZ.
Form
Perennial herb up to 0.8 m tall.
Ecology
Wetland habitat, particularly running water and seepage. Spreads by wind and water mainly.

Ratings
Biological Success and Environmental Impact (0–3)

1 **Versatility** Specific habitat requirements for wet environments.
3 **Maturation rate** Flowers within a few months of establishment, and insect pollinated.
3 **Seeding ability** Produces abundant fine seeds (0.02 mg). High germination rate (33% after 9 days). Seeds remain floating for only a short time.
2 **Dispersal and establishment** Dispersed by water over hundreds of metres, wind, and can pass through animals gut. Carried in sediment down rivers.
1 **Cloning** Spreads vegetatively by high velocity floods and broken pieces can resprout.
3 **Recovery** Recovers readily from damage including partial burial.
3 **Competitive ability**

16 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Slows water movement through small streams.
2 **Suppression** Covers associated plants.
0 **Health impairment**
0 **Quality impairment**
3 **Damage to natural areas** Replaces native species along stream sides, especially in high fertility sites.
0 **Other**

Opportunity

3 **Extent of suitable habitat** There are over 100 specimens in the Lincoln Herbarium, but only one from Northland, dated 1973. Its absence from Northland is therefore not readily explicable. There seems to be very little that is particularly special about the site where it is growing and therefore the area of similar and suitable habitats in Northland would seem to be large.
2 **Resistance to management practices** Limitations to use of sprays because near water.

13 **Esler's Index of Weediness**

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Species

Nardoo (*Marsilea mutica*)

Family
Marsileaceae
Origin
Native of Australia and New Caledonia.
Weed
Naturalised in NZ and Victoria, South Australia and Tasmania. Recently naturalised in SE USA. Has shown weedy tendencies in some sites (two in Auckland Region) but not elsewhere (Waikato and Wellington).
Uses
Utilised as an ornamental pond plant and still legally available in NZ.
Form
Rhizomatous perennial with floating, four-lobed, clover-like fronds produced on flexuous stalks to 1 m long. Fronds to 10-cm diameter and usually glabrous.
Ecology
Grows in shallow, muddy-bottomed water bodies, tolerant of these drying up. First recorded in 1988 and has become established in three North Island farm ponds in Hunua (Franklin), Henderson (Waitakere) and Paraparaumu (Wellington) and some other places.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Grows submerged or as marginal species. Can form floating subsurface mats with floating and emergent leaves.
2 **Maturation rate** Rapidly extending rhizomes. No information on spore production and germination.
0 **Seeding ability** Unknown, possibly no spores produced.
1 **Dispersal and establishment** No spread from existing sites apart from deliberate spread.
3 **Cloning** Far extending rhizomes produce many plants on fragmentation.
2 **Recovery** Recovered from diquat spray at Hunua by covering the same area two seasons after application, but a combination of mechanical control and herbicide has now cleared this site.
1 **Competitive ability** Unknown, only seen in open dams and stream situations where it coexisted with *Paspalum distichum.*

12 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Obstructed water abstraction at Henderson and stock watering at Hunua. In other sites the plant does not form weedy growths.
1 **Suppression** No information, probably slight.
0 **Health impairment**
0 **Quality impairment**
1 **Damage to natural areas** Unknown, possibly minor.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Probably all of Northland in suitable habitats.
2 **Resistance to management practices** Difficult to control where weedy.

9 **Esler's Index of Weediness**

Species

Parrot's feather (*Myriophyllum aquaticum*)

Family
Haloragaceae
Origin
Native of South America.
Weed
Spread to many other countries through the aquarium trade including South Africa, several European countries including France and the UK, Japan, Java, USA, Australia and NZ.
Uses
Utilised as an aquarium/pond plant. Unwanted organism in NZ.
Form
Stout, glabrous perennial freshwater herb with whorled feathery leaves on stems to 2 m long which forms vigorous mats of tangled stems or carpets of short growth where water has receded.
Ecology
Freshwater ponds, dams, ditches and streams, principally in warm-temperate and subtropical regions, where it often extends onto and persists on adjacent saturated muds and gravels. Also grows submerged in fast flowing streams. Grows best in water containing high levels of nitrogen. Tolerates some shading from overhanging vegetation. First record of naturalised plant in NZ in 1929 in Palmerston North and widespread throughout the North Island, with a few sites in the South Island as far south as Orawia in Southland (2007 record).

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerates wide range of temperatures (8–30°C), growing most aggressively in tropical areas. Plants remain alive but dormant when water surface is frozen over. More tolerant to seawater than many other freshwater aquatics.

3 **Maturation rate** Stem fragments produce roots and new stems develop from buds. New plants grow vigorously during summer and less so during winter. Flowers through most of the year in warm coastal conditions.

0 **Seeding ability** Male flowers have not been found on any plants where it has naturalised, including NZ, and are scarce in its native habitat.

2 **Dispersal and establishment** Stem fragments break off by wave action, boats or mechanical harvesting and move readily in stream flow and regenerate wherever they settle on sediments. Long-distance spread by human activity, contamination of ditch diggers and other machinery.

3 **Cloning** Stem fragmentation. In laboratory, new plants produced from nodal stem pieces only 2 mm long.

3 **Recovery** Regrows quickly from submerged rooted bases of stems, and from survivors on moist mud when water level rises.

3 **Competitive ability** Dense mats usually exclude most other plants by shading during marginal spread.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Dense mats impede water movement, which increases chance of flooding and encourages siltation. Fragile stems readily break during storms, forming mats which can block hydroelectric intakes, irrigation pumps, and metering devices, as well as shallow streams, causing flooding. Limits recreational use of water.

3 **Suppression** Invades rice fields, reducing yield. Complete or partial coverage of waterways eliminates all other plant life.

1 **Health impairment** Drowning risk presented by masked water bodies.

0 **Quality impairment**

3 **Damage to natural areas** Reduces animal life in and around infested areas by chemically altering the aquatic environment and impeding movement of fish and birds.

0 **Other**

Opportunity

3 **Extent of suitable habitats** Lake margins and drainage systems throughout NZ, particularly in soils with high organic matter, restricted only by frost. High potential in shallow lakes and sluggish backwaters.

3 **Resistance to management practices** Hand pulling, subsurface cutting, and use of draglines give useful temporary control. Covering small dams with black plastic sheeting for several weeks has given

good control. Garlon 360 herbicide is registered for parrot's feather control and is effective in most situations.

16 Esler's Index of Weediness

Species

Pickerelweed (*Pontederia cordata*)

Family
Pontederiaceae
Origin
Native of North, Central and South America.
Weed
Reported as weed in its native range and also South Africa, Japan, Europe and Australia.
Uses
Utilised as an ornamental pond plant and has been cultivated in NZ for over 40 years.
Form
Aquatic perennial with short rhizomes, often growing in tight clumps. Linear submerged leaves and emergent leaves with a cordate leaf blade.
Ecology
Shallow water emergent species, not recorded as naturalised or a problem species in New Zealand.

Ratings
Biological Success and Environmental Impact (0–3)
2 **Versatility** Tolerates fluctuating water levels, intolerant of desiccation.
1 **Maturation rate** Relatively slow growing species (compared with other Pontederiaceae).
0 **Seeding ability** No evidence of seed set in NZ.
1 **Dispersal and establishment** Dispersal from deliberate planting, unlikely to be spread accidentally.
2 **Cloning** Short rhizomes produced, with plants forming clumps.
1 **Recovery** Intolerant of dewatering.
1 **Competitive ability** Not tested.

8 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)
1 **Obstruction** Minor impact expected.
1 **Suppression** Minor impact expected.
0 **Health impairment**
1 **Quality impairment** Minor impact expected.
1 **Damage to natural areas** Minor impact expected.
0 **Other**

Opportunity
2 **Extent of suitable habitats** Could establish in shallow lake margins throughout Northland.
2 **Resistance to management practices** Diquat and glyphosate apparently control this species.

8 **Esler's Index of Weediness**

Species

Senegal tea (*Gymnocoronis spilanthoides*)

Family
Asteraceae
Origin
Native of South and Central America from Mexico to Argentina.
Weed
Spread to other countries through the aquarium trade including India, Australia and NZ.
Uses
Utilised as an aquarium/pond plant, being sold in NZ as 'costata' a totally unrelated plant. Unwanted organism in NZ.
Form
Perennial aquatic herb with scrambling, floating stems which produce roots at nodes. Stems erect when flowering to 1.5 m tall.
Ecology
Tropics to warm-temperate zone in wet marshy soils often spreading out from still or flowing water margins to form a floating mat. First record of naturalised plant in NZ in 1991 in Clevedon, near Auckland. Scattered sites mostly in the Auckland Region, but throughout the North Island, with a few sites in Tasman and Canterbury.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerant of emersion and exposure. Extremely hardy.
3 **Maturation rate** Seedlings develop rapidly and vegetative fragments rapidly form new colonies. Has a growth rate of > 15 cm a week in fertile situations.
2 **Seeding ability** Seed production reported in Australia. Seeding observed in NZ, with few fertile seed produced per flower, but high viability. Seedlings observed in field sites.
2 **Dispersal and establishment** Water, machinery, deliberate plantings.
3 **Cloning** Fragments of stems rapidly establish.
2 **Recovery** Recovers from herbicide treatment 8 months after application.
2 **Competitive ability** Dominates shorter herbaceous vegetation and floating mat shades out submerged species.

17 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Floating mats impede water flow, navigation and recreation.
2 **Suppression** Does not appear to invade terrestrial sites.
0 **Health impairment**
2 **Quality impairment** Dense mats grossly alters flowing streams and wetland.
3 **Damage to natural areas** Could replace many native herbaceous wetland communities.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Throughout the Northland Region.
2 **Resistance to management practices** Mechanical removal results in stem fragmentation and the fragments are spread downstream. Trials with six herbicides indicate that metsulfuron or high rates of glyphosate may be successful combined with follow-up treatments to remove seedlings. Many sites eradicated, or nearly so.

15 **Esler's Index of Weediness**

Species

Spartina (*Spartina alterniflora*, *S. anglica* and *S.* ×*townsendii*)

Family

Poaceae

Origin

Native of eastern North America (*S. alterniflora*), the other species of hybrid origin from England between the introduced *S. alterniflora* and the native *S. maritima*.

Weed

Introduced to many other countries for estuarine reclamation. Weedy in many countries including the western seaboard of the USA, the Mediterranean, Australia and NZ.

Uses

Planted in many parts of the world, including NZ, to aid foreshore protection or stabilise marshes due to its ability to trap sediment and to assist reclamation of tidal flats. In many parts of NZ from the 1920s this was regarded as wasteland to be reclaimed for farming from "unsightly, useless, and dangerous mud". This practice is now discouraged because sedimentation leads to flooding, navigation problems, restriction of bird and flat fish habitat, and there is no possibility of adequate control by any means. It does not promote land reclamation without the use of barriers because of bank erosion. Cattle will graze this grass and its presence encourages localised nutrient inputs from these animals.

Form

Robust, erect, rhizomatous perennial grass up to 100 cm tall (*S.* ×*townsendii* up to 50 cm tall) with a massive root system, the anchor roots descending > 1 m, and the feeding roots and rhizomes forming a dense mat near the surface. Three closely related species occur in NZ, *S. anglica* and *S.* ×*townsendii* being of recent hybrid origin, *S. alterniflora* being one of their parents. *S. alterniflora* is more robust than the others, seldom flowers, and forms more open clumps.

Ecology

Mostly occur in saline wetlands, especially in estuaries at mid-tide. Prefers moderate saltwater concentration. Spartina grows best in deep, soft, fertile muds of sandy loam texture. In England *S.* ×*townsendii* colonises fine wet silt or clay; *S. alterniflora* wet silty clay; *S. anglica* clay, silt and sand. Freshwater ponds, dams, ditches and streams, principally in warm-temperate and subtropical regions, where it often extends onto and persists on adjacent saturated muds and gravels. First recorded in 1913. *S. alterniflora* occurs in Northland, Auckland, Coromandel, Bay of Plenty, Gisborne; *S. anglica* in Northland, Auckland, Hauraki Gulf, Tauranga, Gisborne, Wellington, Westhaven, Farewell Spit, Tasman Bay, Linkwater, Christchurch, Dunedin, Invercargill; *S.* ×*townsendii* in Helensville, Waitemata Harbour, Tauranga, Foxton, Invercargill (possibly only now found at Te Atatu).

Ratings

Biological Success and Environmental Impact (0–3)

2 **Versatility** Tolerates wide variation in salinity (similar to many native salt marsh species but lower than *Sarcocornia* and *Suaeda*) and temperature. Can tolerate continuous submergence for 7–14 days and considerable exposure. C4 plant - higher rate of photosynthesis above 10°C (most C4 plants have advantage over 30°C). Responds to environmental variation by plasticity of individual plants, with dwarf, non-flowering plants common in sub-optimum habitats. Does not succeed in turbulent water.

1 **Maturation rate** Rhizomes develop during winter, shoot production occurs in spring.

2 **Seeding ability** *S. anglica* reproduces readily by seed, *S.* ×*townsendii* sterile and *S. alterniflora* rarely flowers in NZ. A similar situation occurred on the western seaboard of the USA for 50 years after this species was introduced. After this period, established areas of this species started to flower and seed prolifically.

2 **Dispersal and establishment** Seed and vegetative pieces carried by seawater. Pieces transported by man to establish new colonies to assist salt marsh reclamation.

3 **Cloning** All species have rhizomes that undergo rapid clonal growth. *S. anglica* rate of radial clonal growth is > 30 cm/yr.

3 **Recovery** Recovers after tops killed with most herbicides or grazing. Vigorous regrowth after cutting.

3 **Competitive ability** Generally does not grow with other plants except mangroves. Lateral landward spread limited by competition with mangroves, weakened competitive ability on suboptimal sites, and grazing by cattle. Once established forms dense clumps that may expand area at a rate of 2% per annum. Outer invasive band is entirely vegetative.

16 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Impedes seaward drainage and can cause flooding, navigation problems and preclusion of wading birds and flat fish from feeding grounds. One plant covered area of 18 m^2 in 2 years.

3 **Suppression** Does not compete directly with higher plants apart from eel grass (*Zostera* spp.). Meets mangrove at its upper margin. However, this growth form completely alters the estuarine ecosystem, removing wading bird habitat and shellfish beds, and altering the hydro-dynamics of these important fish spawning and nursery areas.

0 **Health impairment**

2 **Quality impairment** Changes scenic and recreational value of foreshores.

3 **Damage to natural areas** Destroys habitats formerly occupied by a range of faunal species, noticeably restricting the range of wading birds and flat fish, and encouraging trampling and contamination by cattle which otherwise would not be there. Raising silt levels alters drainage on adjacent flats and leads to deterioration of their native plant cover. Interferes with the biological production cycle of estuaries.

0 **Other**

Opportunity

3 **Extent of suitable habitats** There are vast areas of gently sloping sheltered beaches throughout Northland that are liable to invasion.

3 **Resistance to management practices** Removal of plants by digging is costly and not effective. Chemical control requires high and costly application rates, with some success achieved using the grass-specific haloxyfop. Ergot fungus (*Claviceps purpurea*) infects inflorescence of *S. anglica* and prevents seed set. Natural dieback afflicts populations of *S. anglica* and *S. alterniflora* in England. Biological control is being successfully used overseas, but has not been considered for NZ.

17 **Esler's Index of Weediness**

Species

Water poppy (*Hydrocleys nymphoides*)

Family
Limnocharitaceae
Origin
Native of South America (Venezuela, Brazil).
Weed
Spread to other countries through the aquarium trade including England, USA, Japan, Fiji, Australia (introduced from NZ) and NZ.
Uses
Utilised as an ornamental pond plant. Unwanted organism in NZ.
Form
Stoloniferous perennial with tufts of thick, shining, floating leaves and a distinctive solitary yellow flower. Resembles *Nymphoides* but lacks the deep leaf sinus.
Ecology
Grows rapidly in warm, well-lit, nutrient-rich habitats. Aggressive coloniser of ponds, streams, farm dams, and lake margins where it can spread into water depths of 2 m. Grows best in tropical to subtropical regions but can also grow in warm temperate and cool-temperate regions. First recorded in 1914. Found in Lake Rotoehu and lagoons, ponds and dams in Northland (Kokopu near Whangarei), Auckland, Waikato, and Bay of Plenty.

Ratings
Biological Success and Environmental Impact (0–3)

3 **Versatility** Tolerates fast-flowing or still waters. Cold-sensitive and winter dieback occurs, but persists under ice in Waikato.
2 **Maturation rate** Flowers short-lived, lasting for 1 or 2 days, small plantlets produced at end of growing season that may float away and take root.
0 **Seeding ability** No seed found in glasshouse plants in NZ and suggested that seed is seldom, if ever, produced in NZ, apparently due to self-incompatibility. Similar situation reported in Australia.
1 **Dispersal and establishment** Solely vegetative. Plantlets produced along stolons detach and float to surface and eventually take root. Mostly by deliberate introduction at present.
3 **Cloning** Rapid vegetative spread by stolon fragments.
3 **Recovery** Regrows into juvenile-leaved form after severe cutting of foliage. Dense floating masses of tangled stolons and leaves can completely shade out submerged plants.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

3 **Obstruction** Has completely choked streams and several river cutoffs. Obstructs water use.
3 **Suppression** Surface blanket eliminates submerged plants.
0 **Health impairment**
2 **Quality impairment** Spoils water for aesthetic and recreational purposes.
3 **Damage to natural areas** Completely replaces native vegetation.
0 **Other**

Opportunity

3 **Extent of suitable habitats** Potential weed in warm nutrient-rich situations throughout Northland.
2 **Resistance to management practices** Adequate control with herbicides giving total eradication. Mechanical removal not adequate and likely to promote spread of plant.

16 **Esler's Index of Weediness**

Species

Yellow flag iris (*Iris pseudacorus*)

Family
Iridaceae
Origin
Native to Europe, Great Britain, North Africa and the Mediterranean region.
Weed
It has been introduced in temperate areas nearly worldwide and occurs throughout the USA. It is a weed in many countries.
Uses
Historically widely planted for ornamental use in wetlands.
Form
The plant, including flower stalk, is up to 1.5 m tall. The leaves are mostly basal and are folded and clasp. Perennial, and will remain green during winter where the weather is mild. It has stout rhizomes 1–4 cm in diameter and roots to 30 cm long. The fruits are a large capsule to 8 cm long. It is 3-angled, glossy green and contains many flattened brown seeds. The seeds are corky and about 7 mm across. The plants spread rhizomatously and grow tightly bunched together. When flowering, is unmistakable with its showy yellow flowers colorfully displayed along the edge of water and in wetlands. Several flowers can occur on each stem, along with one or two leafy bracts. Each flower resembles a common garden iris with three large (3–8 cm) downward-facing yellow sepals and three smaller upward pointing petals.
Ecology
Grows in temperate wetlands (to 68° N in Scandinavia in wetlands and along the margins of lakes and slow-moving rivers. It will grow in water to 0.25 m deep, though is most common in very shallow water or mud. Dense mats supported by thick floating rhizomes can extend over much deeper water in sheltered embayments. Seeds are windblown a short distance although they are mostly carried by water. Vegetative parts are spread by floods.

Ratings
Biological Success and Environmental Impact (0–3)

2 **Versatility** Will tolerate drying and anoxic sediment and is also tolerant of at least some salinity, as it is found in brackish marshes in its native range. Also tolerant of high soil acidity, occurring from pH 3.6 to 7.7. Does well in nutrient-rich conditions, and has a high nitrogen requirement. Prefers part shade or full sun. Grows in places that are only seasonally wet.

2 **Maturation rate** Produces seeds in the first summer after establishment, 20–30 per pod.

2 **Seeding ability** Seed germination is not light dependent, needs temperatures above 15°C and is most successful at temperatures of 20° to 30° C. Germination is increased by scarification. Submersed seeds will not germinate.

2 **Dispersal and establishment** Spreads by rhizomes and seeds. Up to several hundred flowering plants may be connected rhizomatously. Rhizome fragments can form new plants if they break off and drift to suitable habitat.

3 **Cloning** Spreads by rhizomes.

3 **Recovery** Recovers readily from damage, including browsing and mowing.

3 **Competitive ability** Highly competitive species in wet habitats.

15 **Biological Success and Environmental Impact rating**

Weed status assessment (0–3)

2 **Obstruction** Generally obstructive only in situations where it has become more bulky than the species it replaces.

2 **Suppression** Suppresses many other smaller wetland species.

2 **Health impairment** Will sicken livestock if ingested, and is generally avoided by herbivores. Contact with the resins can cause skin irritation in humans.

0 **Quality impairment**

2 **Damage to natural areas** Primarily a plant of modified and agricultural landscapes but has great potential to modify natural wetlands.

0 **Other**

Opportunity

3 **Extent of suitable habitat** Large areas of wetland throughout Northland are vulnerable to this plant.

2 **Resistance to management practices** It cannot be controlled by physical means and needs spraying, but this is effective.

13 Esler's Index of Weediness

http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Iris_pseudacorus.pdf

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Appendix 1 Existing weeds in the Northland Regional Pest Management Strategy

Common name	Botanical name	DOC weediness score(C. Howell Sept. 06)	No. weed lists overseas (Randall 2002)
Terrestrial plants			
African feather grass	*Pennisetum macrourum*	31	>10
Bathhurst bur	*Xanthium spinosum*	n/a	>10
Broom	*Cytisus scoparius*	25	>10
Californian thistle	*Cirsium arvense*	18	>10
Gorse	*Ulex europaeus*	28	>10
Houttuynia	*Houttuynia chordata*	n/a	>10
Lantana	*Lantana camara*	28	>10
Moth plant	*Araujia sericifera*	31	>10
Nassella tussock	*Nassella trichotoma*	27	>10
Needle grass	*Austrostipa rudis*	n/a	?
Nodding thistle	*Carduus nutans*	20	>10
Old man's beard	*Clematis vitalba*	34	>10
Pampas	*Cortaderia selloana*	28	>10
Privet	*Ligustrum ovalifolium*	23	>10
Ragwort	*Senecio jacobaea*	23	>10
Rhamnus	*Rhamnus alaternus*	29	>10
Skeleton weed	*Chondrilla juncea*	n/a	>10
Spartina	*Spartina spp.*	25	>10
Wild ginger (kahili)	*Hedychium gardnerianum*	31	>10
Wild ginger (yellow)	*Hedychium flavescens*	24	>10
Woolly nightshade	*Solanum mauritianum*	24	>10
Aquatic plants			
Alligator weed	*Alternanthera philoxeroides*	28	>10
Eel grass	*Vallisneria spp. (V.gigantea and V. spiralis)*	n/a	>10
Entire marshwort	*Nymphoides geminata*	24	2
Fringed waterlily	*Nymphoides peltata*	n/a	>10
Hydrilla	*Hydrilla verticillata*	26	>10
Manchurian wild rice	*Zizania latifolia*	34	>10
Nardoo	*Marsilea mutica*	n/a	4
Oxygen weed	*Egeria densa*	24	>10
Parrot's feather	*Myriophyllum aquaticum*	26	>10
Senegal tea	*Gymnocoronis spilanthoides*	29	>10
Water poppy	*Hydrocleys nymphoides*	n/a	>10