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List of environmental weeds in New Zealand 2024

Kate G. McAlpine and Clayson J. Howell



Department of
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Te Papa Atawhai



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The following amendments were made to the published report at the authors' request.

1. Page 11, Table 2: *Cenchrus caudatus*, changed "Auckland (E, SC)" to "Auckland (E)".
2. Page 13, Table 2: changed "*Dimorphotheca fruticosa* (L.) DC." to "*Dimorphotheca fruticosa* (L.) Less., 1832" and changed the entry for this species in the NUMBER OF NEW ZEALAND GBIF RECORDS column to from 4 to 236.
3. Page 31: first sentence of last paragraph, changed "53 species" to "54 species".

Cover: *Asparagus scandens*, climbing asparagus. Photo: Kate McAlpine

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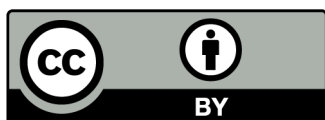
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List of environmental weeds in New Zealand 2024

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Abstract

Environmental weeds are a major cause of global biodiversity decline. There are approximately 30,000 exotic plant species present in New Zealand and at least 2,600 have been recorded in the wild. We considered 759 candidate species for inclusion on a new comprehensive list of environmental weeds in New Zealand. The species considered were drawn from published lists of weed species, lists of plants that must be reported or managed by law if observed, existing national and regional programmes and agreements for pest management, and species already managed by the Department of Conservation (DOC). Candidate species were then assessed to see if they were fully naturalised and whether they have more than minor impacts in natural ecosystems. Of the 759 candidate species considered, 386 species met these criteria and thus comprise the list of current environmental weeds in New Zealand. Climbers, shrubs and trees make up a greater proportion of environmental weeds than are represented in the entire naturalised flora (1,798 species). Environmental weeds are a major component of the species listed in regional pest management plans (RPMPs) and of those species categorised as unwanted organisms. However, more than one quarter of the environmental weed species included on this updated list are not classified as unwanted organisms or included in any RPMP. This updated list of current environmental weeds in New Zealand should be useful for a variety of purposes including: advocacy, improved collaboration between weed control programmes, and improved site management. We recommend that the naturalisation status of exotic plants be assessed regularly by an independent panel. We strongly encourage the use of the nature-recording app iNaturalist (<http://www.inaturalist.org/>) to post weed observations; this will greatly improve our understanding of changing weed distributions in New Zealand.

Keywords: invasive plants, naturalisation, weed, emerging weeds, weed impacts, exotic, New Zealand

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1. Introduction

Environmental weeds (weeds of natural ecosystems) have major impacts on biodiversity globally (Vilà et al. 2011). New Zealand is particularly vulnerable because of extensive and historically recent deforestation (McGlone 1983; McWethy et al. 2009), and the extraordinary pressure of introducing more than 24,000 exotic plant species (Duncan and Williams 2002). The number of introduced flora species is around 10 times greater than that of indigenous flora, including different growth forms (Craine et al. 2006).

Once introduced, there are few effective barriers to naturalisation, so the naturalised exotic flora of NZ is large (1,798 species, Brandt et al. 2020), and continually growing. The subset of naturalised plants that are considered weeds already have large impacts (Hulme 2020), and yet more invasions will inevitably occur under forecasted climate change (Sheppard et al. 2016).

Reports of new naturalisations of exotic plants within particular taxonomic groups (e.g. Howell 2019), regions (e.g. Ogle and La Cock 2019) and nationally (de Lange et al. 2011; Schönberger et al. 2019) mean that lists of naturalised plants in New Zealand – and the subset of naturalised plants that go on to become environmental weeds – need frequent reviews and updates.

Describing the full list of environmental weeds deemed to have significant impacts on indigenous biodiversity is useful for a number of reasons. At local scales, including them on lists can be used to justify and prioritise management, and to secure funding. Lists can also be used to prioritise research on understanding and mitigating the impacts and development of effective control tools and management strategies (Paynter et al. 2017; Minuti et al. 2021). Lists can also inform risk assessments for recently naturalised, or not yet established, weeds (Kriticos et al. 2018) and contribute to global weed analyses (Hulme 2020).

The development of this updated list differs in a number of ways from the previous national list of environmental weeds (Howell 2008). Firstly, the 2008 list only included weed species that were present on land administered by DOC. However in some regions (e.g., Auckland), natural ecosystems are predominantly administered by regional councils rather than DOC (Cutting and Cocklin 1992). This meant that some significant environmental weeds were excluded from the 2008 list because DOC was not responsible for the land where infestations occurred. However, it is clear that weed lists should include the most widespread species with the biggest impacts (Williams et al. 2009), as well as those targeted for containment or eradication. We therefore expanded the criteria for this updated list to consider all environmental weeds, irrespective of land tenure.

Secondly, assessment of the habitat types that each weed occurs in was not explicit in the previous list. The land-use categories specified in the New Zealand Land Cover Database version 5.0 (LCDB v5; Manaaki Whenua Landcare Research 2023), and improved spatial recording of weed occurrences in general, now allow analysis at the national scale. This means we could exclude weeds with presence and impacts confined to highly modified environments with little indigenous biodiversity values.

Finally, unlike the previous list, we have not included any native plant species on this updated list. Although some native plants can have negative impacts outside their natural range in New Zealand, declaring indigenous plant species ‘weeds’ can be difficult to justify for a number of reasons. Defining the ‘natural range’ of a species can be difficult. Additionally, ‘weediness’ can vary depending on the ecosystem type that is invaded (this applies to exotic weed species too). Most importantly though, Māori consider native plant species to be whakapapa and, in many cases, taonga and important rongoā species (McGowan 2021). For all of these reasons, native plant species were not considered for inclusion on this updated list of environmental weeds in New Zealand.

Defining a list of environmental weeds has been difficult for several reasons. Assessing species for inclusion requires collation of information on hundreds of species. Access to comprehensive distribution data between agencies is difficult. Taxonomic treatments differ, and impact assessments are scarce and/or scattered over many publications. Lists should reflect changes in distribution and abundance, not just changes in awareness, so clear justifications for inclusion and exclusion from the list are needed.

The main aim of this paper is to provide an updated list of environmental weeds present in New Zealand. We also identify how environmental weeds vary in growth form and how that compares to whole naturalised flora, and examine the overlap between environmental weeds, species that have been classified as unwanted organisms and species listed in regional pest management plans (RPMPs).

2. Methods

2.1 Compiling the list of candidate species

The first stage of updating the list of environmental weeds in New Zealand was to compile a list of candidate (potential) species. To do this, we included species from the following lists and publications on pest plants.

- All plant species included on the previous list of New Zealand environmental weeds (Howell 2008).
- All plant species identified with weed infestations on land administered by DOC (i.e., plant species recorded in the ‘DOC Weeds Application’, which is an internal spatial database implemented since the publication of the previous weed list; this database was accessed in July 2023).
- All plant species classified as notifiable organisms (pests and diseases that must be reported to MPI, if spotted in New Zealand) or unwanted organisms (organisms determined to be capable of causing harm to natural or physical resources or human health) in New Zealand (Ministry for Primary Industries 2023a). This includes all those listed on the National Pest Plant Accord (NPPA) (Baldwin et al. 2012) and those plants that are subject to National Interest Pest Responses (NIPR) led by the Ministry for Primary Industries (2023b).
- All plant species included in 16 currently ratified regional pest management plans (RPMPs) (Table 1).
- A small number of plant species included in recent publications about threats to native plants (Heenan and Rogers 2019), the DOC Raoul Island weed control programme (West and Havell 2019), and newly naturalised plants (de Lange et al. 2019; Howell 2019; Ogle and La Cock 2019; Schönberger et al. 2019; Perrie and Shepherd 2021).

Table 1. Regional pest management plans (RPMPs) ratified at the time of writing.

COUNCIL	DURATION OF PLAN	RPMP
Auckland Council	2020–2030	AC 2020
Bay of Plenty Regional Council	2020–2030	BOPRC 2022
Chatham Islands Council	2021–2041	CIC 2021
Environment Canterbury Regional Council	2018–2038	ECRC 2018
Environment Southland Regional Council	2019–2029	ESRC 2019
Gisborne District Council	2017–2027	GDC 2017
Greater Wellington Regional Council	2019–2039	GWRC 2019
Hawke’s Bay Regional Council	2018–2038	HBRC 2023
Horizons Regional Council (Manawatū-Whanganui)	2017–2037	HRC 2017
Marlborough District Council	2018–2028	MDC 2018
Northland Regional Council	2017–2027	NRC 2018
Otago Regional Council	2019–2029	ORC 2019
Taranaki Regional Council	2018–2028	TRC 2018
Tasman District Council and Nelson City Council	2019–2029	TDC and NCC 2019
Waikato Regional Council	2022–2032	WRC 2022
West Coast Regional Council	2018–2028	WCRC 2018

2.2 Managing taxonomic issues

The broad range of sources used to compile the new list of candidate species created some taxonomic issues. For simplicity, weeds were assessed at the species level and we used the Global Biodiversity Information Facility (GBIF) Taxonomic Backbone to standardise names (GBIF 2020). Known synonyms and misapplied names were cross-referenced to ensure consistency between lists.

Previous work aggregated all species of naturalised blackberries in New Zealand under *Rubus fruticosus* L., except for *R. laciniatus* (Given 1982). The individual species have been described (Webb et al. 1988), but most operational records still use *Rubus fruticosus* L. aggregate (agg.). For this project, we included all blackberry species within the genus *Rubus* that have been recorded in the wild in New Zealand (AVH 2020) on the list of candidate species.

We used the same approach where weeds were listed at genus level only (e.g., '*Hakea* spp.', '*Pinus* spp. '), including all species within that genus that have been recorded in the wild in New Zealand (AVH 2020).

Where candidate species were hybrids, we searched the literature to establish both likely parents. Where the hybrid taxa arose outside New Zealand they were included as candidate species (e.g., *Crocasmia* × *crocosmiiflora* and *Reynoutria* × *bohemica*). However, where hybrids are formed within New Zealand, the hybrid was omitted and the parent(s) were included as candidate species (e.g., *Myoporum laetum* × *M. insulare*).

The identity of one plant could not be resolved: "*Cotoneaster ovata*"; this is listed on the Chatham Islands Pest Management Plan (CIC 2021). This possibly relates to *Cotoneaster ovatus*, but this species has never been recorded elsewhere in New Zealand so it was excluded.

We excluded exotic bryophytes from the list of candidate species because distributions and impacts of this taxonomic group in New Zealand are poorly understood at present. However, it is likely that some exotic moss and liverwort species are already established and invasive, so future list updates should reconsider inclusion.

2.3 Excluding species that only occur in highly modified habitats

To inform the inclusion and exclusion of candidate species as environmental weeds, we used three major sources of available distribution data:

1. Global Biodiversity Information Facility (GBIF)
 - The GBIF occurrence database contains records from major herbaria and 'research grade' observations from iNaturalist. All records of candidate species were extracted on 17 June 2020 using the R packages 'rgbif' (Chamberlain, Ram, et al. 2017) and 'taxize' (Chamberlain, Szoecs, et al. 2017). We only extracted records made in New Zealand after 1990 and with no data quality issues (e.g. terrestrial plant record located in the ocean).
2. DOC Weeds application
 - Weed infestations that have been under DOC management since 2015 are entered into this ArcGIS application. All infestation records were extracted on 10 January 2020. For simplicity, we used the centroid of each infestation polygon as the location.

3. BioWeb Weeds database

- Observations arising from inventories of land managed by DOC are entered into this internal SQL database. The coordinates for observations of all candidate species were extracted on 10 January 2020.

We overlaid digital maps of New Zealand land use from LCBD over the distribution data to exclude weed species that only impact highly modified environments (e.g., LCDB land-use categories such as 'High Producing Exotic Grassland', 'Built-up Area' and 'Surface Mine or Dump').

We used all known synonyms and names of subordinate taxa for each candidate species to aggregate distribution records at the species level.

2.4 Assessment of candidate species

We used our collective knowledge, along with input from other weed experts, to assess all candidate species to determine which should be included on the updated environmental weeds list. First, we classified the growth form using the six categories in Brandt et al. (2020): tree, shrub, subshrub, herb (including ferns and lycophytes), caespitose (means 'tuft-forming' and includes grasses, sedges and rushes), and climber (including vines and lianas). We then assessed all candidate species against the following three criteria:

1. Is fully naturalised (i.e., has self-sustaining populations in the wild)
2. Occurs in natural ecosystems or habitats
3. Has 'more than minor' impacts as per the categories published in Blackburn et al. (2014). Note that 'more than minor' impact categories include 'moderate', 'major' and 'massive' impact. Species were assigned to a 'more than minor' category rather than a particular impact category because the detail required to differentiate between categories is simply not available.

We accepted candidate species as environmental weeds if they met all three criteria. This meant fully naturalised species were excluded if they only occurred in non-natural habitats (such as urban or agricultural habitats) and/or only had minor impacts.

2.5 Analyses of growth forms and proportional relationships

We conducted two-sample proportion tests using the R programming language (R Core Team 2021) to compare the proportion of different growth forms (caespitose, climbers, herbs, shrubs, subshrubs and trees) in the updated environmental weed list compared to the 1,798 species of naturalised flora identified in Brandt et al. (2020).

We also examined the proportional relationships between species on the environmental weed list, with those species listed in the RPMPs and those classified as unwanted organisms.

3. Results

3.1 The updated environmental weeds list

From a pool of 759 candidate species, 386 species met the requirements to be classified as environmental weeds (Table 2; also available online [here](#)).

The list of 386 environmental weeds includes plants from a broad taxonomic range comprising seven classes, 45 orders, 108 families and 260 genera. The majority are seed plants (259 being Magnoliopsida, 98 Liliopsida and 17 Pinopsida). However, two algae are also included (*Caulerpa brachypus*, class Ulvophyceae, and *Undaria pinnatifida*, class Phaeophyceae), and nine ferns (class Polypodiopsida) are also included. The families containing the largest number of environmental weeds were Poaceae (48 taxa), Asteraceae (30 taxa), Fabaceae (29 taxa) and Rosaceae (28 taxa). Fifty-five families are represented by only one environmental weed.

One consequence of using GBIF taxonomy is that some scientific names differ from those typically used in New Zealand. For example, kiwifruit is typically called *Actinidia deliciosa* in New Zealand, whereas in GBIF *A. deliciosa* is listed as a synonym of the accepted name *A. chinensis*. A similar example is moth plant, which is typically called *Araujia hortorum* in New Zealand, whereas in GBIF *A. hortorum* is listed as a synonym of the accepted name *A. sericifera*.

One consequence of assessing taxa no lower than the species level is that subspecies are not listed separately; for example, European olive and African olive are both included under *Olea europaea*, and Sydney golden wattle and coastal wattle are both included under *Acacia longifolia*.

The number of GBIF records ranged from zero (white bryony, *Bryonia cretica* and Australian sedge, *Carex longibrachiata*) to 3,509 (old man's beard, *Clematis vitalba*) (Table 2). The number of DOC records (i.e., infestation records on land administered by DOC) ranged from zero (31 species) to 14,899 (old man's beard, *Clematis vitalba*) (Table 2).

Table 2. Environmental weeds in New Zealand 2024 (386 species)

Weed species were included if they were assessed as being: fully naturalised, present in natural ecosystems, and likely to have more than minor impacts. The taxonomy follows the Global Biodiversity Information Facility (GBIF) Taxonomic Backbone. Unwanted organism (UO); notifiable organism (NO); National Pest Plant Accord (NPPA); National Interest Pest Response (NIPR). Department of Conservation (DOC) infestation records are from internal resources: DOC Weed App and Bioweb database (both accessed July 2023). New Zealand GBIF records include 'research grade' observations from iNaturalist (www.inaturalist.org) and all records from major herbaria (accessed July 2023). In the column on regional pest management plans (on right), the letters in brackets indicate management programme categories: Exclusion (EX); Eradication (E); Progressive Containment (PC); Sustained Control (SC); Site-led (SL); Organism of Interest (OOI). The National Policy Direction for Pest Management defines these categories (Ministry for Primary Industries 2015). Inclusion on a regional pest management plan does not necessarily mean that a regional council manages that species across the whole region. This list is also available as an electronic spreadsheet: www.doc.govt.nz/documents/science-and-technical/environmental-weeds-in-nz.xlsx

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Acacia baileyana</i> F.Muell.	Cootamundra wattle	tree	—	—	134	26	—
<i>Acacia dealbata</i> Link	silver wattle	tree	—	—	209	100	—
<i>Acacia longifolia</i> (Andrews) Willd.	Sydney golden wattle and coastal wattle	tree	—	—	468	189	Northland (SC), Auckland (SC), Bay of Plenty (SC), Chatham Islands (OOI)
<i>Acacia mearnsii</i> De Wild.	black wattle	tree	—	—	124	169	Auckland (SC)
<i>Acacia melanoxylon</i> R.Br.	blackwood	tree	—	—	288	74	—
<i>Acacia paradoxa</i> DC.	kangaroo acacia	tree	—	—	87	41	Northland (SC), Auckland (PC, SC)
<i>Acacia verticillata</i> (L'Her.) Willd.	prickly moses	tree	—	—	115	30	Northland (SC), Auckland (SC)
<i>Acanthus mollis</i> L.	bear's breeches	herb	—	—	750	89	—
<i>Acer negundo</i> L.	box elder	tree	—	—	210	5	—
<i>Acer pseudoplatanus</i> L.	sycamore	tree	—	—	1618	423	Northland (SC), Tasman-Nelson (SL, OOI), Canterbury (OOI), Otago (SL), Chatham Islands (PC)
<i>Actinidia chinensis</i> Planch.	kiwifruit	climber	—	—	388	101	Northland (E), Auckland (PC), Waikato (PC), Bay of Plenty (PC), Tasman-Nelson (E)
<i>Adiantum raddianum</i> C.Presl.	maidenhair	herb	—	—	324	3	—
<i>Agapanthus praecox</i> Willd.	agapanthus	herb	—	—	886	493	Northland (SC), Auckland (SL, SC), Gisborne (SL)
<i>Agave americana</i> L.	century plant	shrub	—	—	110	48	Northland (SC), Auckland (SC)
<i>Ageratina adenophora</i> (Spreng.) R.M.King & H.Rob.	Mexican devil	herb	—	—	277	1037	Auckland (SC)
<i>Ageratina riparia</i> (Regel) R.M.King & H.Rob.	mistflower	herb	—	—	266	415	Auckland (SC), Bay of Plenty (SC), Canterbury (OOI)
<i>Ageratum houstonianum</i> Mill.	blue billy goat weed	herb	—	—	51	32	—
<i>Agrostis capillaris</i> L.	browntop	caespitose	—	—	2059	396	—
<i>Ailanthus altissima</i> (Mill.) Swingle	tree of heaven	tree	UO	NPPA	117	6	Auckland (E, SC)

Continued on next page

Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Akebia quinata</i> (Houtt.) Decne.	chocolate vine	climber	UO	NPPA	113	110	Northland (E), Auckland (SC), Waikato (PC), Bay of Plenty (SC), Tasman-Nelson (SC), West Coast (PC)
<i>Allium triquetrum</i> L.	onion weed	caespitose	—	—	890	171	—
<i>Alnus glutinosa</i> (L.) Gaertn.	common alder	tree	—	—	250	131	Auckland (SC), Waikato (SL)
<i>Alocasia brisbanensis</i> (F.M.Bailey) Domin	elephant's ears	herb	—	—	240	124	Northland (SC), Auckland (SC)
<i>Aloe maculata</i> All.	spotted aloe	caespitose	—	—	74	1	Auckland (SC)
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	alligator weed	herb	UO	NPPA	373	176	Auckland (EX, SL, SC), Waikato (PC), Bay of Plenty (EX, E, PC), Gisborne (EX), Hawke's Bay (EX), Manawatū-Whanganui (E), Wellington (EX)
<i>Amphilophium crucigerum</i> (L.) L.G.Lohmann	monkey's comb	climber	UO	NPPA	18	0	Gisborne (E)
<i>Andropogon virginicus</i> L.	broomsedge	caespitose	—	—	26	10	Auckland (E), Canterbury (EX)
<i>Angelica pachycarpa</i> Lange	angelica	herb	—	—	253	41	—
<i>Anredera cordifolia</i> (Ten.) Steenis	Madeira vine	climber	UO	NPPA	340	238	Auckland (PC, SL, SC), Gisborne (PC), Taranaki (E), Tasman-Nelson (E), Marlborough (SC), West Coast (E)
<i>Aponogeton distachyos</i> L.f.	Cape pondweed	herb	—	—	241	18	Auckland (E)
<i>Araujia sericifera</i> Brot.	moth plant	climber	UO	NPPA	1285	438	Auckland (SL, E, SC), Waikato (PC, SC), Bay of Plenty (SC), Gisborne (PC), Hawke's Bay (OOI), Manawatū-Whanganui (PC), Taranaki (E), Wellington (E), Marlborough (SC), Canterbury (E), Otago (EX)
<i>Archontophoenix cunninghamiana</i> (H.Wendl.) H.Wendl. & Drude	Bangalow palm	tree	—	—	220	2	Auckland (SL, SC)
<i>Arctium minus</i> (Hill) Bernh.	common burdock	herb	—	—	309	90	Auckland (SC), Gisborne (PC), Canterbury (OOI), Otago (OOI)
<i>Aristea ecklonii</i> Baker	blue-eyed iris	caespitose	UO	NPPA	369	876	Auckland (SL, SC)
<i>Artemisia verlotiorum</i> Lamotte	Chinese mugwort	herb	—	—	80	3	Gisborne (EX)
<i>Arum italicum</i> Mill.	Italian arum	herb	—	—	316	82	Auckland (SC)
<i>Arundo donax</i> L.	giant reed	herb	UO	NPPA	203	109	Auckland (E, SL, SC), Gisborne (SL), Taranaki (E)
<i>Asparagus aethiopicus</i> L.	bushy asparagus	herb	UO	NPPA	162	27	Auckland (E, SL, SC), West Coast (E)
<i>Asparagus asparagoides</i> (L.) Druce	smilax	climber	UO	NPPA	400	441	Auckland (PC, SC), Gisborne (SL), West Coast (EX), Southland (E)

Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Asparagus scandens</i> Thunb.	climbing asparagus	herb	UO	NPPA	1202	651	Auckland (E, SL, SC), Bay of Plenty (SC), Tasman-Nelson (SC, OOI)
<i>Asphodelus fistulosus</i> L.	asphodel	caespitose	—	—	72	8	—
<i>Azolla pinnata</i> R.Br.	ferry azolla	herb	—	—	383	15	—
<i>Baccharis halimifolia</i> L.	baccharis	shrub	—	—	30	1	Auckland (SC), Canterbury (PC)
<i>Banksia integrifolia</i> L.fil.	coastal banksia	tree	—	—	402	98	Northland (SC), Auckland (SL, SC), Bay of Plenty (SC)
<i>Bartlettina sordida</i> (Less.) R.M.King & H.Rob.	bartlettina	shrub	—	—	75	15	Auckland (SC)
<i>Bellis perennis</i> L.	lawn daisy	herb	—	—	1085	60	—
<i>Berberis darwinii</i> Hook.	Darwin's barberry	shrub	UO	NPPA	864	2154	Auckland (SC), Waikato (PC), Bay of Plenty (EX, PC), Hawke's Bay (PC), Manawatū-Whanganui (PC), Tasman-Nelson (SL, OOI), Canterbury (SC), West Coast (PC), Otago (SL), Southland (PC)
<i>Berberis glaucocarpa</i> Stapf	barberry	shrub	—	—	564	952	Auckland (SC), Gisborne (SC), Canterbury (OOI)
<i>Betula pendula</i> Roth	silver birch	tree	—	—	238	110	Canterbury (OOI)
<i>Biancaea decapetala</i> (Roth) O.Deg.	Mysore thorn	shrub	—	—	16	12	—
<i>Bidens frondosa</i> L.	beggars' ticks	herb	—	—	339	67	Canterbury (OOI)
<i>Bomarea multiflora</i> (L.f.) Mirb.	bomarea	climber	UO	NPPA	163	28	Auckland (SC), Manawatū-Whanganui (E), Tasman-Nelson (PC), Otago (PC), Southland (PC)
<i>Bromus tectorum</i> L.	downy brome	caespitose	—	—	134	7	—
<i>Bryonia cretica</i> L.	white bryony	herb	UO, NO	NIPR	0	12	—
<i>Buddleja davidii</i> Franch.	buddleia	shrub	—	—	939	1092	Northland (SC), Auckland (SC), Gisborne (SL), Canterbury (OOI), Otago (OOI), Southland (PC), Chatham Islands (PC)
<i>Buddleja madagascariensis</i> Lam.	orange Madagascar buddleia	shrub	—	—	24	29	—
<i>Calamagrostis arenaria</i> (L.) Roth	marram	caespitose	—	—	848	627	Auckland (SC)
<i>Callistachys lanceolata</i> Vent.	oxylobium	tree	—	—	68	11	Northland (SC), Auckland (SC), Canterbury (EX)
<i>Calluna vulgaris</i> (L.) Hull	heather	shrub	UO	NPPA	324	612	Auckland (SC), Southland (PC, SL), Chatham Islands (OOI)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Calystegia silvatica</i> (Kit.) Griseb.	greater bindweed	herb	—	—	710	261	Northland (SC), Tasman-Nelson (SL, OOI)
<i>Canna indica</i> L.	Indian shot	subshrub	—	—	100	38	—
<i>Carex demissa</i> Hornem.	European yellow sedge	caespitose	—	—	152	23	—
<i>Carex divisa</i> Huds.	divided sedge	caespitose	—	—	108	22	Auckland (SC)
<i>Carex divulsa</i> Stokes	grey sedge	caespitose	—	—	256	32	Auckland (SC)
<i>Carex flacca</i> Schreb.	blue sedge	caespitose	—	—	132	2	—
<i>Carex leporina</i> L.	oval sedge	caespitose	—	—	444	0	—
<i>Carex longebrachiata</i> Boeckeler	Australian sedge	caespitose	—	—	0	30	Auckland (SC), Gisborne (PC), Hawke's Bay (PC), Manawatū-Whanganui (PC), Tasman-Nelson (OOI), Canterbury (EX)
<i>Carex lurida</i> Wahlenb.	sallow sedge	caespitose	—	—	38	6	—
<i>Carex pendula</i> Huds.	pendulous sedge	caespitose	UO	NPPA	172	0	Canterbury (OOI)
<i>Carex scoparia</i> Schkuhr ex Willd.	broom sedge	caespitose	—	—	27	2	Auckland (E, SC), Waikato (SL)
<i>Carpobrotus chilensis</i> (Molina) N.E.Br.	purple-flowered iceplant	herb	—	—	219	0	—
<i>Carpobrotus edulis</i> (L.) N.E.Br.	iceplant	herb	UO	NPPA	676	142	Auckland (SC), Chatham Islands (PC)
<i>Casuarina glauca</i> Sieber	swamp she-oak	tree	—	—	5	11	—
<i>Caulerpa brachypus</i> Harv.	caulerpa	herb	UO	—	4	0	—
<i>Celastrus orbiculatus</i> Thunb.	climbing spindleberry	climber	UO	NPPA	84	287	Northland (EX), Auckland (PC), Waikato (PC), Bay of Plenty (PC, SC), Gisborne (E), Hawke's Bay (OOI), Manawatū-Whanganui (E), Taranaki (E), Wellington (SC), Tasman-Nelson (E), Marlborough (E)
<i>Cenchrus alopecuroides</i> (L.) Thunb.	Chinese fountain grass	caespitose	UO	NPPA	17	0	Auckland (SC), Manawatū-Whanganui (E), Tasman-Nelson (PC), Marlborough (SC)
<i>Cenchrus caudatus</i> (Schrud.) Kuntze	African feather grass	caespitose	UO	NPPA	138	142	Northland (PC), Auckland (E), Waikato (E), Bay of Plenty (PC), Gisborne (E), Hawke's Bay (E), Manawatū-Whanganui (E), Tasman-Nelson (E), Marlborough (SC), Canterbury (PC), West Coast (E), Otago (EX)
<i>Cenchrus clandestinus</i> (Hochst. ex Chiov.) Morrone	Kikuyu grass	caespitose	UO	—	549	278	—
<i>Cenchrus longisetus</i> M.C.Johnst.	feathertop	caespitose	UO	NPPA	55	0	Auckland (SC), Gisborne (E)
<i>Cenchrus purpureus</i> (Schumach.) Morrone	elephant grass	caespitose	UO	NPPA	14	0	Auckland (SC)
<i>Cenchrus setaceus</i> (Forssk.) Morrone	African fountain grass	caespitose	UO	NPPA	85	0	Auckland (SC)
<i>Centranthus ruber</i> (L.) DC.	spur valerian	herb	—	—	807	51	Auckland (SC), Canterbury (OOI)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Ceratophyllum demersum</i> L.	hornwort	herb	UO	NPPA	542	81	Auckland (EX, SL, SC), Bay of Plenty (EX, E, PC), Gisborne (PC), Hawke's Bay (OOI), Manawatū-Whanganui (PC), Tasman-Nelson (EX), Canterbury (EX), West Coast (EX), Otago (EX)
<i>Cestrum aurantiacum</i> Lindl.	orange cestrum	shrub	UO	NPPA	84	87	—
<i>Cestrum elegans</i> (Brongn. ex Neumann) Schltld.	red cestrum	shrub	UO	NPPA	113	46	Gisborne (E)
<i>Cestrum fasciculatum</i> (Schltld.) Miers	red cestrum	shrub	UO	NPPA	42	7	Gisborne (E)
<i>Cestrum nocturnum</i> L.	night-blooming jasmine	shrub	UO	NPPA	140	6	Northland (SC), Auckland (SC)
<i>Chamaecytisus prolifer</i> (L.f.) Link	tagasaste	tree	—	—	806	52	Canterbury (OOI)
<i>Chlorophytum comosum</i> (Thunb.) Jacques	spider plant	herb	—	—	86	14	—
<i>Chrysojasminum humile</i> (L.) Banfi	Italian jasmine	shrub	UO	NPPA	40	14	Auckland (SC), Tasman-Nelson (SC)
<i>Cirsium arvense</i> (L.) Scop.	Californian thistle	herb	—	—	1035	382	Auckland (SC), Tasman-Nelson (OOI)
<i>Cirsium vulgare</i> (Savi) Ten.	Scotch thistle	herb	—	—	2311	764	—
<i>Clematis flammula</i> L.	fragrant virgin's bower	climber	UO	NPPA	54	9	Auckland (EX, SC)
<i>Clematis terniflora</i> DC.	sweet autumn clematis	climber	—	—	68	4	—
<i>Clematis vitalba</i> L.	old man's beard	climber	UO	NPPA	3509	14899	Northland (EX), Auckland (PC), Waikato (PC, SL), Bay of Plenty (PC, SC), Gisborne (PC), Hawke's Bay (PC), Manawatū-Whanganui (PC), Taranaki (SC), Wellington (SL), Tasman-Nelson (SC, OOI), Canterbury (SC, SL), West Coast (PC), Otago (PC), Southland (PC), Chatham Islands (E)
<i>Cobaea scandens</i> Cav.	cathedral bells	climber	UO	NPPA	174	153	Northland (E), Auckland (PC), Waikato (E), Bay of Plenty (SC), Hawke's Bay (E), Manawatū-Whanganui (E), Wellington (SL), Tasman-Nelson (E), Marlborough (SC), Canterbury (SL), West Coast (E)
<i>Cornus capitata</i> Wall.	strawberry dogwood	tree	—	—	311	111	Bay of Plenty (SC)
<i>Cortaderia jubata</i> (Lemoine) Stapf	purple pampas	caespitose	UO	NPPA	259	2006	Auckland (SL, SC), Waikato (SC, SL), Gisborne (SC), Tasman-Nelson (OOI), West Coast (PC), Chatham Islands (OOI)
<i>Cortaderia selloana</i> (Schult. & Schult.f.) Asch. & Graebn.	white pampas	caespitose	UO	NPPA	1253	2537	Auckland (SL, SC), Waikato (SC, SL), Gisborne (SC), Hawke's Bay (OOI), Tasman-Nelson (OOI), West Coast (PC), Chatham Islands (OOI)
<i>Cotoneaster coriaceus</i> Franch.	milk-flower cotoneaster	shrub	—	—	366	0	Tasman-Nelson (SL), Otago (OOI)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Cotoneaster franchetii</i> Boiss.	Franchet's cotoneaster	shrub	—	—	372	193	Northland (SC), Auckland (SC), Hawke's Bay (OOI), Tasman-Nelson (SL), Canterbury (OOI), Otago (OOI), Southland (PC), Chatham Islands (OOI)
<i>Cotoneaster glaucophyllus</i> Franch.	large-leaved cotoneaster	shrub	—	—	414	1137	Northland (SC), Auckland (SC), Bay of Plenty (SC), Hawke's Bay (OOI), Tasman-Nelson (SL, OOI), Canterbury (OOI), Otago (OOI), Southland (PC), Chatham Islands (OOI)
<i>Cotoneaster simonsii</i> Baker	Khasia berry	shrub	UO	NPPA	351	387	Auckland (SC), Tasman-Nelson (SL), Otago (OOI), Southland (PC)
<i>Cotyledon orbiculata</i> L.	pig's ear	subshrub	UO	NPPA	434	27	Auckland (SC), Canterbury (OOI)
<i>Crassula multicava</i> Lem.	fairly crassula	herb	UO	NPPA	401	63	Auckland (SC)
<i>Crataegus monogyna</i> Jacq.	hawthorn	tree	—	—	1071	724	Auckland (SC), Gisborne (SC), Canterbury (OOI), Otago (OOI), Southland (SL)
<i>Crocosmia ×crocosmiiflora</i> (Lemoine) N.E.Br.	montbretia	caespitose	—	—	950	1171	Auckland (SC)
<i>Cupressus macrocarpa</i> Hartw. ex Gordon	macrocarpa	tree	—	—	595	310	—
<i>Cuscuta campestris</i> Yunck.	golden dodder	herb	UO	—	15	145	Waikato (PC)
<i>Cynodon dactylon</i> (L.) Pers.	Indian doab	caespitose	—	—	308	36	—
<i>Cyperus eragrostis</i> Lam.	umbrella sedge	caespitose	—	—	745	121	—
<i>Cyperus rotundus</i> L.	nutgrass	caespitose	—	—	47	4	Northland (E), Auckland (SC), Tasman-Nelson (OOI), Canterbury (EX)
<i>Cyrtomium falcatum</i> (L.fil.) C.Presl	holly fern	herb	—	—	155	9	—
<i>Cytisus multiflorus</i> (L'Hér.) Sweet	white broom	shrub	—	—	47	9	Canterbury (SC, SL), Chatham Islands (E)
<i>Cytisus scoparius</i> (L.) Link	Scotch broom	shrub	—	—	1922	3734	Northland (SC), Auckland (PC), Waikato (SC, SL), Gisborne (SL), Hawke's Bay (OOI), Manawatū-Whanganui (PC), Taranaki (SC), Tasman-Nelson (SC), Marlborough (SC), Canterbury (SC, SL), West Coast (PC, SC), Otago (SC), Southland (SC), Chatham Islands (E)
<i>Dactylis glomerata</i> L.	cocksfoot	caespitose	—	—	1476	417	—
<i>Datura stramonium</i> L.	thornapple	herb	—	—	348	23	Gisborne (SC)
<i>Delairea odorata</i> Lem.	German ivy	herb	—	—	608	406	Northland (SC), Auckland (SC), Canterbury (OOI), Southland (E)
<i>Digitalis purpurea</i> L.	foxglove	herb	—	—	2009	735	—
<i>Dimorphotheca fruticosa</i> (L.) Less., 1832	dimorphotheca	herb	—	—	236	9	—

Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Dipogon lignosus</i> (L.) Verdc.	mile a minute	climber	UO	NPPA	234	432	Northland (PC), Auckland (PC, SC), Waikato (E), Bay of Plenty (SC), West Coast (PC)
<i>Dolichandra unguis-cati</i> (L.) L.G.Lohmann	cat's claw creeper	climber	UO	NPPA	25	7	Auckland (SC)
<i>Dryopteris affinis</i> (Lowe) Fraser-Jenk.	scaly male fern	herb	–	–	172	0	–
<i>Dryopteris filix-mas</i> (L.) Schott	male fern	herb	–	–	716	52	Auckland (SC), Bay of Plenty (SC), Tasman-Nelson (OOI), Chatham Islands (OOI)
<i>Eccremocarpus scaber</i> Ruiz & Pav.	Chilean glory creeper	subshrub	UO	NPPA	74	10	Auckland (SC), Canterbury (OOI)
<i>Echium vulgare</i> L.	viper's bugloss	herb	–	–	1006	62	Canterbury (OOI)
<i>Ehrharta erecta</i> Lam.	veldt grass	caespitose	–	–	621	1038	Tasman-Nelson (OOI), Otago (OOI), Chatham Islands (OOI)
<i>Ehrharta villosa</i> Schult.f.	pyp grass	caespitose	UO, NO	NPPA, NIPR	21	23	–
<i>Elaeagnus xreflexa</i> É.Morren & Decne.	elaeagnus	shrub	–	–	337	337	Northland (SC), Auckland (SC), Canterbury (OOI), West Coast (PC)
<i>Elodea canadensis</i> Michx.	Canadian pondweed	herb	–	–	1320	158	Auckland (EX, SC), Bay of Plenty (EX, SC)
<i>Elodea densa</i> (Planch.) Casp.	dense waterweed	herb	UO	NPPA	729	75	Auckland (E, SL SC), Bay of Plenty (EX, PC), Gisborne (EX), Manawatū-Whanganui (PC), Tasman-Nelson (E), Canterbury (E), West Coast (PC), Otago (EX)
<i>Embothrium coccineum</i> J.R.Forst. & G.Forst.	Chilean fire bush	tree	–	–	70	20	–
<i>Epilobium hirsutum</i> L.	great willowherb	herb	UO	–	82	5	–
<i>Equisetum arvense</i> L.	field horsetail	herb	UO	NPPA	251	88	Northland (E), Auckland (SC), Waikato (EX), Bay of Plenty (EX), Manawatū-Whanganui (PC), Southland (E)
<i>Eragrostis curvula</i> (Schrud.) Nees	African love grass	caespitose	UO	NPPA	61	1	Canterbury (PC), Otago (PC)
<i>Erica arborea</i> L.	tree heath	shrub	–	–	65	3	–
<i>Erica baccans</i> L.	berry heath	shrub	–	–	77	11	Auckland (SC)
<i>Erica caffra</i> L.	hedge heath	shrub	–	–	36	1	–
<i>Erica cinerea</i> L.	bell heather	shrub	UO	–	46	4	Canterbury (SC)
<i>Erica lusitanica</i> Rudolphi	Spanish heath	shrub	–	–	839	1058	Auckland (SC), Tasman-Nelson (OOI), Canterbury (OOI), Otago (OOI), Southland (SL), Chatham Islands (OOI)
<i>Erica vagans</i> L.	Cornish heath	shrub	–	–	27	3	–
<i>Erigeron karvinskianus</i> DC.	Mexican daisy	herb	UO	NPPA	773	425	Auckland (SC), Gisborne (SL)

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<i>Erythranthe guttata</i> (DC.) G.L.Nesom	monkey musk	herb	—	—	881	174	Northland (E)
<i>Erythrina xsykesii</i> Barneby & Krukoff	Australian coral tree	tree	—	—	123	60	—
<i>Eschscholzia californica</i> Cham.	California poppy	herb	—	—	596	22	—
<i>Eucalyptus delegatensis</i> F.Muell. ex R.T.Baker	alpine ash	tree	—	—	58	9	—
<i>Euonymus europaeus</i> L.	spindle tree	tree	—	—	645	67	—
<i>Euonymus japonicus</i> Thunb.	Japanese spindleberry	tree	—	NPPA	366	96	Auckland (SC)
<i>Eupatorium cannabinum</i> L.	hemp agrimony	herb	—	—	38	17	—
<i>Euphorbia paralias</i> L.	sea spurge	Herb	UO	—	72	54	Northland (EX), Chatham Islands (OOI)
<i>Fatsia japonica</i> (Thunb.) Decne. & Planch.	fatsia	shrub	—	—	836	41	Auckland (SC)
<i>Festuca rubra</i> L.	red fescue	caespitose	—	—	1195	67	—
<i>Ficus macrophylla</i> Pers.	Moreton Bay fig	tree	—	—	310	11	Auckland (SC)
<i>Fraxinus excelsior</i> L.	ash	tree	—	—	145	29	Canterbury (OOI)
<i>Fuchsia boliviana</i> Carrière	Bolivian fuchsia	shrub	UO	NPPA	152	3	Auckland (SC)
<i>Furcraea foetida</i> (L.) Haw.	Mauritius hemp	shrub	—	—	33	2	Northland (SC), Auckland (SC)
<i>Furcraea selloa</i> K.Koch	wild sisal	shrub	—	—	11	0	Northland (SC), Auckland (SC)
<i>Genista monspessulana</i> (L.) L.A.S.Johnson	Montpellier broom	shrub	—	—	505	176	Auckland (SC), Gisborne (SL), Manawatū-Whanganui (PC), Canterbury (SC, SL), Otago (SC), Chatham Islands (E)
<i>Glaucium flavum</i> Crantz	horned poppy	herb	—	—	328	39	—
<i>Glyceria declinata</i> Bréb.	blue sweet grass	caespitose	—	—	257	66	—
<i>Glyceria fluitans</i> (L.) R.Br.	floating sweetgrass	caespitose	—	—	127	51	Waikato (SL)
<i>Glyceria maxima</i> (Hartm.) Holmb.	reed sweetgrass	caespitose	—	—	435	365	Auckland (E, SC), Waikato (SL), Bay of Plenty (SC), Gisborne (PC), Hawke's Bay (OOI), Manawatū-Whanganui (PC), Tasman-Nelson (PC), Marlborough (SC), Canterbury (OOI), Otago (OOI), Southland (PC), Chatham Islands (E)
<i>Gunnera tinctoria</i> (Molina) Mirb.	Chilean rhubarb	herb	UO	NPPA	399	947	Northland (E), Auckland (SC), Waikato (PC, SL), Bay of Plenty (SC), Gisborne (SL), Manawatū-Whanganui (E), Taranaki (SC), Tasman-Nelson (SC), West Coast (PC), Otago (SL), Southland (SL), Chatham Islands (E)

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SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Gymnocoronis spilanthoides</i> DC.	Senegal tea	herb	UO	NPPA	115	7	Northland (E), Auckland (PC), Waikato (E), Bay of Plenty (E), Gisborne (EX), Hawke's Bay (EX), Manawatū-Whanganui (E), Taranaki (E), Wellington (E), Tasman-Nelson (EX), Marlborough (EX), Canterbury (OOI)
<i>Hakea gibbosa</i> (Sm.) Cav.	downy hakea	shrub	—	—	58	64	Northland (SC), Auckland (SC)
<i>Hakea salicifolia</i> (Vent.) B.L.Burt	willow-leaved hakea	tree	—	—	253	86	Northland (SC), Auckland (SC), Marlborough (E), Tasman-Nelson (OOI)
<i>Hakea sericea</i> Schrad. & J.C.Wendl.	prickly hakea	shrub	—	—	357	253	Northland (SC), Auckland (SC), Tasman-Nelson (OOI)
<i>Hedera canariensis</i> Willd.	Canary Islands ivy	climber	—	—	71	0	Auckland (SC)
<i>Hedera helix</i> L.	English ivy	climber	—	—	1619	619	Northland (SC), Auckland (SL, SC), Bay of Plenty (SC), Gisborne (SL)
<i>Hedychium flavescens</i> Carey ex Roscoe	yellow ginger	herb	UO	NPPA	96	142	Northland (SC), Auckland (E, SL, SC), Waikato (SC), Bay of Plenty (SC), Gisborne (SC), Taranaki (SC), Tasman-Nelson (SC, OOI), West Coast (PC), Chatham Islands (E)
<i>Hedychium gardnerianum</i> Sheph. ex Ker Gawl.	wild ginger	herb	UO	NPPA	1058	1325	Northland (SC), Auckland (E, SL, SC), Waikato (SC), Bay of Plenty (SC), Gisborne (SC), Taranaki (SC), Tasman-Nelson (SC, OOI), West Coast (PC), Otago (OOI), Chatham Islands (E)
<i>Helichrysum petiolare</i> Hilliard & B.L.Burt	liquorice plant	subshrub	—	—	209	16	—
<i>Helosciadium nodiflorum</i> (L.) W.D.J.Koch	water celery	herb	—	—	360	28	Hawke's Bay (OOI)
<i>Hieracium levicaule</i> Jord.	tussock hawkweed	herb	UO	NPPA	568	570	Auckland (SC), Manawatū-Whanganui (EX), Canterbury (OOI), Otago (OOI)
<i>Holcus lanatus</i> L.	Yorkshire fog	caespitose	—	—	2556	400	—
<i>Homalanthus populifolius</i> Graham	Queensland poplar	tree	UO	NPPA	219	18	Auckland (E, SC), Manawatū-Whanganui (E), Tasman-Nelson (SC)
<i>Humulus lupulus</i> L.	hops	climber	—	—	130	0	Tasman-Nelson (OOI)
<i>Hydrangea macrophylla</i> (Thunb.) Ser.	hydrangea	shrub	—	—	333	395	—
<i>Hypericum androsaemum</i> L.	tutsan	shrub	UO	NPPA	893	567	Auckland (SC), Waikato (SC), Manawatū-Whanganui (PC), Canterbury (OOI)
<i>Hypericum perforatum</i> L.	St John's wort	herb	—	—	590	51	—
<i>Ilex aquifolium</i> L.	holly	tree	—	—	873	298	Tasman-Nelson (SL, OOI), Canterbury (OOI)

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<i>Impatiens glandulifera</i> Royle	Himalayan balsam	herb	—	—	222	41	Manawatū-Whanganui (E), Tasman-Nelson (E), Canterbury (OOI)
<i>Impatiens sodenii</i> Engl. & Warb. ex Engl.	shrub balsam	subshrub	—	—	229	45	—
<i>Imperata cylindrica</i> (L.) P.Beauv.	blood grass	caespitose	—	—	19	0	—
<i>Ipomoea indica</i> (Burm.) Merr.	blue morning glory	herb	UO	NPPA	387	203	Auckland (SL, SC), Gisborne (SL), Hawke's Bay (OOI), West Coast (PC)
<i>Iris foetidissima</i> L.	stinking iris	caespitose	—	—	715	174	—
<i>Iris pseudacorus</i> L.	yellow flag iris	caespitose	UO	NPPA	435	389	Northland (E), Auckland (SC), Waikato (PC, SL), Bay of Plenty (PC), Gisborne (SL), Tasman-Nelson (SC), West Coast (PC), Chatham Islands (OOI)
<i>Jacobaea vulgaris</i> Gaertn.	ragwort	herb	—	—	1702	1051	Auckland (SC), Waikato (SC), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Taranaki (SC), Tasman-Nelson (SC), Canterbury (OOI), West Coast (SC), Otago (SC), Southland (SC), Chatham Islands (PC)
<i>Jasminum polyanthum</i> Franch.	white jasmine	shrub	—	—	448	271	Northland (SC), Auckland (SL, SC)
<i>Juglans ailantifolia</i> Carrière	Japanese walnut	tree	UO	NPPA	88	195	Auckland (SC), Waikato (SL)
<i>Juncus acutus</i> L.	sharp rush	caespitose	—	—	267	33	Northland (SC), Auckland (EX, SL, SC), Waikato (SL)
<i>Juncus articulatus</i> L.	jointed rush	caespitose	—	—	822	276	—
<i>Juncus bulbosus</i> L.	bulbous rush	caespitose	—	—	254	5	Waikato (SL)
<i>Juncus squarrosus</i> L.	heath rush	caespitose	—	—	110	160	Waikato (SL), Manawatū-Whanganui (EX), Otago (OOI)
<i>Kalanchoe pinnata</i> (Lam.) Pers.	air plant	herb	—	—	23	0	—
<i>Kennedia rubicunda</i> (Schneev.) Vent.	dusky coral pea	herb	UO	NPPA	35	16	Auckland (SC)
<i>Lagarosiphon major</i> (Ridl.) Moss	lakeweed	herb	UO	NPPA	916	152	Auckland (EX, SC), Bay of Plenty (EX, PC), Gisborne (E), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (SL), West Coast (PC), Otago (SL), Southland (PC)
<i>Lagunaria patersonia</i> (Andrews) G.Don	Norfolk Island hibiscus	tree	—	—	63	6	Auckland (SL, SC)
<i>Lamium galeobdolon</i> (L.) L.	aluminium plant	herb	UO	NPPA	627	289	Auckland (SC)
<i>Lantana camara</i> L.	lantana	shrub	UO	NPPA	190	90	Northland (PC), Auckland (PC), Waikato (PC), Bay of Plenty (E, PC, SC)

Table 2 continued

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<i>Larix decidua</i> Mill.	European larch	tree	—	—	145	97	Waikato (PC), Bay of Plenty (PC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Lathyrus latifolius</i> L.	everlasting pea	herb	—	—	232	40	—
<i>Lathyrus tingitanus</i> L.	Tangier pea	herb	—	—	208	34	—
<i>Laurus nobilis</i> L.	bay tree	tree	—	—	283	29	—
<i>Leptospermum laevigatum</i> (Gaertn.) F.Muell.	Victorian tea tree	tree	—	—	37	6	Bay of Plenty (E)
<i>Leucanthemum vulgare</i> Lam.	oxeye daisy	herb	—	—	718	77	—
<i>Leycesteria formosa</i> Wall.	Himalayan honeysuckle	shrub	—	—	1321	1255	Northland (SC), Auckland (SC), Canterbury (OOI), West Coast (PC)
<i>Leymus racemosus</i> (Lam.) Tzvelev	Siberian lyme grass	caespitose	—	—	75	28	Southland (PC)
<i>Ligustrum lucidum</i> W.T.Aiton	tree privet	tree	UO	NPPA	889	399	Northland (SC), Auckland (E, SL, SC), Gisborne (SL), Hawke's Bay (SC), Tasman-Nelson (OOI), West Coast (EX)
<i>Ligustrum ovalifolium</i> Hassk.	Californian privet	shrub	—	—	70	94	Northland (SC)
<i>Ligustrum sinense</i> Lour.	Chinese privet	tree	—	—	678	435	Northland (SC), Auckland (SL, SC), Waikato (SL), Gisborne (SL), Hawke's Bay (SC), Tasman-Nelson (OOI), Canterbury (OOI)
<i>Ligustrum vulgare</i> L.	European privet	shrub	—	—	19	8	Northland (SC), Waikato (SC)
<i>Lilium formosanum</i> A.Wallace	Formosan lily	caespitose	UO	NPPA	327	125	Auckland (SL, SC)
<i>Lolium arundinaceum</i> (Schreb.) Darbysh.	tall fescue	caespitose	—	—	583	0	—
<i>Lolium perenne</i> L.	perennial rye grass	caespitose	—	—	518	190	—
<i>Lomatia fraseri</i> R.Br.	tree lomatia	tree	—	—	56	0	—
<i>Lonicera japonica</i> Thunb.	Japanese honeysuckle	climber	UO	NPPA	1507	1368	Auckland (SL, SC), Waikato (SL), Gisborne (SL), Hawke's Bay (PC), West Coast (PC), Otago (OOI), Southland (PC)
<i>Lophospermum erubescens</i> D.Don ex Sweet	climbing gloxinia	herb	—	—	31	172	Auckland (E, SC), Bay of Plenty (E)
<i>Ludwigia peploides</i> (Kunth) P.H.Raven	primrose willow	herb	UO	NPPA	261	18	Auckland (SC)
<i>Luma apiculata</i> (DC.) Burret	Chilean myrtle	tree	—	—	49	3	—
<i>Lupinus arboreus</i> Sims	tree lupin	shrub	—	—	1799	989	Auckland (SC), Waikato (SL), Canterbury (OOI), Otago (OOI)

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<i>Lupinus polyphyllus</i> Lindl.	Russell lupin	herb	—	—	534	260	Tasman-Nelson (SL, OOI), Canterbury (SC), Otago (SC)
<i>Lycium ferocissimum</i> Miers	boxthorn	shrub	—	—	745	604	Auckland (SL, E, SC), Gisborne (PC), Tasman-Nelson (E), Canterbury (OOI), Southland (E), Chatham Islands (OOI), Otago (OOI)
<i>Lycopus europaeus</i> L.	gypsywort	herb	—	—	352	21	Northland (E), Auckland (SC)
<i>Lythrum salicaria</i> L.	purple loosestrife	herb	UO	NPPA	203	236	Northland (EX), Waikato (E, SL), Bay of Plenty (E), Gisborne (EX), Hawke's Bay (E), Manawatū-Whanganui (E), Wellington (PC), Tasman-Nelson (PC), Marlborough (SC), Canterbury (SC), West Coast (PC), Otago (OOI), Southland (E)
<i>Malva arborea</i> (L.) Webb & Berthel.	tree mallow	herb	—	—	569	211	—
<i>Maytenus boaria</i> Molina	Chilean maiten	tree	UO	NPPA	454	11	Canterbury (OOI)
<i>Medicago lupulina</i> L.	black medick	herb	—	—	310	21	—
<i>Melianthus major</i> L.	Cape honey flower	shrub	—	—	315	138	Northland (SC), Auckland (SC), Canterbury (OOI)
<i>Miscanthus nepalensis</i> (Trin.) Hack.	Himalayan fairy grass	caespitose	—	—	185	47	Northland (SC), Bay of Plenty (SC)
<i>Moraea flaccida</i> (Sweet) Steud.	Cape tulip	caespitose	UO, NO	NPPA, NIPR	47	2	Northland (E), Gisborne (E), Tasman-Nelson (EX)
<i>Myoporum insulare</i> R.Br.	Tasmanian ngaio	tree	UO	NPPA	144	50	Auckland (SL, SC)
<i>Myricaria germanica</i> Qaiser	false tamarisk	shrub	UO	NPPA	67	379	Auckland (SC), Canterbury (OOI), Otago (EX)
<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	parrot's feather	herb	UO	NPPA	443	84	Auckland (EX, SC), Gisborne (PC), Hawke's Bay (OOI), Marlborough (SC), Tasman-Nelson (OOI), Canterbury (OOI), West Coast (PC), Southland (E)
<i>Nardus stricta</i> L.	mat grass	caespitose	—	—	40	17	—
<i>Nassella neesiana</i> (Trin. & Rupr.) Barkworth	Chilean needle grass	caespitose	UO	NPPA	50	9	Auckland (E), Waikato (EX), Bay of Plenty (EX), Gisborne (EX), Hawke's Bay (SC), Manawatū-Whanganui (EX), Wellington (EX), Tasman-Nelson (EX), Marlborough (SC), Canterbury (SC), West Coast (EX), Otago (EX), Southland (EX), Chatham Islands (EX)
<i>Nassella tenuissima</i> (Trin.) Barkworth	fine stemmed needle grass	caespitose	UO	NPPA	85	6	Northland (E), Auckland (E), Waikato (E), Gisborne (EX), Manawatū-Whanganui (E)

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<i>Nassella trichotoma</i> (Nees) Hack. & Arechav.	nasella tussock	caespitose	UO	NPPA	110	71	Northland (E), Auckland (E), Waikato (E), Bay of Plenty (E), Gisborne (EX), Hawke's Bay (PC), Manawatū-Whanganui (E), Wellington (EX), Tasman-Nelson (PC), Marlborough (SC), Canterbury (SC), Otago (PC), Southland (EX)
<i>Nephrolepis cordifolia</i> (L.) C.Presl	tuber ladder fern	herb	UO	NPPA	614	144	Auckland (SC)
<i>Nymphaea alba</i> L.	common water lily	herb	—	—	100	91	—
<i>Nymphaea mexicana</i> Zucc.	Mexican water lily	herb	UO	NPPA	29	2	Auckland (SC), Waikato (PC), Gisborne (EX)
<i>Ochna serrulata</i> (Hochst.) Walp.	mickey mouse plant	shrub	UO	NPPA	51	47	Northland (E), Auckland (EX, SC)
<i>Olea europaea</i> L.	European olive and African olive	tree	—	—	169	76	—
<i>Opuntia monacantha</i> Haw.	drooping prickly pear	tree	—	—	67	13	Auckland (SC)
<i>Osmunda regalis</i> L.	royal fern	herb	UO	NPPA	148	127	Northland (E), Auckland (PC, SL, SC), Waikato (SL), Bay of Plenty (SC)
<i>Osteospermum moniliferum</i> L.	boneseed	shrub	UO	NPPA	1096	684	Auckland (E, SL, SC), Waikato (PC), Bay of Plenty (PC), Gisborne (PC), Hawke's Bay (OOI), Manawatū-Whanganui (PC), Wellington (SC), Tasman-Nelson (E, OOI), Marlborough (SC), Canterbury (SC), Otago (PC), Southland (EX), Chatham Islands (EX)
<i>Paraserianthes lophantha</i> (Willd.) I.C.Nielsen	brush wattle	tree	—	—	767	432	Northland (SC), Auckland (SL, SC), Chatham Islands (OOI)
<i>Paspalum distichum</i> L.	Mercer grass	caespitose	—	—	695	120	—
<i>Paspalum vaginatum</i> Sw.	saltwater paspalum	caespitose	—	—	156	34	Auckland (SL, SC)
<i>Passiflora caerulea</i> L.	blue passionflower	climber	UO	NPPA	152	41	Auckland (SC), Manawatū-Whanganui (E), Wellington (SC), Canterbury (SL), Otago (SL)
<i>Passiflora edulis</i> Sims	black passionfruit	climber	—	—	110	67	—
<i>Passiflora mixta</i> L.fil.	banana passionfruit	climber	—	—	79	45	Auckland (SC), Gisborne (PC), Manawatū-Whanganui (PC), Wellington (SL)
<i>Passiflora pinnatistipula</i> Cav.	yellow passionfruit	climber	—	—	85	21	Manawatū-Whanganui (PC), Canterbury (SL), Otago (SL)
<i>Passiflora xrosea</i> (H.Karst.) Killip	passion vine	climber	—	—	31	8	Manawatū-Whanganui (PC), Canterbury (SL), Otago (SL)
<i>Passiflora tarminiana</i> Coppens & V.E.Barney	banana passionfruit	climber	UO	NPPA	211	180	Auckland (SC), Bay of Plenty (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC, OOI), Canterbury (PC), West Coast (PC), Otago (SL), Chatham Islands (E)

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<i>Passiflora tripartita</i> (Juss.) Poir.	banana passionfruit	climber	UO	NPPA	399	641	Auckland (SC), Waikato (PC, SC), Bay of Plenty (SC), Gisborne (PC), Manawatū-Whanganui (PC), Wellington (SL), Tasman-Nelson (SC, OOI), Canterbury (SL), West Coast (PC), Otago (SL), Chatham Islands (E)
<i>Persicaria capitata</i> (Buch.-Ham. ex D.Don) H.Gross	pink-headed knotweed	herb	—	—	214	44	—
<i>Phalaris arundinacea</i> L.	reed canary grass	caespitose	—	—	106	65	Waikato (SL), Tasman-Nelson (OOI), Canterbury (OOI)
<i>Phoenix canariensis</i> H.Wildpret	Phoenix palm	tree	—	—	237	58	Northland (SC), Auckland (SL, SC), Bay of Plenty (SC), Gisborne (SL)
<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	tall reed	caespitose	—	—	129	0	Auckland (E)
<i>Phyllostachys aurea</i> (André) Rivière & C.Rivière	fishpole bamboo	caespitose	—	—	101	12	Auckland (SC)
<i>Phytolacca icosandra</i> L.	inkweed	shrub	—	—	879	447	—
<i>Pilosella officinarum</i> Vaill.	mouse-ear hawkweed	herb	UO	NPPA	1875	181	Auckland (SC)
<i>Pilosella piloselloides</i> (Vill.) Soják	king devil and tall hawkweed	herb	—	—	1096	48	Auckland (SC)
<i>Pinus contorta</i> Douglas ex Loudon	contorta pine	tree	UO	NPPA	346	898	Northland (SC), Auckland (SC), Waikato (PC), Bay of Plenty (PC), Gisborne (SL), Hawke's Bay (PC), Manawatū-Whanganui (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus halepensis</i> Mill.	Aleppo pine	tree	—	—	33	4	Wellington (PC)
<i>Pinus monticola</i> Douglas ex. D.Don.	western white pine		—	—	28	0	Wellington (PC)
<i>Pinus mugo</i> Turra	dwarf mountain pine	tree	—	—	109	27	Waikato (PC), Bay of Plenty (PC), Manawatū-Whanganui (PC), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus muricata</i> D.Don	bishop pine	tree	—	—	128	14	Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus nigra</i> J.F.Arnold	Corsican pine and black pine	tree	—	—	294	103	Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)

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<i>Pinus patula</i> Schiede ex Schltdl. & Cham.	Mexican weeping pine	tree	—	—	111	10	Wellington (PC)
<i>Pinus pinaster</i> Aiton	maritime pine	tree	—	—	252	133	Northland (SC), Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus ponderosa</i> Douglas ex C.Lawson	Ponderosa pine	tree	—	—	161	25	Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus radiata</i> D.Don	radiata pine	tree	—	—	1354	1558	Northland (SC), Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus strobus</i> L.	eastern white pine	tree	—	—	81	26	Wellington (PC)
<i>Pinus sylvestris</i> L.	Scots pine	tree	—	—	121	30	Waikato (PC), Bay of Plenty (PC), Gisborne (SL), Manawatū-Whanganui (PC), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pinus thunbergii</i> Parl.	Japanese black pine	tree	—	—	20	0	Wellington (PC)
<i>Pinus uncinata</i> Ramond ex DC.	mountain pine	tree	—	—	38	0	Waikato (PC), Bay of Plenty (PC), Gisborne (SL), Manawatū-Whanganui (PC), Hawke's Bay (PC), Wellington (PC), Tasman-Nelson (OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Pittosporum undulatum</i> Vent.	sweet pittosporum	tree	UO	NPPA	36	3	Auckland (EX, SC), Manawatū-Whanganui (EX)
<i>Plectranthus ciliatus</i> E.Mey.	purple-leaved plectranthus	subshrub	UO	NPPA	227	144	Auckland (SC)
<i>Plectranthus ecklonii</i> Benth.	blue spur flower	shrub	—	—	118	35	Auckland (SC), Canterbury (OOI)
<i>Poa annua</i> L.	annual poa	caespitose	—	—	517	117	—
<i>Polygala myrtifolia</i> L.	sweet pea shrub	shrub	UO	NPPA	279	515	Auckland (SC)
<i>Polypodium vulgare</i> L.	common polypody	herb	UO	NPPA	378	2	Canterbury (OOI)
<i>Pomaderris aspera</i> Sieber ex DC.	hazel pomaderris	shrub	—	—	94	14	—
<i>Populus alba</i> L.	white poplar	tree	—	—	215	130	—
<i>Potamogeton crispus</i> L.	curled pondweed	herb	—	—	853	130	—

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<i>Prunus avium</i> (L.) L.	sweet cherry	tree	—	—	177	147	—
<i>Prunus campanulata</i> Maxim.	bell-flowered cherry, Taiwan cherry	tree	—	—	161	27	Northland (SC), Auckland (SC), Bay of Plenty (SC), Tasman-Nelson (E)
<i>Prunus domestica</i> L.	plum	tree	—	—	99	59	—
<i>Prunus laurocerasus</i> L.	cherry laurel	tree	—	—	412	132	Tasman-Nelson (OOI)
<i>Prunus lusitanica</i> L.	Portuguese laurel	tree	—	—	119	4	—
<i>Prunus serotina</i> Ehrh.	rum cherry	tree	UO	NPPA	18	14	Auckland (SC), Manawatū-Whanganui (E), Canterbury (OOI)
<i>Prunus serrulata</i> Lindl.	Japanese hill cherry	tree	—	—	217	29	Auckland (SC)
<i>Pseudosasa japonica</i> (Siebold & Zucc. ex Steud.) Makino ex Nakai	arrow bamboo	caespitose	—	—	223	101	Auckland (SC)
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Douglas fir	tree	—	—	1532	683	Northland (SC), Waikato (PC), Bay of Plenty (SC), Gisborne (SL), Hawke's Bay (PC, OOI), Wellington (PC), Tasman-Nelson (SL, OOI), Canterbury (PC), Otago (PC), Southland (PC), Chatham Islands (OOI)
<i>Psidium cattleianum</i> Afzel. ex Sabine	purple guava	shrub	—	—	95	35	Auckland (SC)
<i>Psidium guajava</i> L.	yellow guava	shrub	—	—	14	5	Auckland (SC)
<i>Psoralea pinnata</i> L.	Dally pine	shrub	—	—	137	84	Auckland (SC)
<i>Pteris cretica</i> L.	Cretan brake	herb	—	—	496	22	Tasman-Nelson (OOI)
<i>Pueraria montana</i> (Lour.) Merr.	kudzu	climber	—	—	11	5	Auckland (SC), Waikato (EX), Bay of Plenty (E)
<i>Pultenaea daphnoides</i> J.C.Wendl.	pultenaea	shrub	—	—	20	0	Northland (PC)
<i>Pyracantha angustifolia</i> (Franch.) C.K.Schneid.	narrowleaf firethorn	shrub	UO	NPPA	48	34	Northland (E), Auckland (SC)
<i>Quercus robur</i> L.	European oak	tree	—	—	256	24	—
<i>Reynoutria xbohemica</i> Chrtek & Chrtková	bohemian knotweed	herb	UO	NPPA	4	0	Auckland (PC), Tasman-Nelson (E), Canterbury (E)
<i>Reynoutria japonica</i> Houtt.	Asiatic knotweed	herb	UO	NPPA	145	234	Northland (EX), Auckland (PC), Waikato (E), Bay of Plenty (PC), Manawatū-Whanganui (E), Tasman-Nelson (E), Canterbury (E), West Coast (PC), Otago (OOI)
<i>Reynoutria sachalinensis</i> (F.Schmidt) Nakai	giant knotweed	herb	UO	NPPA	39	12	Northland (EX), Auckland (PC), Waikato (E), Manawatū-Whanganui (E), Tasman-Nelson (E), Canterbury (E), West Coast (PC)

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<i>Rhamnus alaternus</i> L.	evergreen buckthorn	shrub	UO	NPPA	361	507	Northland (E), Auckland (PC, EX, SL, SC), Waikato (E), Bay of Plenty (EX, PC), Manawatū-Whanganui (PC), Marlborough (SC)
<i>Rhaphiolepis bibas</i> (Lour.) Galasso & Banfi	loquat	tree	—	—	573	157	Auckland (SC)
<i>Rhaphiolepis umbellata</i> (Thunb.) Makino	sexton's bride	shrub	—	—	49	24	Northland (SC), Auckland (E, SC)
<i>Rhododendron ponticum</i> L.	rhododendron	shrub	UO	NPPA	53	91	Waikato (E)
<i>Ribes sanguineum</i> Pursh	flowering currant	shrub	—	—	350	29	Canterbury (OOI)
<i>Ribes uva-crispa</i> L.	gooseberry	shrub	—	—	167	159	—
<i>Ricinus communis</i> L.	castor oil plant	shrub	—	—	218	18	Auckland (SC)
<i>Robinia pseudoacacia</i> L.	black locust, false acacia	tree	—	—	207	6	—
<i>Roldana petasitis</i> (Sims) H. Rob. & Brettell	velvet groundsel	shrub	—	—	244	108	Northland (SC), Auckland (SC)
<i>Rosa rubiginosa</i> L.	sweet briar	shrub	—	—	880	758	Auckland (SC), Gisborne (SL), Canterbury (OOI), Otago (OOI), Chatham Islands (OOI)
<i>Rubus armeniacus</i> Focke	Armenian blackberry	shrub	—	—	18	0	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus cardiophyllus</i> P.J.Müll. & Lefèvre	blackberry	shrub	—	—	17	0	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus cissburiensis</i> W.P.C. Barton & Ridd.	blackberry	shrub	—	—	78	1	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus echinatus</i> Lindl.	blackberry	shrub	—	—	67	1	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus laciniatus</i> Willd.	cut-leaved blackberry	shrub	—	—	168	46	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Rubus leptothyrsos</i> G.Braun	blackberry	shrub	—	—	21	0	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus phoenicolasius</i> Maxim.	Japanese wineberry	shrub	—	—	149	33	—
<i>Rubus polyanthemus</i> Lindeb.	blackberry	shrub	—	—	20	0	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus ulmifolius</i> Schott	blackberry	shrub	—	—	89	1	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rubus vestitus</i> Weihe	blackberry	shrub	—	—	44	1	Auckland (SC), Waikato (SL), Bay of Plenty (SC), Gisborne (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (SC), Canterbury (OOI), Otago (OOI)
<i>Rumex sagittatus</i> Thunb.	climbing dock	herb	—	—	538	134	Auckland (SC)
<i>Sagina procumbens</i> L.	procumbent pearlwort	herb	—	—	644	107	—
<i>Salix cinerea</i> L.	grey willow	tree	UO	NPPA	435	1003	Auckland (E, SC), Waikato (SL), Manawatū-Whanganui (PC), Otago (OOI), Southland (SL), Chatham Islands (E)
<i>Salix purpurea</i> L.	purple willow	tree	—	—	125	1	—
<i>Salix fragilis</i> L.	crack willow	tree	UO	NPPA	649	1495	Auckland (SC), Waikato (SL), Otago (OOI), Southland (SL), Chatham Islands (E)
<i>Salpichroa origanifolia</i> (Lam.) Baill.	lily of the valley vine	herb	—	—	104	20	Northland (SC)
<i>Sambucus nigra</i> L.	elder	tree	—	—	1121	724	—
<i>Schinus terebinthifolia</i> Raddi	Brazilian pepper tree	tree	UO	NPPA	89	0	Northland (SC), Auckland (SC)
<i>Schoenoplectus californicus</i> (C.A.Mey.) Soják	California bullrush	caespitose	UO	NPPA	22	3	Auckland (SC), Waikato (SL), Manawatū-Whanganui (EX)
<i>Sedum acre</i> L.	stonecrop	herb	—	—	565	246	—
<i>Sedum praealtum</i> A.DC.	shrubby stonecrop	subshrub	—	—	91	12	—
<i>Selaginella kraussiana</i> (Kunze) A.Braun	African clubmoss, selaginella	herb	UO	NPPA	1046	879	Auckland (SC), Bay of Plenty (SC), Southland (SL), Chatham Islands (PC)
<i>Senecio angulatus</i> L.fil.	Cape ivy	herb	—	—	396	555	Northland (SC), Auckland (SC), Bay of Plenty (SC), Canterbury (OOI), West Coast (E), Otago (PC)
<i>Senecio elegans</i> L.	purple groundsel	herb	—	—	1157	218	Auckland (PC), Hawke's Bay (OOI)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Senecio glastifolius</i> L.fil.	holly-leaved senecio	herb	—	—	657	128	Northland (EX), Auckland (SC), Gisborne (PC), Hawke's Bay (OOI)
<i>Senecio skirrhodon</i> DC.	gravel groundsel	herb	—	—	990	8	Northland (SC)
<i>Senna septemtrionalis</i> (Viv.) H.S.Irwin & Barneby	Brazilian buttercup	shrub	—	—	94	103	Auckland (SC)
<i>Setaria palmifolia</i> (J.König) Stapf	palm grass	caespitose	—	—	215	23	Auckland (SC), Bay of Plenty (SC), Canterbury (EX)
<i>Setaria pumila</i> (Poir.) Roem. & Schult.	yellow bristle grass	caespitose	—	—	148	1	Auckland (SC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Tasman-Nelson (PC, OOI), Canterbury (E), West Coast (PC), Otago (OOI)
<i>Silybum marianum</i> (L.) Gaertn.	variegated thistle	herb	—	—	292	60	Auckland (SC), Waikato (E), Bay of Plenty (PC), Gisborne (PC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Taranaki (SC), Tasman-Nelson (PC), Canterbury (OOI)
<i>Solanum dulcamara</i> L.	bittersweet	herb	—	—	566	55	—
<i>Solanum laxum</i> Spreng.	potato vine	climber	—	—	174	0	—
<i>Solanum linnaeanum</i> Hepper & P.-M.L.Jaeger	apple of sodom	shrub	—	—	118	226	Bay of Plenty (PC), Gisborne (E), Hawke's Bay (PC)
<i>Solanum marginatum</i> L.fil.	white-edged nightshade	shrub	UO	NPPA	60	17	Auckland (E), Bay of Plenty (E), Gisborne (E), Hawke's Bay (E), Tasman-Nelson (PC), Marlborough (SC), Canterbury (SL), West Coast (EX), Otago (PC)
<i>Solanum mauritianum</i> Scop.	woolly nightshade	shrub	UO	NPPA	1229	599	Northland (SC), Auckland (E, SL, SC), Waikato (PC, SC), Bay of Plenty (PC, SC), Gisborne (PC), Hawke's Bay (PC), Manawatū-Whanganui (E), Wellington (E), Tasman-Nelson (SC, OOI), Marlborough (SC), Canterbury (EX), West Coast (E)
<i>Solanum pseudocapsicum</i> L.	Jerusalem cherry	shrub	—	—	306	273	—
<i>Sorbus aucuparia</i> L.	rowan	tree	—	—	468	232	Tasman-Nelson (SL, OOI), Canterbury (OOI), Otago (OOI)
<i>Spartium junceum</i> L.	Spanish broom	shrub	—	—	109	9	Auckland (E, SC), Manawatū-Whanganui (PC), Canterbury (SL)
<i>Sphaeropteris cooperi</i> (Hook. ex F.Muell.) R.M.Tryon	Australian tree fern	tree	UO	NPPA	47	1	Auckland (SC)
<i>Spiraea japonica</i> L.fil.	Japanese meadowsweet	shrub	—	—	27	55	—

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Sporobolus alterniflorus</i> (Loisel.) P.M.Peterson & Saarela	American spartina	caespitose	—	—	68	324	Northland (E), Auckland (PC, SC), Waikato (E), Bay of Plenty (E), Gisborne (PC), Hawke's Bay (EX), Manawatū-Whanganui (E), Wellington (E), Tasman-Nelson (E), Canterbury (SL), West Coast (EX), Otago (PC), Chatham Islands (OOI)
<i>Sporobolus anglicus</i> (C.E.Hubb.) P.M.Peterson & Saarela	cord grass	caespitose	—	—	115	942	Northland (E), Auckland (PC, SC), Waikato (E), Bay of Plenty (E), Gisborne (PC), Hawke's Bay (EX), Manawatū-Whanganui (E), Wellington (E), Tasman-Nelson (E), Marlborough (E), Canterbury (SL), West Coast (EX), Otago (PC), Southland (E), Chatham Islands (OOI)
<i>Sporobolus ×townsendii</i> (H.Groves & J.Groves) P.M.Peterson & Saarela	spartina	caespitose	—	—	42	58	Northland (E), Auckland (SC), Hawke's Bay (EX), Canterbury (SL), West Coast (EX), Chatham Islands (OOI)
<i>Stenotaphrum secundatum</i> (Walter) Kuntze	buffalo grass	caespitose	—	—	289	89	—
<i>Syzygium australe</i> (J.C.Wendl. ex Link) B.Hyland	brush cherry	tree	—	—	77	2	—
<i>Syzygium smithii</i> (Poir.) Nied.	monkey apple, lilly pillly	tree	UO	NPPA	226	104	Auckland (SL, SC), Bay of Plenty (SC)
<i>Tecomaria capensis</i> (Thunb.) Spach	Cape honeysuckle	shrub	—	—	160	87	—
<i>Thinopyrum acutum</i> (DC.) Banfi	sea couch	caespitose	—	—	81	17	—
<i>Thinopyrum obtusiflorum</i> (DC.) Banfi	tall wheatgrass	caespitose	—	—	5	0	Marlborough (SC)
<i>Thunbergia alata</i> Bojer ex Sims	black-eyed Susan	climber	—	—	127	4	Northland (SC)
<i>Thymus vulgaris</i> L.	wild thyme	shrub	—	—	164	42	Canterbury (SL), Otago (OOI)
<i>Toxicodendron succedaneum</i> (L.) Kuntze	Japanese wax tree	tree	—	—	49	6	Northland (SC), Auckland (E, SC)
<i>Trachycarpus fortunei</i> (Hook.) H.Wendl.	Chinese windmill palm	tree	—	—	223	35	Auckland (SL, SC), Bay of Plenty (SC), Tasman-Nelson (OOI)
<i>Tradescantia fluminensis</i> Vell.	tradescantia	herb	UO	NPPA	2740	2004	Auckland (SC), Otago (SL), Chatham Islands (OOI)
<i>Tropaeolum majus</i> L.	nasturtium	herb	—	—	784	145	—
<i>Tropaeolum speciosum</i> Poepp. & Endl.	Chilean flame creeper	climber	UO	NPPA	388	416	Auckland (SC), Waikato (E), Bay of Plenty (EX), Hawke's Bay (OOI), Canterbury (OOI), Otago (SL)
<i>Tussilago farfara</i> L.	coltsfoot	herb	UO	NPPA	17	3	Auckland (SC), Canterbury (SC), West Coast (EX)
<i>Ugni molinae</i> Turcz.	Chilean guava	shrub	—	—	68	32	Chatham Islands (E, SC)

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Table 2 continued

SCIENTIFIC NAME	COMMON NAME	GROWTH FORM	UO OR NO	NPPA OR NIPR	NUMBER OF NEW ZEALAND GBIF RECORDS	NUMBER OF DOC RECORDS	SPECIES INCLUDED ON REGIONAL PEST MANAGEMENT PLANS AT TIME OF PUBLICATION
<i>Ulex europaeus</i> L.	gorse	shrub	—	—	3155	6395	Northland (SC), Auckland (SL, SC), Waikato (SC, SL), Bay of Plenty (SC), Gisborne (PC), Hawke's Bay (SC), Manawatū-Whanganui (PC), Taranaki (SC), Tasman-Nelson (SC), Marlborough (SC), Canterbury (SC, SL), West Coast (SC), Otago (SC), Southland (SC), Chatham Islands (SC)
<i>Undaria pinnatifida</i> (Harv.) Suringar	undaria	herb	UO	—	256	4	Northland (SC), Auckland (SC), Gisborne (PC), Tasman-Nelson (OOI)
<i>Utricularia gibba</i> L.	bladderwort	herb	UO	NPPA	429	3	Auckland (SC), Gisborne (EX), Manawatū-Whanganui (EX)
<i>Vallisneria australis</i> S.W.L.Jacobs & Les	eel grass	herb	UO	NPPA	38	3	Northland (E), Auckland (EX, SC), Waikato (EX), Manawatū-Whanganui (PC), Wellington (SC), Marlborough (SC)
<i>Verbascum thapsus</i> L.	woolly mullein	herb	—	—	1107	139	—
<i>Vinca major</i> L.	periwinkle	herb	—	—	1162	551	Northland (SC), Auckland (SL, SC), Bay of Plenty (SC), Gisborne (SL), Otago (OOI)
<i>Vitis vinifera</i> L.	grape	climber	—	—	105	77	—
<i>Watsonia meriana</i> (L.) Mill.	watsonia	caespitose	—	—	198	12	—
<i>Yucca gloriosa</i> L.	Spanish dagger yucca	shrub	—	—	105	31	—
<i>Zantedeschia aethiopica</i> (L.) Spreng.	arum lily	herb	UO	NPPA	1136	576	Auckland (SC), Waikato (SL)
<i>Zizania latifolia</i> (Griseb.) Hance ex F.Muell.	Manchurian wild rice	caespitose	UO, NO	NPPA, NIPR	8	5	Northland (PC), Waikato (SL), Manawatū-Whanganui (EX)

3.2 Growth forms

Our analysis shows that climbers, shrubs and trees make up a greater proportion of environmental weeds than are represented in the entire naturalised flora (Figure 1; Table 3). In contrast, herbs comprise 52% of the naturalised flora but constitute only 28% of environmental weeds.

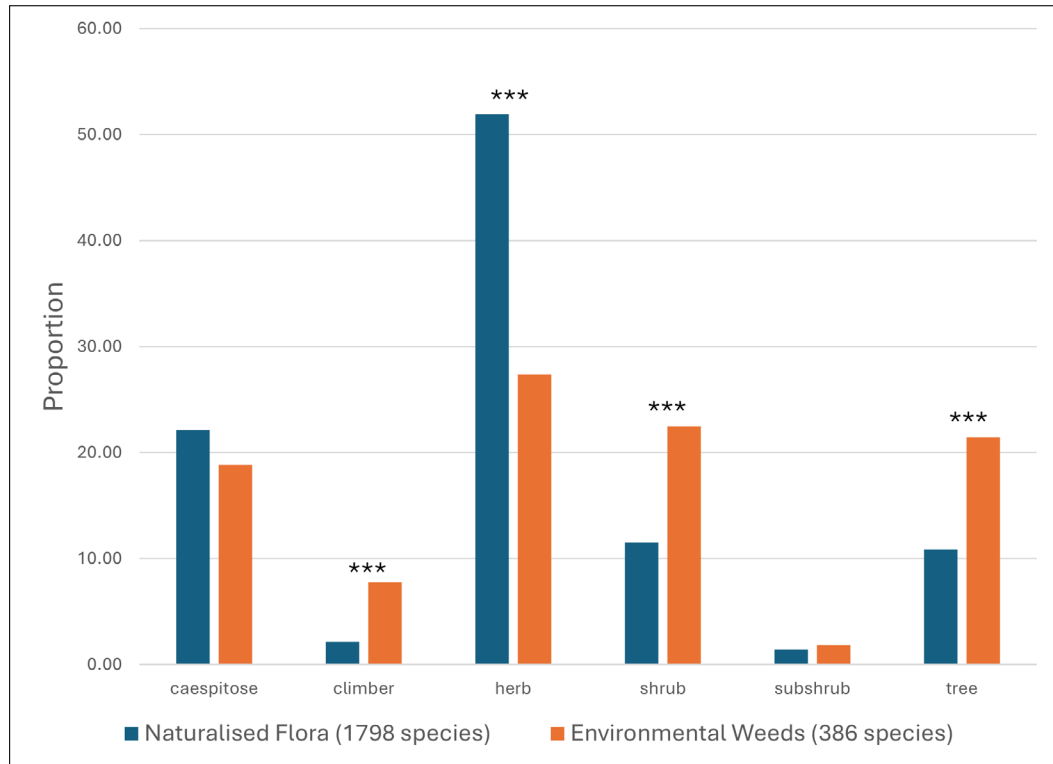


Figure 1. Comparison of the naturalised flora and environmental weeds by growth form ($P < 0.001$).

Table 3. Two-sample proportion tests comparing growth forms of the naturalised flora (1,798 species) versus the identified environmental weeds (386 species)

Growth forms	NATURALISED FLORA VS. ENVIRONMENTAL WEEDS		
	χ^2	df	P
caespitose	1.78	1	0.182
climber	28.30	1	<0.0001
herb	73.63	1	<0.0001
shrub	32.17	1	<0.0001
subshrub	0.09	1	0.760
tree	31.92	1	<0.0001

3.3 Congruence with other weed lists

A total of 529 plant species are currently listed as environmental weeds, pest plants in regional pest management plans, or as unwanted organisms in New Zealand (Figure 2). Environmental weeds comprise a major component of the species included in both RPMP and unwanted organism lists (Figure 2).

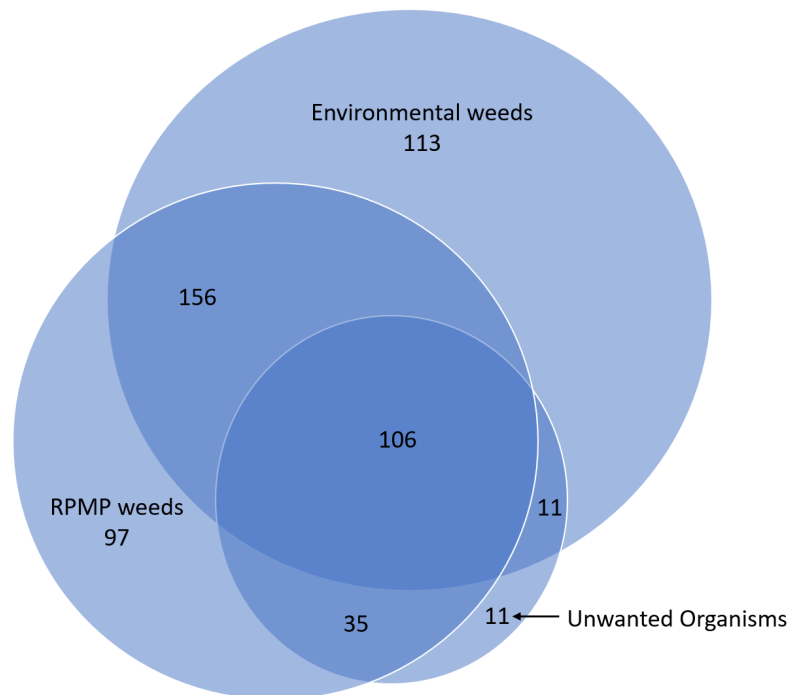


Figure 2. Congruence of species listed as environmental weeds, unwanted organisms, and plants included in at least one RPMP (not including species defined as ‘organisms of interest’).

A total of 262 (67.9%) environmental weeds are also listed in regional pest management plans in at least one region.

The majority (117/164 = 71.3%) of plant species already declared in New Zealand as unwanted organisms are environmental weeds. Of the remaining 46 unwanted organisms that are not environmental weeds, most are at very early stages of naturalisation and have yet to have significant impacts. But several plants have purely agricultural impacts (e.g., velvet-leaf *Abutilon theophrasti*), or have human health impacts (e.g., giant hogweed *Heracleum mantegazzianum*).

Five species covered under the National Interest Pest Response (NIPR) programme were excluded from the updated environmental weeds list because effective, ongoing management by MPI means they no longer have self-sustaining populations in the wild. This means they do not meet the criteria of being fully naturalised. These are salvinia (*Salvinia ×molesta*), water hyacinth (*Eichhornia crassipes*), phragmites (*Phragmites australis*), hydrilla (*Hydrilla verticillata*), and Johnson grass (*Sorghum halepense*).

More than one quarter of environmental weeds (113/386 = 29%) are not classified as unwanted organisms, or included on any regional pest management plan. This includes a number of grasses including Kikuyu grass (*Cenchrus clandestinus*) and buffalo grass (*Stenotaphrum secundatum*). This also includes species that have negative impacts in some environments

but are valuable commercial crops elsewhere e.g., European olive (*Olea europaea*) and black passionfruit (*Passiflora edulis*).

Eleven environmental weeds are unwanted organisms but are not listed in any regional pest management plan. These are monkey's comb (*Amphilophium crucigerum*), white bryony (*Bryonia cretica*), pendulous sedge (*Carex pendula*), orange cestrum (*Cestrum aurantiacum*), red cestrum (*Cestrum elegans* and *Cestrum fasciculatum*), caulerpa (*Caulerpa brachypus*), pyp grass (*Ehrharta villosa*), hairy willowherb (*Epilobium hirsutum*), Chilean maiten (*Maytenus boaria*) and common polypody (*Polypodium vulgare*).

4. Discussion

This updated list of environmental weeds in New Zealand comprises 386 species, marking an 18% rise from the 328 species on the previous list (Howell 2008). While 112 of these species are entirely new additions since 2008, 54 species from the previous list were also omitted in this update.

The overall increase is partly due to the inevitable fact that more species have naturalised in the fifteen years since the 2008 list was published. Most newly included species were the result of increased knowledge of infestations. However, some additions were due to changes in our criteria that resulted in certain weed species being excluded from the 2008 list. For example, unlike the 2008 list, this new list of environmental weeds was not limited to land or freshwater sites administered by DOC. In the previous list, this criterion resulted in some omissions e.g., Bangalow palm (*Archontophoenix cunninghamiana*). Another criteria change meant that, unlike the 2008 list, the new list includes species even if there is no record of that species being controlled or managed in some way. This was decided because not all weeds are controlled, and/or control measures are not always documented.

The inclusion of some new species into this updated list were due to taxonomic changes or decisions. The most obvious was the decision to replace the catch-all '*Rubus fruticosus* agg.' name with the nine species of *Rubus* blackberry that are known to be present in New Zealand. European and North American blackberries in the subgenus *Rubus* have high levels of polyploidy, hybridisation and a long history of cultivation. This makes them difficult to identify. However, separating these species is important because of differences in susceptibility to herbicide formulations and biological control agents (Evans et al. 2007). Blackberries from different world regions are also likely to have different climatic tolerances (Marshall 2017) and susceptibility to diseases (Hall and Shaw 1987), and may vary considerably in their invasiveness in New Zealand environments. Taxonomic research into blackberries in Australia, using morphological and genetic techniques, has improved identification tools (Barker RM and Barker WR 2005). Together with excellent phone cameras and citizen-science platforms such as iNaturalist, these tools allow the species of most new blackberry observations to be identified.

Other notable additions to the list are two exotic invasive seaweeds present in New Zealand: undaria (*Undaria pinnatifida*) and caulerpa (*Caulerpa brachypus*). Both species can have devastating impacts on marine habitats (Russell et al. 2008; South et al. 2017; Middleton 2023).

The 54 species on the 2008 list that were omitted from the current list were excluded for various reasons. Some were assessed as being not fully naturalised and/or only having minor impacts (e.g., trailing lantana *Lantana montevidensis* and Dutch elm *Ulmus ×hollandica*). Some are not known outside urban or agricultural areas (e.g., night bells *Brugmansia suaveolens* and stiff bottlebrush *Callistemon linearis*). We also excluded some former weeds

that have been controlled to very low levels, and the only populations arise from deliberate releases (e.g., water poppy *Hydrocleys nymphoides*).

The addition of 112 species that are new to the environmental weed list, while not unexpected, is cause for concern. While relatively few species have major, irreversible impacts on their own, the combined pressure from an increasing suite of environmental weeds has an enormous impact on indigenous biodiversity. It is also likely that most environmental weed species are becoming more widespread, given the difficulty and cost of eradicating even small infestations (Howell 2012).

We reported New Zealand GBIF records and DOC records for each species as a way of determining how widespread each species is (Table 2). However, the numbers reported are unlikely to reflect accurate distributions, because search-and-recording efforts are not evenly spread across the whole of New Zealand. Nevertheless, the species with the highest number of records do seem to be those that are most obviously common in the New Zealand landscape: old man's beard (*Clematis vitalba*), gorse (*Ulex europaeus*), Scotch broom (*Cytisus scoparius*), white pampas (*Cortaderia selloana*), crack willow (*Salix fragilis*) and tradescantia (*Tradescantia fluminensis*). In reporting the record numbers, we also set a baseline against which future spread can be monitored; this will be increasingly important as weed distributions begin to shift under climate change.

4.1 From naturalised to weedy

The subset of naturalised plants considered environmental weeds is clearly not random; there is a greater proportion of climbers, shrubs and trees on this updated list of environmental weeds than would be expected by chance from the entire naturalised flora. This is likely due to the impacts of physical smothering and overtopping being obvious in these growth forms, and perhaps also because these conspicuous growth forms are more frequently reported.

In contrast, there are fewer herbs on the list than would be expected by chance from the naturalised flora, as has been observed in other assessments of environmental weeds (e.g., Batiagoff and Butler 2003). This is likely because herbaceous plants typically inhabit highly modified environments and mostly have minor impacts (Henderson 2006). However, exotic grasses can be a major threat to the persistence of threatened low-stature plants (Molloy 1994; Reid 1998). Exotic grasses can also be a significant impediment to forest restoration (Eliason and Allen 1997; Norton 2009; Sullivan et al. 2009). This is especially true in New Zealand, as many areas have been subjected to rapid recent deforestation (Ogden et al. 1998; McGlone 2001; McWethy et al. 2009) and exotic grasses fill niches not utilised by indigenous plants (Craine et al. 2006).

4.2 Future weeds

As Kirk (1870) foresaw, many exotic plants in New Zealand have become invasive. Unfortunately, regular comprehensive assessments of the status of the exotic flora of New Zealand have not occurred. There is no curated list of exotic plants in cultivation (Dawson 2010). Updates on exotic plants outside cultivation do not include species with specimens lodged outside of the Allan Herbarium (e.g., Schönberger et al. 2019). Furthermore, monocots other than grasses have not been comprehensively examined at a national level since 1980 (Ogle and La Cock 2019).

In this paper, we did not attempt a full classification of all plants in New Zealand. Rather, we focused on a subset of potential environmental weeds (i.e. our list of candidate species) that represent approximately one quarter of the 2,800 exotic plant species that have been recorded wild (Schönberger et al. 2019). Full national assessments of exotic plants, excluding those in

cultivation have been made elsewhere (Pyšek et al. 2012). Assessment of the invasion status of all the estimated 25,000 exotic plant species in New Zealand (Duncan and Williams 2002) would also be possible – and useful.

In compiling this list of environmental weeds, we only included those species that currently have self-sustaining populations in the wild. This resulted in the exclusion of ‘sleepers’ weeds that are forecast to become fully invasive and to have significant impacts if allowed to establish; Himalayan wineberry (*Rubus ellipticus*) and octopus tree (*Schefflera actinophylla*) are two examples. The pool of sleeper weeds is potentially huge, considering that there are at least 25,000 exotic plant species present in New Zealand (Duncan and Williams 2002). The proportion of exotic plants that naturalise and then go on to become invasive is variable and difficult to predict, but an often-cited approximation is that c. 10% of exotics naturalise and c. 10% of naturalised species go on to become invasive. If that proves accurate in New Zealand, there could be another 250 environmental weeds amongst the 25,000 exotic plant species already here. As was recently highlighted in a review of environmental weed management in New Zealand (Parliamentary Commissioner for the Environment 2021), there is an urgent need to improve national and regional surveillance methods so that emerging weeds can be detected quickly and controlled early. Prediction of future weeds also needs to be improved (Sheppard et al. 2016), especially with the growing impacts of climate change, many of which will suit environmental weeds (Sheppard 2013; Hannah et al. 2019).

4.3 Next update

This updated list of 386 environmental weeds has been produced as an update to Howell’s (2008) consolidated list of 328 environmental weeds in New Zealand. The number of environmental weeds in New Zealand is likely to continue to increase, so the list will need to be updated on a more regular basis, ideally by an independent panel of experts. A separate list of potential sleeper weeds would also be useful, particularly for surveillance purposes, and should include all species that didn’t meet the criteria for this updated list of confirmed environment weeds in New Zealand. We strongly encourage the reporting of weed observations through apps such as iNaturalist; this will improve knowledge of current and changing weed distributions.

5. Acknowledgements

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