Manaaki Whenua
Landcare Research

MANAAKI WHENUA – LANDCARE RESEARCH

Weed or valued garden plant?
Resolving the conflict

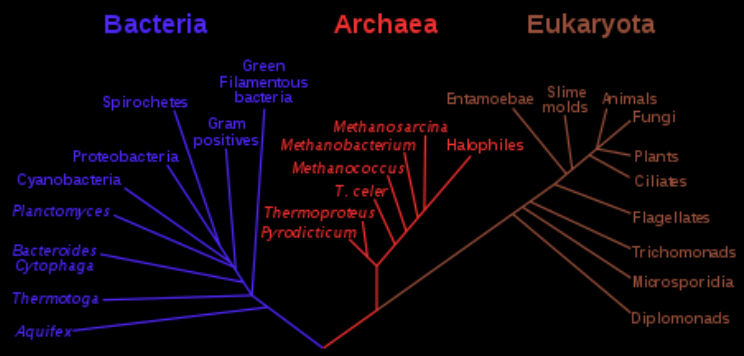
Murray Dawson

Outline

- Species & list based regulatory environment
  - Plants Biosecurity Index (PBI)
  - National Pest Plant Accord (NPPA)
  - Regional Pest Management Plans (RPMP's)
- Environmental weeds vs popular garden plants
  - Differing perceptions and values
  - A couple of case studies
  - Reproductive biology and fertility
- How can we resolve the conflict?
  - Better science: what do we have, really?
  - Better management: taxon, not species based decisions
  - Better communication

Species based regulatory approach

- Species don't always fit into neat boxes
  - Species concepts
    - Biological species concept
    - Phenetic species concept
    - Phylogenetic species concept
  - Species complexes and microspecies
  - Hybridism and introgression



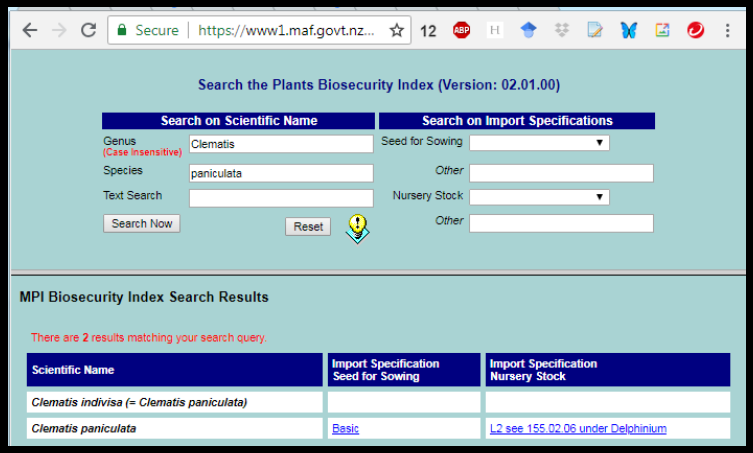
Wikipedia (public domain)

- Regulatory decisions should make biological sense

- Reproductive biology of plants are far more variable than animals

MPI Plants Biosecurity Index (PBI)

- Online biosecurity database
- Governed by two Acts
  - Biosecurity Act (1993)
  - Hazardous Substances and New Organisms Act (1996) (HSNO)
- Species present in NZ before 29 July 1998
- Identifies requirements for importing seed for sowing and nursery stock
- "Almost 30,000 spp." listed



Ministry for Primary Industries
Manatū Ahu Matua
NEW ZEALAND

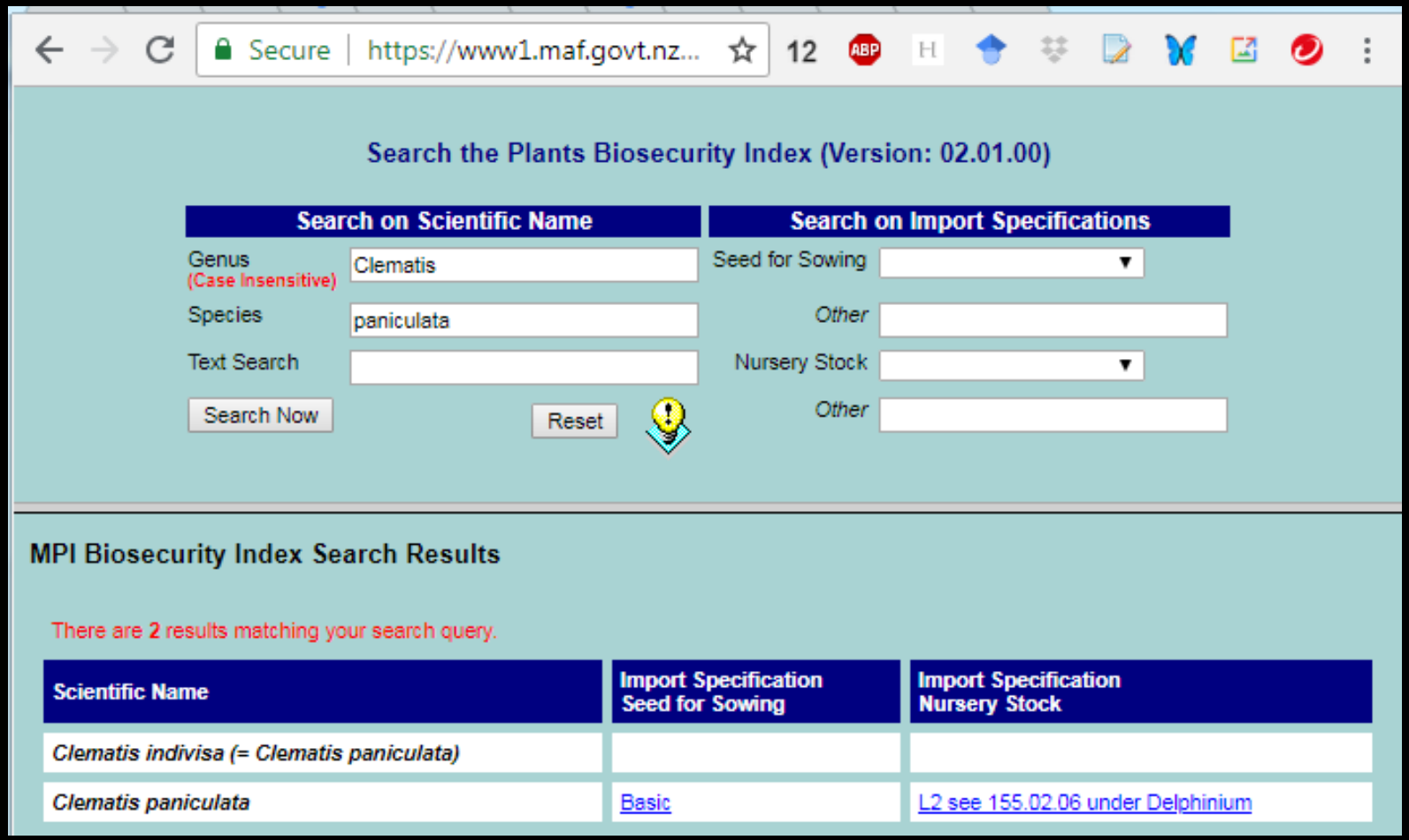
https://www1.maf.govt.nz/cgi-bin/bioindex/bioindex.pl

MPI Plants Biosecurity Index (PBI)

- Imperfect tool, hard to maintain, frustrating for nursery industry
  - Incomplete (but who really knows?)
  - Largely species based
  - Few synonyms
  - No plant families
  - No higher taxonomic hierarchy
  - No author authorities
  - No references to plant names
  - No biostatus (native, naturalised, in cultivation)
  - No connections to other databases
  - No GUID's (Global Unique Identifier)
  - Outdated taxonomy
- Legal, environmental and commercial implications

MPI Plants Biosecurity Index (PBI)

- No authorities or publication details, so what? …



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MPI Plants Biosecurity Index (PBI)

Clematis paniculata sensu Thunb. (1794) (nom. inv.) =
Clematis terniflora DC. (1818) [1817] – exotic weed species?

Erin G. (CC BY-NC), via iNaturalist

Sam Kieschnick (CC BY-NC)

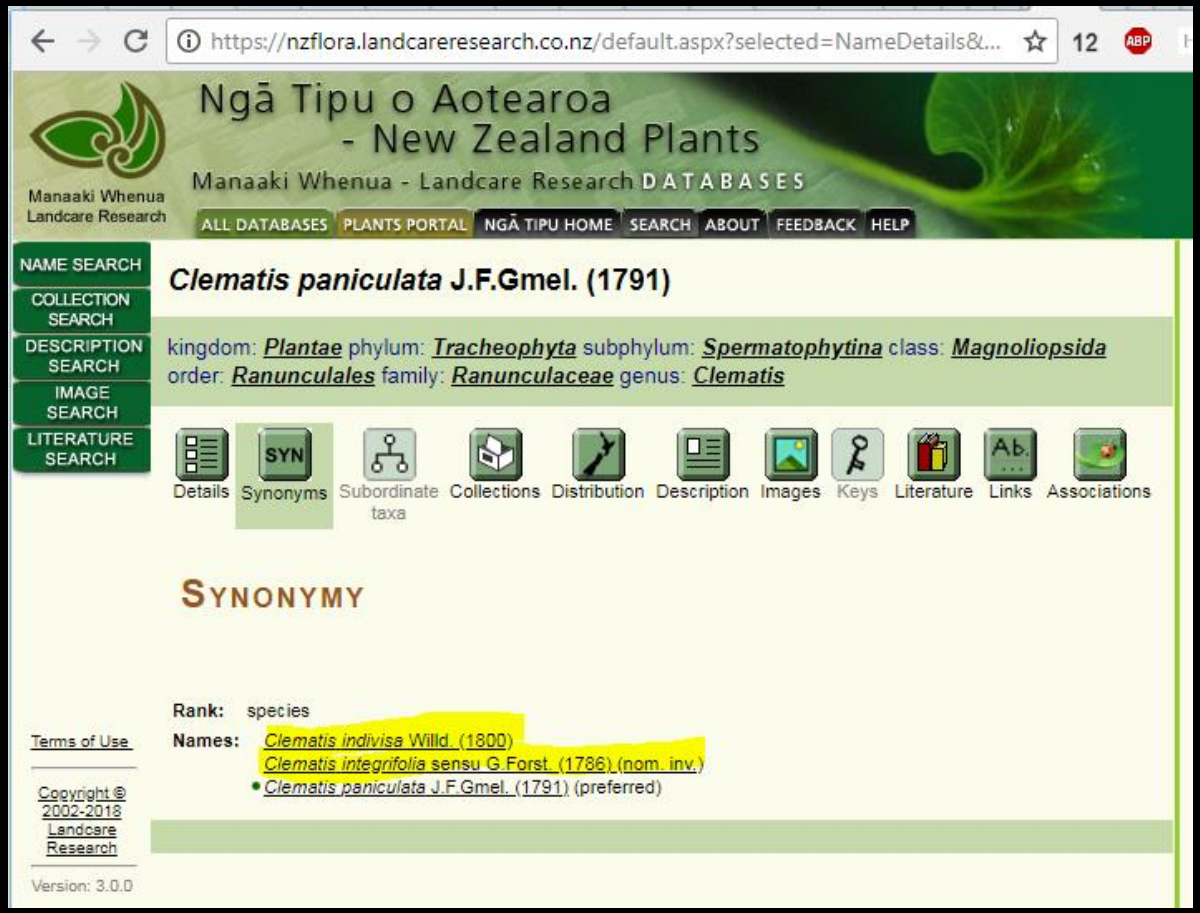
harum.koh (CC BY-NC)

MPI Plants Biosecurity Index (PBI)

... or = *Clematis paniculata* J.F.Gmel. (1791) – NZ native?

MPI Plants Biosecurity Index (PBI)

- *Clematis paniculata* J.F.Gmel. (1791) (accepted)
  - *Clematis indivisa* Willd. (1800)
  - *Clematis integrifolia* sensu G.Forst. (1786) (nom. inv.)



MPI Plants Biosecurity Index (PBI)

- Exceptions from the species based regulatory approach
  - Some cultivar and hybrid names accepted even if full species parentage is not known
    - *Hemerocallis* hybrids
    - Some cultivated orchid bigenerics



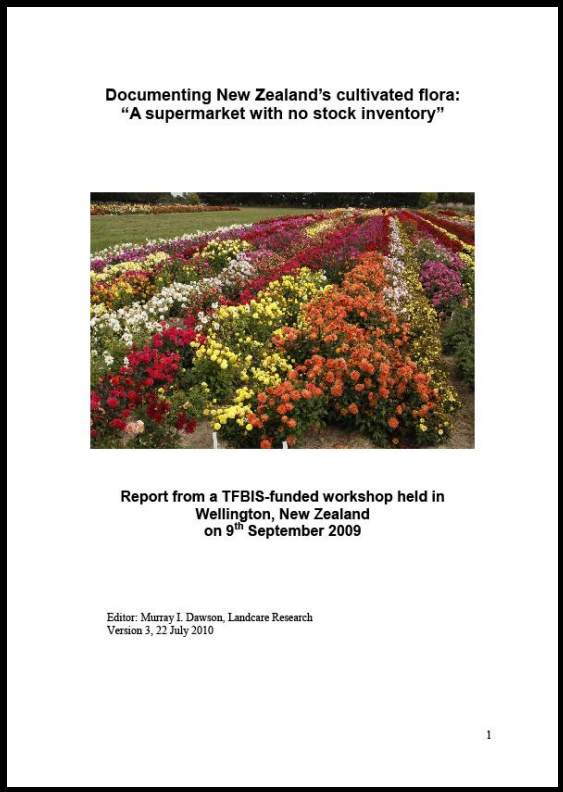
Hemerocallis cultivars. Images: Jack Hobbs, Auckland Botanic Gardens

The cultivated plants problem

"Managing the country without knowing everything in the flora is like managing a supermarket without knowing everything on the shelf."

Dr K.R. Hammett, 2009

- What is in this country?
- What is it called?
- Where is it growing?



The cultivated plants problem

- Pre-border Biosecurity
  Breeders and growers trying to import plants but not being able to confirm if those species are already present in New Zealand

- Post-border Biosecurity
  Management of weeds is difficult when we do not know the full range of potential weed escapes from cultivation

The cultivated plants problem

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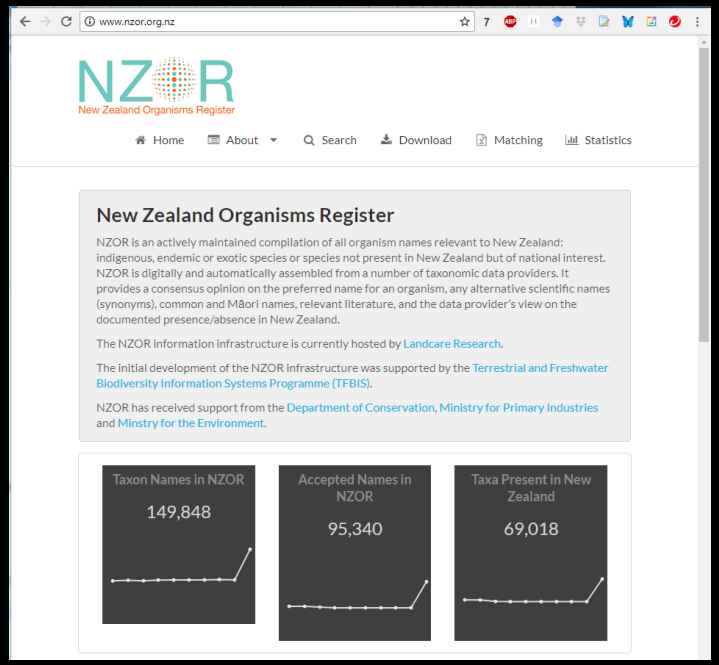
- Post-border Biosecurity
  Management of weeds is difficult when we do not know the full range of potential weed escapes from cultivation

- 25,000-50,000 species (or taxa?), which need to be resolved
  - Accepted name
  - Synonyms
  - Correct identification
    - Vital for pre- and post-border management
    - Vital for biological control

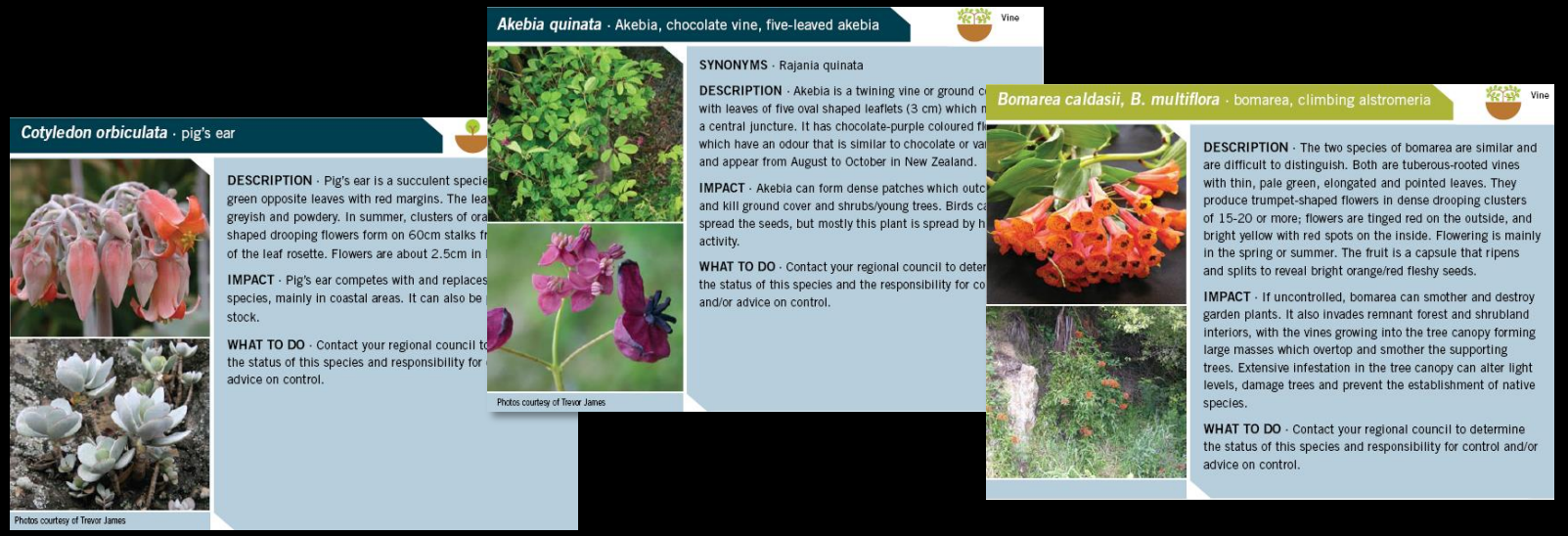
The cultivated plants problem

- Need to connect regulators and plant experts
  - EPA
  - MPI
  - Nursery industry and plant societies
  - Researchers
- Need to connect/federate taxonomic databases (e.g., NZOR)
- Funding dependent
  - Recognised as nationally important
  - Falling between the cracks?



National Pest Plant Accord (NPPA)

- "Pest plant species banned from propagation, sale, and distribution within New Zealand".
- >150 spp.
- Agreement between different parties
  - Feels eclectic, subjective
  - Rules around selection criteria?
  - Policy for removing spp.?



National Pest Plant Accord (NPPA)

- Many NPPA species still very widespread in cultivation, e.g.,
  - *Arundo donax* (giant reed)
  - *Carpobrotus edulis* (ice plant)
  - *Cortaderia jubata*, *C. selloana* (pampas grass)
  - *Cotyledon orbiculata* (pig's ear)
  - *Erigeron karvinskianus* (Mexican daisy)
  - *Euonymus japonicus* (Japanese spindle tree)
  - *Fuchsia boliviana* (Bolivian fuchsia)
  - *Iris pseudacorus* (yellow flag iris)
  - *Juglans ailantifolia* (Japanese walnut)
  - *Lamium galeobdolon* (aluminium plant)
  - *Lonicera japonica* (Japanese honeysuckle)
  - *Maytenus boaria* (Chilean mayten)
  - *Myoporum insulare* (Tasmanian ngaio)
  - *Nephrolepis cordifolia* (tuber ladder fern)
  - *Salix* × *fragilis* (crack willow)
  - *Syzygium smithii* (monkey apple)

National Pest Plant Accord (NPPA)

- And some NPPA spp. are also major environmental weeds …

Cortaderia selloana (pampas grass). Mount Auckland (Atuanui) Walkway

National Pest Plant Accord (NPPA)

Cotyledon orbiculata (pig's ear). Godley Heads Walkway.
Not an Environmental Weed, but probably should be.

National Pest Plant Accord (NPPA)

Carpobrotus edulis (ice plant).
Taiaroa Head, Otago Peninsula.

National Pest Plant Accord (NPPA)

Erigeron karvinskianus (Mexican daisy).
Lake Wainamu track, Waitakeres, Auckland.

National Pest Plant Accord (NPPA)

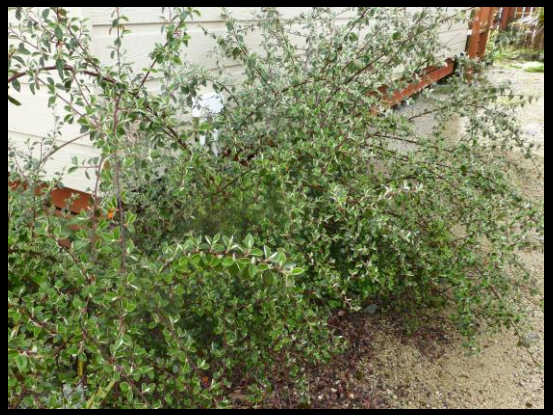
- Apparent inconsistencies and omissions
  - *Cotoneaster simonsii* (Khasia berry) but not other *Cotoneaster* spp.
  - *Gunnera tinctoria* (Chilean rhubarb) but not *G. manicata*
  - *Prunus serotina* (rum cherry) but not other *Prunus* spp.
  - Not agapanthus
  - Not *Crocosmia* × *crocosmiiflora*
  - Not *Eschscholzia californica*
  - Not *Hedera* (ivy)
  - Not *Paraserianthes lophantha* (brush wattle)
  - Not *Ulex europaeus* (gorse)
  - Not *Vinca major* (periwinkle)
- Commercially useful species understandably excluded (weed is a plant growing where it's not wanted)
  - Clover (*Trifolium* spp.) and forage grasses
  - *Pinus contorta* (lodgepole pine) but not other wilding conifers
  - Weedy grapes and kiwifruit

National Pest Plant Accord (NPPA)

All three were growing rampantly in the Franz Josef Top 10 Holiday Park; only one is an NPPA species.

Cotoneaster simonsii
NPPA

C. glaucophyllus
Not NPPA



C. franchetii
Not NPPA

National Pest Plant Accord (NPPA)

Gunnera tinctoria (Chilean rhubarb). Coastal cliffs between Cape Foulwind and Kawau Point.

Gunnera tinctoria

Gunnera tinctoria and *G. manicata*

Gunnera tinctoria. Cultivated, Christchurch Botanic Gardens.

National Pest Plant Accord (NPPA)

Crocosmia × *crocosmiiflora* (montbretia).
Near Birchfield, West Coast, South Island.

National Pest Plant Accord (NPPA)

Eschscholzia californica (Californian poppy).
Selwyn River, Canterbury.

National Pest Plant Accord (NPPA)

Hedera (ivy). Kaniere Tailings, Westland.

National Pest Plant Accord (NPPA)

Paraserianthes lophantha (brush wattle). Otago Peninsula.

National Pest Plant Accord (NPPA)

Vinca major (greater periwinkle). Trices Road, Canterbury. Growing on stream bank, under shade.

National Pest Plant Accord (NPPA)

- Exceptions from a species based approach
  - *Calluna vulgaris* (Scotch heather), but excluding double flowered cultivars (e.g., 'County Wicklow', 'HE Beale', 'Kinlochruel')

Image: Simon Fowler, Manaaki Whenua Landcare Research

Image: Trevor James, AgResearch

National Pest Plant Accord (NPPA)

- Exceptions from a species based approach
  - *Polygala myrtifolia* (sweet pea shrub), but excluding "Grandiflora" (= *P.* × *dalmaisiana*)

Polygala myrtifolia. Image: Trevor James, AgResearch

P. × *dalmaisiana*.
Image: Peter Heenan

National Pest Plant Accord (NPPA)

- A few rare or eradicated spp.
  - *Menyanthes trifoliata* (bogbean)
  - *Morella faya* (candleberry myrtle)
  - *Passiflora apetala* (bat-wing passion flower)
  - *Potamogeton perfoliatus* (clasped pondweed)
  - *Vallisneria australis* (eelgrass)

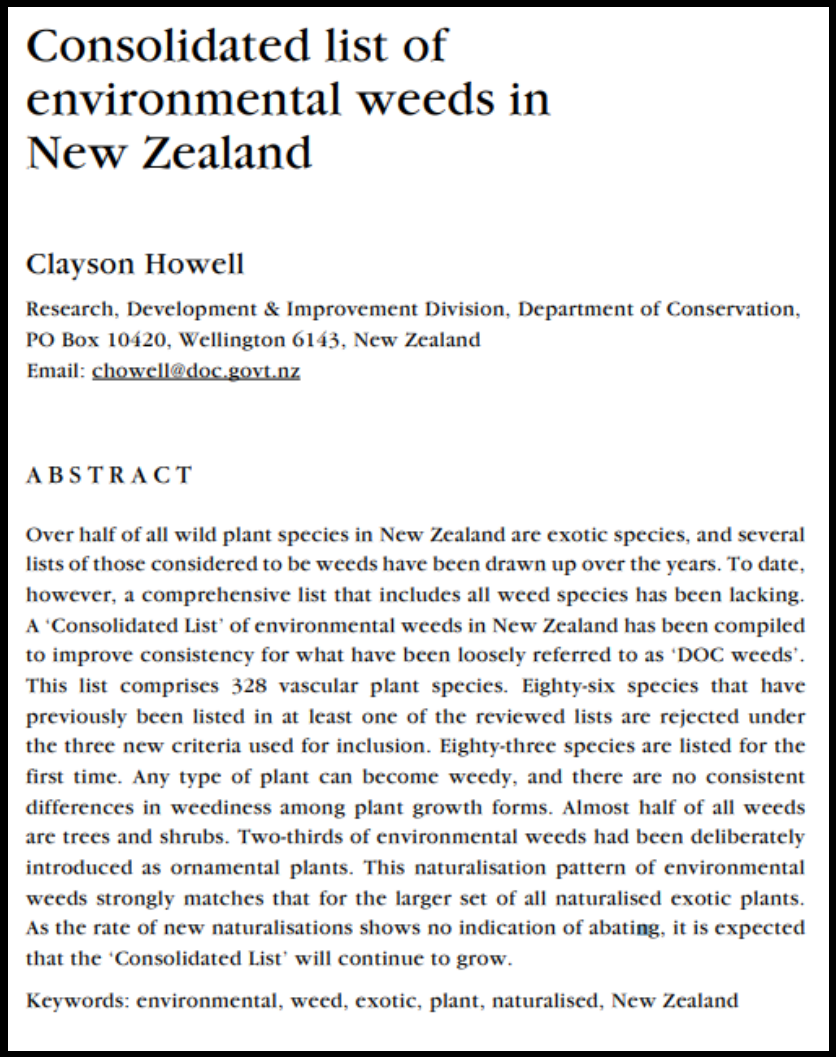
Bogbean. Image: Paul Champion, NIWA

Clasped pondweed. Image: Trevor James, AgResearch

Passiflora apetala. Image: Trevor James, AgResearch

DOC Environmental Weeds List (EW)

- NZ-wide (DOC estate)
- >328 spp.
- Howell (2008)
- Solid list, clear purpose, compiled by experts
- 10 years old, some taxonomy out-of-date, new species to add?



Consolidated list of environmental weeds in New Zealand

Clayson Howell

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Email: chowell@doc.govt.nz

ABSTRACT

Over half of all wild plant species in New Zealand are exotic species, and several lists of those considered to be weeds have been drawn up over the years. To date, however, a comprehensive list that includes all weed species has been lacking. A 'Consolidated List' of environmental weeds in New Zealand has been compiled to improve consistency for what have been loosely referred to as 'DOC weeds'. This list comprises 328 vascular plant species. Eighty-six species that have previously been listed in at least one of the reviewed lists are rejected under the three new criteria used for inclusion. Eighty-three species are listed for the first time. Any type of plant can become weedy, and there are no consistent differences in weediness among plant growth forms. Almost half of all weeds are trees and shrubs. Two-thirds of environmental weeds had been deliberately introduced as ornamental plants. This naturalisation pattern of environmental weeds strongly matches that for the larger set of all naturalised exotic plants. As the rate of new naturalisations shows no indication of abating, it is expected that the 'Consolidated List' will continue to grow.

Keywords: environmental, weed, exotic, plant, naturalised, New Zealand

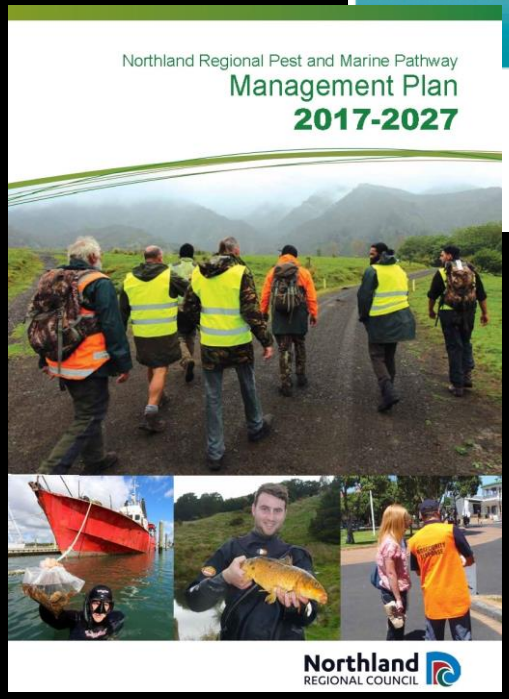
Billion Tree Programme

When communication between planners/policy makers and plants people fails …

Species	Common name	Weed status
Alnus glutinosa	black alder	EW, RPMP
Banksia integrifolia	coastal banksia	EW, RPMP
Clerodendrum trichotomum	harlequin glorybower	NPPA
Cornus capitata	strawberry tree	EW, RPMP
Euonymus japonicus	Japanese spindle tree	EW, NPPA, RPMP
Larix decidua	larch	EW, RPMP, Wilding
Prunus campanulata	Taiwan cherry tree	EW, RPMP
Prunus laurocerasus	cherry laurel	EW, RPMP
Pseudotsuga menziesii	Douglas fir	EW, RPMP, Wilding
Psoralea pinnata	dally pine	EW, RPMP

Regional Pest Management Plan (RPMP)

- Regional councils
- Renewed (perhaps) every 10 years
- Public consultation and feedback
- Regionally based lists of priority pest species to manage
- 348 spp. across NZ



Agapanthus in Auckland

- Particularly invasive in the Auckland Region
- Coastal areas, dune lands, cliffs, roadsides, waste land
- Abundant seed (wind and water dispersed)
- Difficult to control (vigorous rhizomes are extremely difficult to dig out; resistant to herbicides)

Agapanthus in Auckland

- RPMP Surveillance Plant, large forms only, Auckland Region (2008)
- Decision controversial despite consultation

White and blue agapanthus, Opito Bay, Coromandel Peninsula. Image: Trevor James, AgResearch.

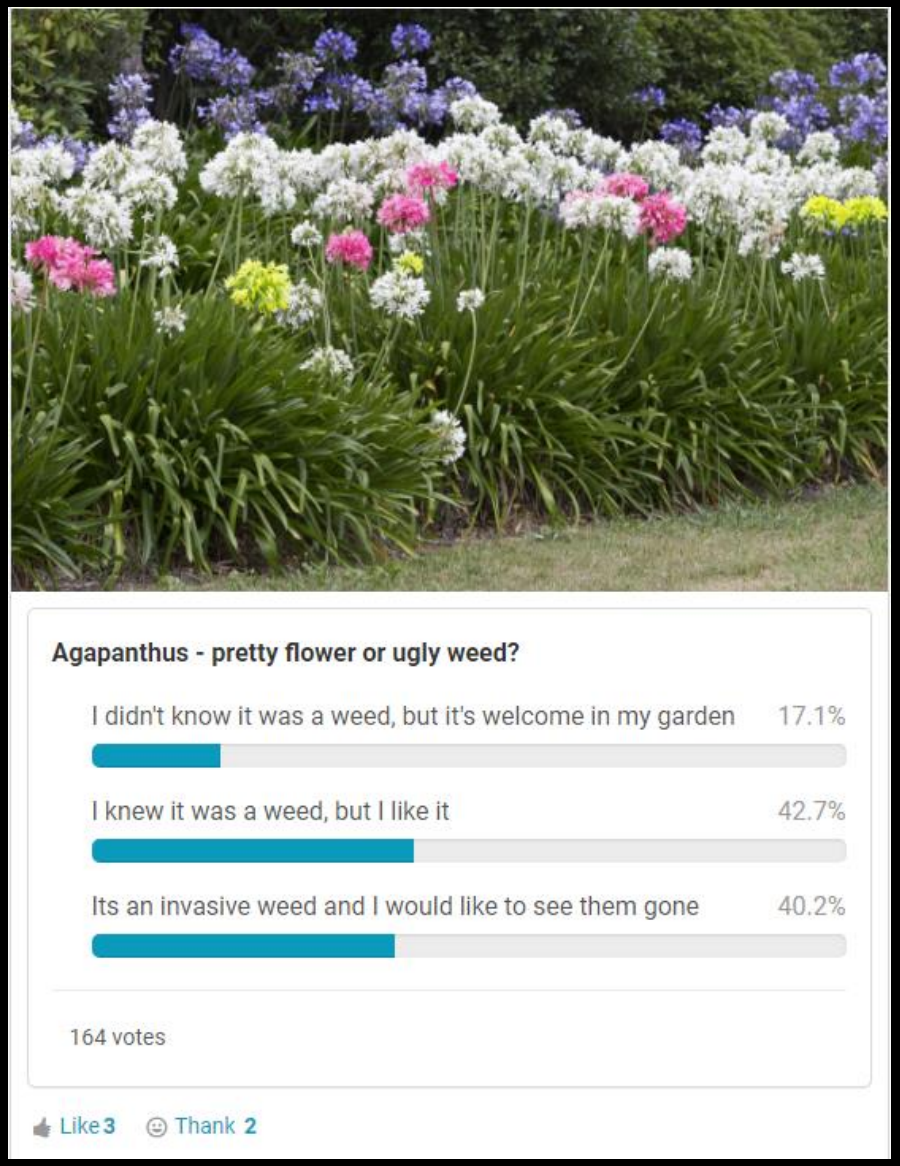
Agapanthus in Auckland

Love it or loath it?
Online polls equally divided

"Agapanthus is a beautiful plant and I grow it in my garden. It's really strange to hear it called a weed."

"I love Agapanthus. They hold my steep banks up, their blue flowers are gorgeous, and most importantly, the bees love them. What's the problem for God's sake?"

"It's hardy and reliable as well as beautiful and makes an amazing cut flower – also very popular overseas."



Neighbourly online poll: www.neighbourly.co.nz

Agapanthus in Auckland

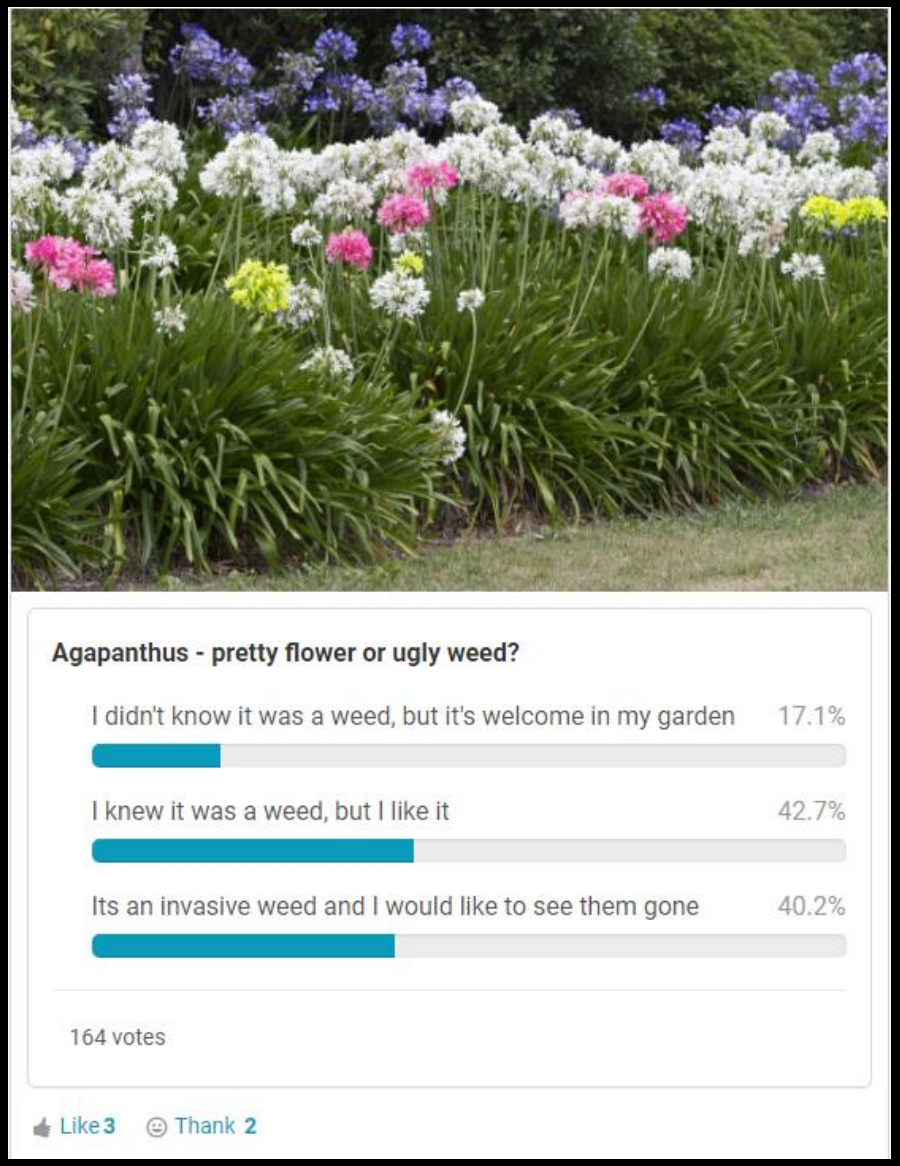
Love it or loath it?
Online polls equally divided

"I've been trying to dig them out of the garden for ten years and still the damn things come back."

"I can only associate them with cheap, tacky and ugly commercial landscaping."

"This is a corporate strength plant. It will survive balls of fire and lightning bolts of blight."

"I hate them with a passion as they spread like triffids and strangle everything else to death."

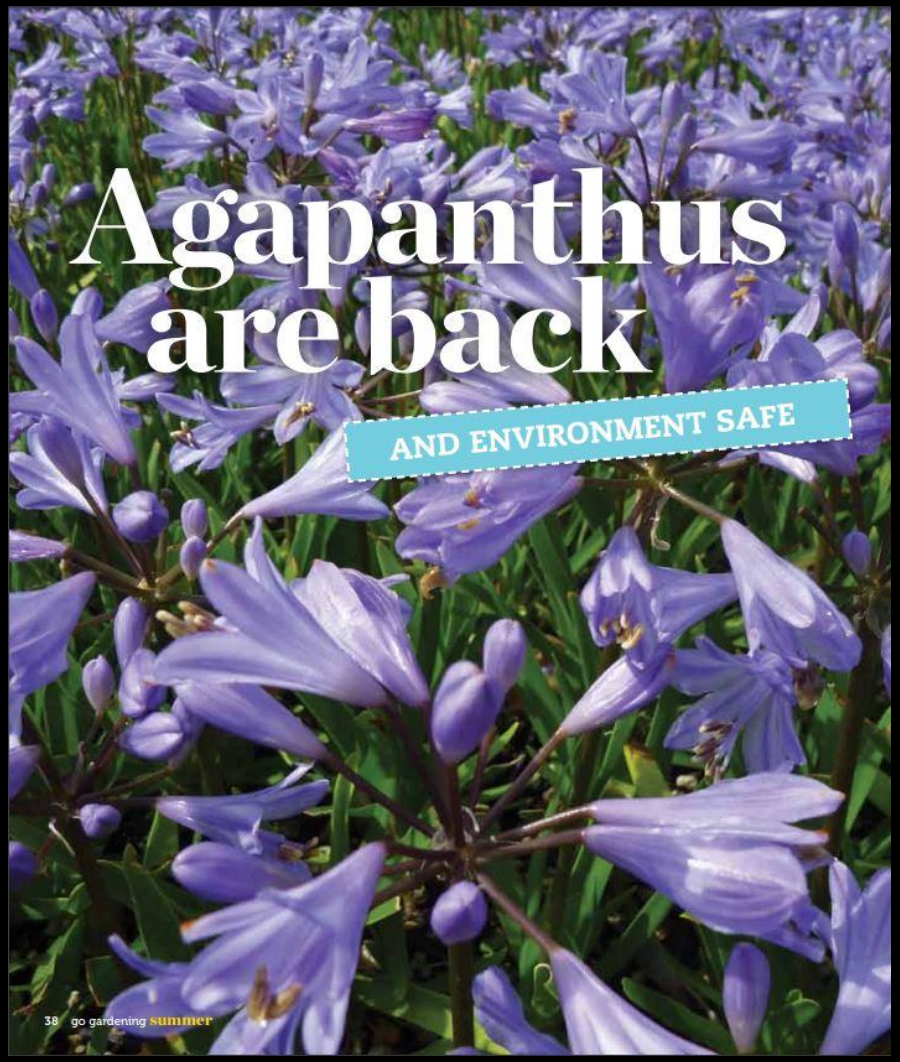


Neighbourly online poll: www.neighbourly.co.nz

Agapanthus in Auckland

- Public demanded selections they could still grow

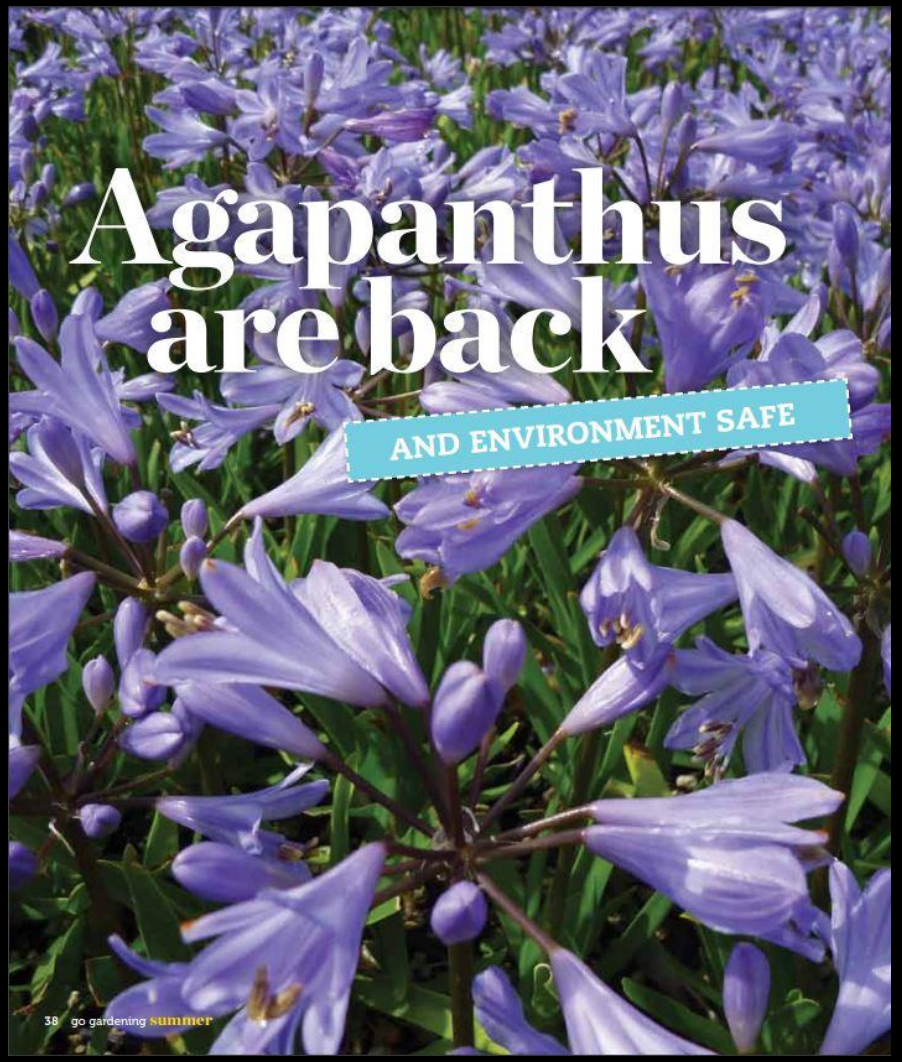
- NZ nursery industry responded by selling existing low-growing selections thought to be less invasive …



Agapanthus in Auckland

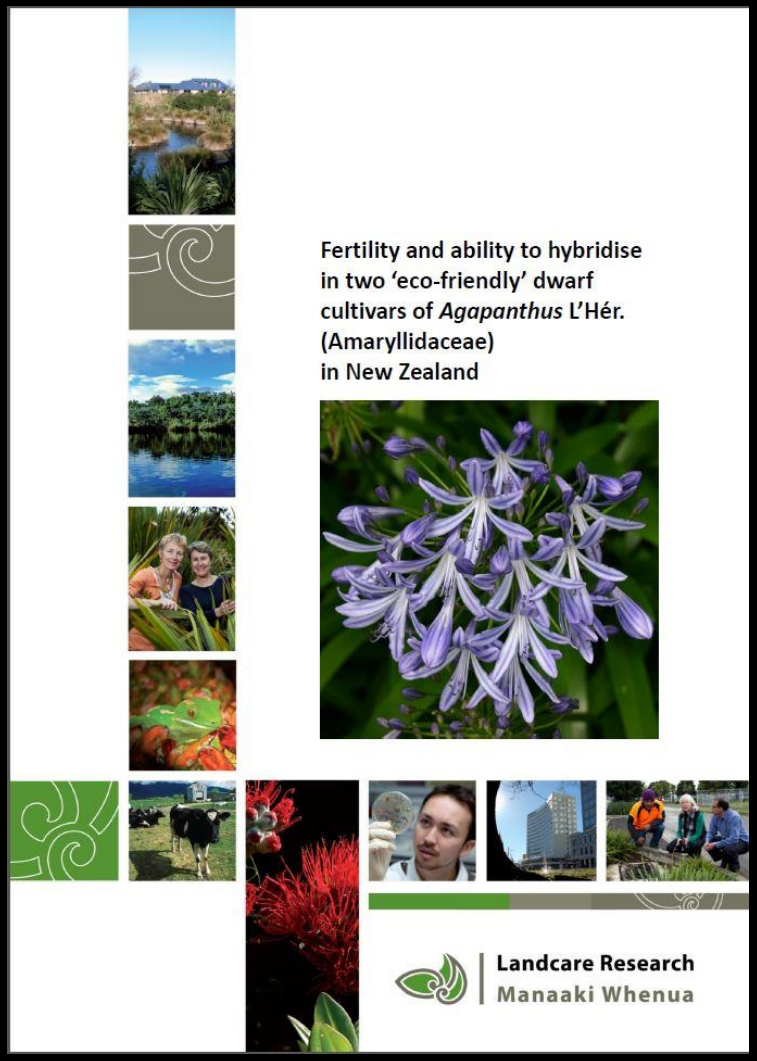
- Several terms used
  - "Auckland safe"
  - "eco-friendly"
  - "environment safe"
  - "low-fertility"
  - "self sterile"
  - "sterile"

- Where was the science to support these claims?



Agapanthus in Auckland

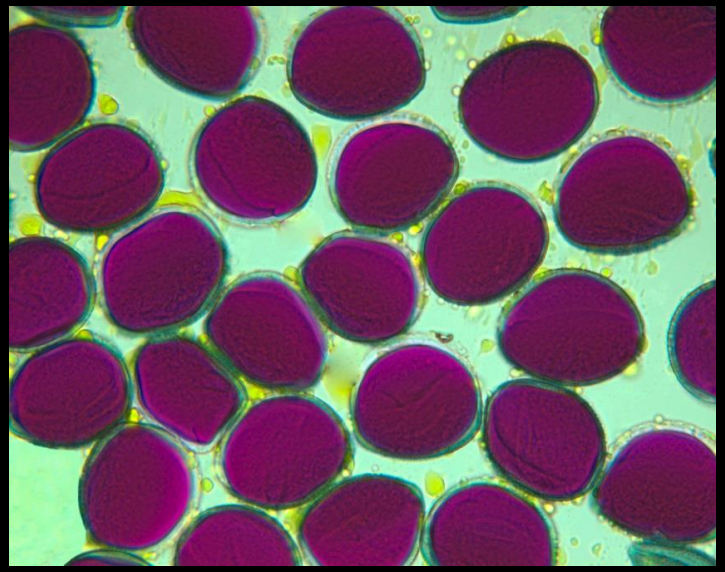
- Auckland Council funded MW-LR to investigate eco-friendly claims
- Two "low-fertility" cultivars studied in detail (*A.* 'Finn' and *A.* 'Sarah')
- Compared against "wild type" and fertile dwarf
- Published report Nov 2010 (Ford & Dawson)

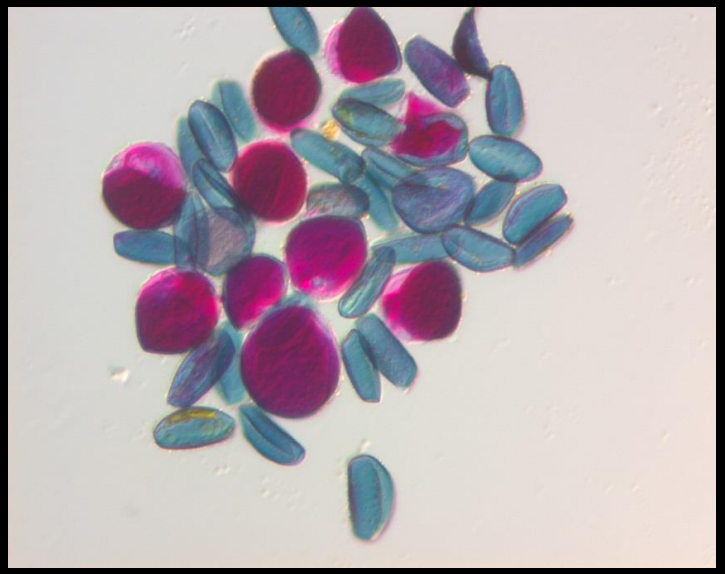


Agapanthus in Auckland

How did we assess fertility?

- Male fertility (pollen):
  - Pollen stainability
  - Pollen tube growth (in- and ex-situ)





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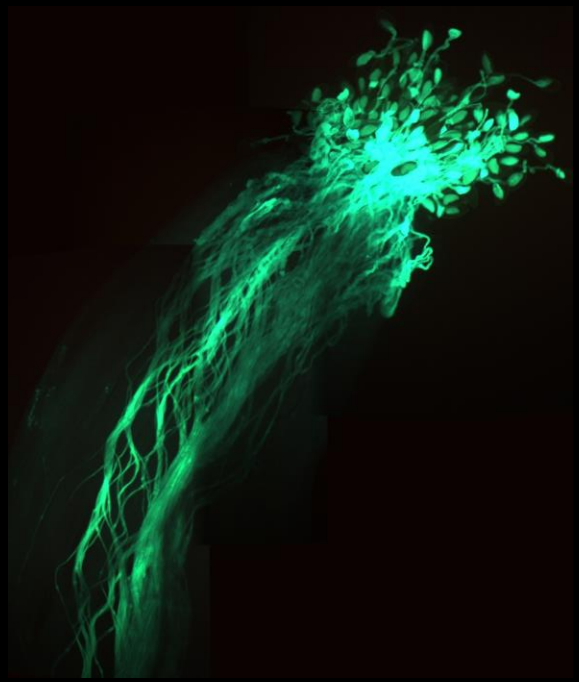

Fertile: Abundant pollen tube growth down the full length of the style of "wild-type" *Agapanthus* using fluorescence microscopy.

Agapanthus in Auckland

How did we assess fertility?

- Male fertility (pollen):
  - Pollen stainability
  - Pollen tube growth (in- and ex-situ)
- Female fertility (seed):
  - Controlled hand-pollinations
    - Selfing
    - Outcrossing
  - Open pollinated (o.p.) seed set observations
  - Seed production estimates
  - Seed germination rates

Agapanthus in Auckland

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Agapanthus in Auckland

- High seed set (o.p.)
  - 640–4,200 seeds/flower head
  - 12,880–70,700 seeds/plant

Agapanthus wild type

Agapanthus in Auckland

- Very low seed set (o.p.)
  - 3.15 “viable” seeds/plant

Agapanthus ‘Finn’

Agapanthus in Auckland

- Auckland Council's 2018 RPMP proposes an exception for agapanthus that "produce less than 2% viable seed…" so cv's will need to be quantified

- Breeding is underway to create fully sterile ("seedless") cultivars – both dwarf and tall-growing selections

- Win-Win: AC, Nursery Industry and Researchers have come together to solve an environmental problem and public need

Maytenus boaria (Chilean mayten) in Canterbury

- What is Chilean mayten?
  - Native to South America
  - Evergreen & graceful tree
  - Shrub (2 m) → tall tree (30 m)
  - Hardy & drought resistant
  - Pendulous branchlets that sway in the wind (similar in effect to a weeping willow)
  - Straight trunk & fissured grey bark

Maytenus boaria (Chilean mayten) in Canterbury

- Horticultural introductions
  - 1881: Introduced into the ChCh Botanic Gardens from overseas
  - 1929: Sold commercially by Duncan & Davies nursery, New Plymouth, as a new release
  - 1948: Imported from Hillier Nurseries (UK) into Eastwoodhill Arboretum

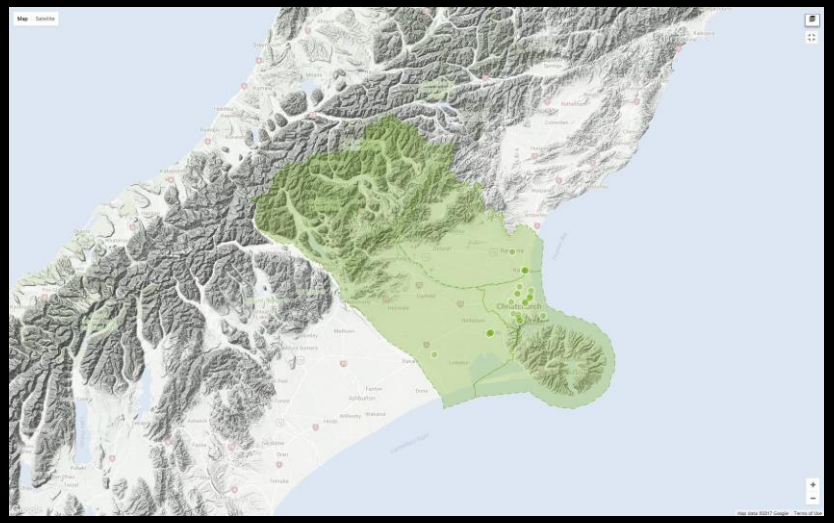
Maytenus boaria (Chilean mayten) in Canterbury

- History of naturalisation
  - 1975/1986: Dubiously recorded as naturalised from herbarium specimens – Canterbury (ChCh and Church Bay)
  - 1989: Herbarium specimens near but outside of Eastwoodhill Arboretum boundary, Gisborne
  - 2012: Herbarium specimens of obvious seedlings from Bason Botanic Gardens, near Whanganui

Allan Herbarium. Image: © MW-LR

Maytenus boaria (Chilean mayten) in Canterbury

- History of naturalisation
  - 2012: Chilean mayten was added to the NPPA list
  - 2012: Joe Cartman and Kate McCombs published an article outlining the emerging weed threat
  - 2016: Murray Dawson wrote several articles
  - Present day: Citizen Science observations indicate an expanding distribution, particularly in Canterbury



Maytenus boaria (Chilean mayten) in Canterbury

- Why is it becoming weedy, more than 130 years after its first introduction into New Zealand?
- Why is this previously benign and desirable tree going rogue?

Maytenus boaria (Chilean mayten) in Canterbury

- Before mid-1980s only male plants were sold by nurseries
- After mid-1980s seed-grown plants started to appear on the market
  - Male and now female
  - Birds love to eat the fruit so Chilean mayten has now gained its wings

Male flowers close-up

Female flowers close-up

Maytenus boaria (Chilean mayten) in Canterbury

Fruit.
Image: Peter Heenan

Capsules.
Image: Murray Dawson

Maytenus boaria (Chilean mayten) in Canterbury

- Weedy characteristics
  - Long-lived
  - Drought resistant
  - Persistent suckering from roots
  - Resistant to poisoning
  - Very shade tolerant but also grows in full sun
  - Difficult to distinguish from New Zealand native plants
  - Flowers and fruits from an early age (3–5 years, 2 m tall)
  - Seed readily dispersed by birds

Maytenus boaria (Chilean mayten) in Canterbury

- Although an NPPA species in 2012, it was listed in a landscaping and tree planting appendix to the proposed 2014 Christchurch Replacement District Plan
- Now on ECan's radar and is a future Canterbury RPMP candidate
- Breeding system knowledge may have prevented the problem

Summary

- Species based regulatory decisions not always the best level
  - Biological systems are complex
  - Decisions should make biological sense

- Should be informed by research
  - Plant taxonomy, nomenclature and identifications
  - Genetic variation and DNA evidence
  - Ecology
  - Reproductive biology and fecundity
  - Breeding for sterility

- Should be ongoing communication between regulators, policy makers and researchers