Shared exotica: Plant invasions of Japan and south eastern Australia

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Abstract: Japan and south eastern Australia have a large exotic flora in common, in spite of contrasting histories, physiographies and land-use patterns. There are some 187 common invading species and at least 71 of these are widespread in both locations. Some 15 widespread exotic invaders in Japan have not been recorded in Australia and a number of native Japanese plants that could be introduced as ornamentals and escape cultivation are noted. The incursion of most exotic species to Japan has been historically recent. The lack of quarantine for plants (apart from parasitic plants and plants infected with disease) coupled with large importations of wheat and soybeans from north America and contaminated grain and fodder for farm animals has led to an exponential rate of plant invasion in Japan. The apparent lack of impact of woody invading species in Japanese forests and forests margins may be due simply to the relatively short time invading species (some with long juvenile periods) have been naturalised.

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Introduction

In spite of vastly different histories of human occupation and land use, Japan and south eastern Australia host many of the same exotic plant species. Michael (2001) noted over a score of taxa in the family Asteraceae common to eastern Asia and eastern Australia and mentioned that many other plants from other plant families could be included. In this paper we compare the invasive floras of Japan and south eastern Australia.

Southern Australia and Japan are spread over similar latitudes in different hemispheres and the range of climates on the east coast of Australia are similar to those in Japan, from warm temperate to cool temperate, although rainfall is more summer-dominant at mid-latitudes (around 35°) and winters are colder in Japan especially at high-latitude (Michael 2001). Inland from the coast in eastern Australia, immediately west of the Great Dividing Range, the climate becomes drier than Japan and increases in aridity to the west. For the purposes of this paper south eastern Australia is defined as south of latitude 25° and east of longitude 141° and includes Tasmania.

Japan is 70% mountainous and its physiography is a much more complex mosaic than eastern Australia which has larger contiguous areas of similar altitude. As a consequence of this, patterns of land use are quite different in each country including the types of agriculture practised.

Prior to 1788, Australia had been occupied for at least 60 000 years by the Koori people who were principally, semi-nomadic hunter-gatherers, relying on indigenous plants and animals. Most of the eastern area of Australia was covered with evergreen forests and woodlands. With European settlement came forest clearing, European agricultural practices and the plants of European agriculture as well as familiar ornamental plants and herbs. There was a huge influx of exotic plants into Australia in the 19th and early 20th centuries. Agricultural enterprises have been principally sheep and cattle grazing and dry-land wheat farming, although a greater range of agricultural and horticultural activities has been taking place in the last 30 years.

In Japan, agriculture has been practised for more than 2 500 years (Maekawa 1943, Kasahara 1976). Paddy rice was introduced at the end of the Jomon period (circa 300 B.C.) but upland farming with *Echinochloa, Setaria, Fagopyrum* and tropical *Japonica* upland rice was conducted even earlier. Although there was a period of contact with Europe in the 16th century, Japan had remained generally isolated by *sakoku* (national seclusion) from external influences, apart from neighbouring Korea and China, until 1853, the end of the Edo period just before the Meiji revolution in 1868. So it was after this date that the majority of exotic plants have been introduced to Japan. From 1910 to 1945 Korea was a Japanese colony and migration flows built up to a total of about 2 million Koreans in Japan in 1945; Chinese also migrated in smaller numbers at this time.

In view of these contrasting histories and agricultural practices, it is remarkable that so many invading plants are common to both Japan and Australia. Understanding the reasons for this and why some exotic plants are exclusive to one country may contribute to the development of invasion theory.

Early invasions

Based on archaeological evidence in Japan a limited number of exotic species that are also exotic invaders in eastern Australia are thought to have arrived during the Jomon or the Yayoi period (i.e. before 300 A.D.) (Kasahara 1976) (Table 1).

There are a number of other plant species which are putatively prehistoric invaders of Japan (Maekawa 1943) but for which no archeological evidence has been cited (Table 2).

Table 1. Prehistoric exotic invaders of Japan that also have invaded south eastern Australia.

ASTERACEAE	LAMIACEAE
Sonchus oleraceus L.*	*Lamium amplexicaule* L.
BRASSICACEAE	POACEAE
Capsella bursapastoris (L.) Medik.	*Poa annua* L.

**'S. oleraceus'* was noted by early botanists in Australia (including Cunningham) (D. Benson pers. comm., 2002).

Table 2. Putative prehistoric exotic invaders to Japan that have also invaded south eastern Australia.*

ASTERACEAE	POLYGONACEAE
Bidens tripartita L.	*Polygonum aviculare* L
Eclipta prostrata (L.) L.	*Polygonum hydropiper* L.
CYPERACEAE	PORTULACACEAE
Cyperus difformis L.	*Portulaca oleracea* L.
Cyperus rotundus L.	
POACEAE	SOLANACEAE
Cynodon dactylon (L.) Pers.	*Solanum nigrum* L.
Digitaria ciliaris (Retz.) Koeler	
Eleusine indica (L.) Gaertn.	

*Perhaps as prehistoric invaders.

The routes of the early invading plants are thought to have been from Eurasia through China and the Korean peninsula and from South East Asia with the spread of shifting cultivation agriculture (slash and burn).

In Australia there are a few probable exotic species that are thought to have invaded before European settlement, such as *Acacia farnesiana* (L.) Willd. and there is good evidence that *Tamarindus indica* L. was introduced by Macassan traders to northern Australia in the eighteenth century (Macknight 1976).

Invasions since the 18th and 19th centuries

Following the arrival of Europeans in Australia in 1788, new plant species began to arrive in considerable numbers both intentionally and accidentally. By 1804, 29 species of introduced plants were collected around Sydney by Robert Brown (Groves 1986, 2002). In Brown's list first published in Britten (1906), the well-known plants *Anagallis arvensis* L., *Cynodon dactylon* (L.) Pers. (*Panicum dactylon* L.), *Euphorbia peplus* L., *Plantago major* L., *Poa annua* L. and *Stachys arvensis* L. were included. The numbers of new species to become naturalised in eastern and southern Australia have been estimated to have increased approximately linearly with time (Specht 1981). However Groves (2002) has shown that while the rate of naturalisation of plant species in the Sydney region has remained at a constant linear rate, the rate for naturalisation of plants in New South Wales increased sometime after 1893. The total number of alien plants in Australia was estimated to be about 2000 in 1994 (Michael 1994). Current estimates of the number of naturalised plant taxa in New South Wales and Australia based on vouchered herbarium specimens are 1564 and 2795 respectively (J. Hosking pers. comm., cited by Groves (2002).

Although the beginning of the Meiji period saw increased contact between Japan and other countries only some 25 new species were naturalised by the end of the Meiji period in 1910. Another 88 species had arrived by 1931, but most of the naturalised plants in Japan arrived after the second world war. The USA occupied Japan from 1945 to 1952 (USA military personnel are still present in several locations in Japan) but the rate of new incursions has continued at a constant logarithmic rate since the 1950's (Enomoto 1999). Of these, Enomoto (1998) listed 1195 species of naturalised plants from 105 families plus 3 subspecies, 69 varieties and 6 hybrids as weeds. Asai (1993) suggested that many weeds arrived as contaminants of wheat and soybeans imported from North America to alleviate food shortages after World War II.

Thus the total number of alien plants is similar in Japan and south eastern Australia but the time of arrival of most is more recent in Japan. Their arrival coincided with a period of rapid economic growth with the construction of highways and extension of the railway system providing corridors of disturbance for invasive plants. Appendix 1 lists the common exotic species that have invaded Japan (since the mid-nineteenth century) and south eastern Australia (since 1788) and become naturalised. This list includes species which have spread to the point where they are conspicuous and often troublesome but it does not include all naturalised species. There are some 187 species, from 36 plant families. Among these, 72 species are now widespread (see* Appendix 1) in both countries. The sources for this table include Asai (1993), Auld and Medd (1997), Kurokawa (2001), Harden (1990–2003), Ito and Morita (1999), Morita (1997), Rozefelds et al. (1999) Shimizu, Morita and Hirota (2001), Stanley and Ross (1983–1989), Walsh and Entwisle (1994–1999) and field observations by the authors. Apart from pasture grasses such as *Dactylis glomerata* and pasture legumes such as *Trifolium* species, most of these common invading species are regarded as weeds throughout the world (Holm et al. 1979). *Lilium formosanum*, a native of Taiwan, appears to be restricted to Japan, Australia and South Africa (Henderson 2001) as an invading species.

The weedy plant families Asteraceae (39 species) and Poaceae (34 species) are the most strongly represented (Appendix 1). In the Asteraceae annuals out-number perennials by two to

one, but in the grasses they are in about equal numbers. Some of these weedy species have been deliberately planted in Japan such as *Vulpia myuros* for green mulch in orchards and *Eragrostis curvula* as a roadside cover species. Many species were originally planted as ornamentals in both countries (e.g. *Mirabilis jalapa*). Some species that are invasive in eastern Australia do not appear to have escaped cultivation in Japan, including *Tradescantia fluminensis* Vell. (*Tradescantia albiflora* Kunth).

Most of these invasive species originated from either the broad regions of Europe/Mediterranean/ Eurasia or the Americas. Five species are of South African origin and only two, *Persicaria capitata* and *Lilium formosanum* are from eastern Asia.

Euchiton sphaericus (Willd.) Anderb. (syn. *Gnaphalium sphaericum* Willd.), usually considered native in Australia, occurs in Taiwan and may extend to Japan (Michael 2001). There are several other Australian native species that are weeds in eastern Australia and could prove invasive in Japan such as *Poa labillardieri* Steud. and *Urtica incisa* Poir.

Threats to Australia

Of the naturalised floras in both countries, there is only a relatively small number of other widespread, invasive species in either Japan or eastern Australia. Given that there is so much in common in the invasive floras, one is drawn to consider the potential threat that these other exotic invaders in Japan may pose for Australia and vice versa.

Some 15 widespread exotic weeds in Japan have not been recorded as naturalised in Australia (Table 3).

While some of these species appear to be troublesome only in Japan, such as *Rudbeckia laciniata*, several such as *Bidens frondosa*, *Erechtites hieracifolia* and *Erigeron annuus* are widespread and could invade from several sources.

There are some native Japanese plants that have become troublesome as weeds in Japan that have not been recorded in Australia; in particular, the following species which spread by subterranean vegetative organs: *Metaplexis japonica* (Thunb.) Makino, Asclepiadaceae; and *Petasites japonicus* (Siebold & Zucc.) Maxim., Asteraceae. One such species, *Reynoutria japonica* Houtt., Polygonaceae, has been planted apparently as an ornamental and recently escaped cultivation in south eastern Australia.

Since Australia does not generally import unprocessed agricultural produce from Japan, it is more likely that any Japanese plants that may become weeds in Australia would arise from species that were introduced as ornamentals (Table 4). Other relevant factors would include their capacity to spread e.g. by berry fruits which were attractive to birds and attributes such as shade tolerance; Senryo, *Chloranthus glaber* (Thunb.) Makino, Chloranthaceae, is an example.

Table 3. Widespread weeds in Japan of recent (after mid 19th century) exotic origin which have not been recorded as naturalised in Australia and their quarantine (Q) status in Australia (see below).

ASTERACEAE
Ambrosia trifida L.
prohibited Q
Bidens frondosa L.
Erechtites hieracifolia (L.) Raf. ex DC.
Erigeron annuus (L.) Pers.
prohibited Q
Erigeron philadeliphicus L.
Galinsoga quadriradiata Ruiz & Pavon
Rudbeckia laciniata L.
prohibited Q
Solidago gigantea Ait.
var. *leiophylla* Fernald

BRASSICACEAE
Barbarea vulgaris R.Br.
permitted Q

CONVOLVULACEAE
Ipomoea coccinea L.

CUCURBITACEAE
Sicyos angulatus L.

GERANIACEAE
Geranium carolinianum L.

LYTHRACEAE
Ammannia coccinea Rottb.
prohibited Q

SCROPHULARIACEAE
Lindernia dubia Penn.

SOLANACEAE
Solanum carolinense L.
prohibited Q

Q: The Australian Quarantine and Inspection Service (AQIS) assesses each request to import plants to Australia. If a species is considered a potential weed in Australia it will be prohibited from importation. If an application has already been made for the importation of a species, the status of that species in terms of quarantine can be found on the AQIS web site from the AQIS Import Conditions (ICON) database (http://www.aqis.gov.au/icon/). If a species is not on the database it means that there has been no previous assessment of it because there has been no request to import it. It does not mean that the species is not prohibited from entry.

Table 4. Ornamentals from Japan, not naturalised in Australia

Scientific name (Family)	Japanese name	English name
Aucuba japonica Thunb. (Cornaceae)	Aoki	Japanese Aucuba
Enkianthus campanulatus (Miq.) G. Nicholson (Ericaceae)	Sarasa-dodan	Redvein Enkianthus
Eurya japonica Thunb. (Theaceae)	Hisakaki	
Callicarpa japonica Thunb. (Verbenaceae)	Murasaki-shikibu	Japanese beauty berry

Some Japanese native plants have become weeds in Australia and these were presumably deliberately introduced e.g. *Lonicera japonica* Thunb. and the trees *Celtis sinensis* Pers. and *Cinnamomum camphora* (L.) J.Presl. The latter, a native of the island of Kyushu, has spread from deliberate plantings in Japan beyond its 'natural' range as many *Acacia* species have done in Australia.

Several other ornamentals from Japan do not appear to have escaped cultivation although *Ardisia crenata* Sims, coral or spice berry is listed as a potential invader by Randall (2001), is now naturalised in NSW and Qld.

Anomalies and threats to Japan

There are a number of species that are major weeds in eastern Australia and although naturalised in Japan are not yet widespread or invasive. Surprisingly this group includes *Carthamus lanatus* L., *Parthenium hysterophorus* L., *Marrubium vulgare* L. and *Urtica urens* L.

A noticeable feature of the invasive flora in mainland Japan is the lack of woody species and invaders of forest areas. *Cytisus scoparius* (L.) Link, *Ulex europaeus* L., *Ligustrum lucidum* W.T. Aiton, a native of China and *Pyracantha angustifolia* (Franch.) C.K. Schneid. are all naturalised in Japan but not yet widespread or invasive as they are in eastern Australia. *Robinia pseudoacacia* L. is one of the few invasive trees on mainland Japan (Maekawa and Nakagoshi 1997) although in Australia it often only occurs as a relic in areas around animal yards where it was planted.

Rubus fruticosus agg. (Appendix 1) although invasive in Japan is not nearly so widespread and troublesome as it is in Australia. However the taxa naturalised in Japan may differ from those in Australia. It is only one of several woody shrubs that are important weeds in Australia which could become major problems in forests and on forest margins in Japan. The common pink *Lantana camara* L. *sens. lat.* is still sold as an ornamental in Japan. *Baccharis halimifolia* L. and *Ageratina adenophora* (Spreng.) R.M. King & H. Rob. have not yet been recorded in Japan, although the latter is a weed in Thailand, China and Vietnam.

The reason for the lack of impact of exotic woody species in Japanese forests and forest margins is intriguing. It may simply be that there has been insufficient time (< 50 years) for their populations to build up to conspicuous proportions. Moreover as the current populations of invaders are small, there may also be some degree of tolerance of their presence in the landscape.

Another factor that may contribute to resistance to invasion of forested areas is the allelopathic effects of the resident trees. Ito et al. (2002) recently demonstrated the allelopathic influence of soil collected from under several tree species in Japan.

Generalisations

There has been an increasing interest in and analyses of plant invasions in the last 20 years. These overviews (see Rejmanek (2001) for a succinct account) have yielded few useful general rules for predicting future invasions. The most robust of these is that a history of invasion of a species in one location indicates a greater likelihood of invasion in another location: the 'historical' or 'extrapolation' approach. The observations reported here broadly support that generalisation with some apparent anomalies (above).

Another two fairly safe general predictors are that with increasing time since introduction and number of introductions, the rate of invasion for a species will increase; the 'stochastic' approach. The former is clearly implicated in the lack of impact of woody species, some of which have a long juvenile period, in Japan to this point in time. Increasing number of introductions is most likely to occur with ornamentals and forest species. Several Australian native woody species have become weeds as a consequence of massive, widespread, deliberate plantings, particularly in South Africa (Henderson 2001). The majority of the invasive successes of these species can be ascribed to chance. It is simply that their chances of establishing beyond the area in which they were planted have been markedly increased by the huge numbers and geographic extent of their deliberate plantings. These cases are in stark contrast to the epidemic spread of some weed species, such as *Parthenium hysterophorus* in Australia (Auld, Hosking and McFadyen 1983), which have invaded widely without deliberate involvement of humans.

The subsequent invasive spread of exotic species from massive, deliberate ornamental and forestry plantings around the world presents a strong case for care in horticultural plantings and the use of sterile plants in forest plantations. The latter could provide a broadly acceptable role for genetically modified plants in the environment.

Resisting invasion

In Australia, in spite of an active quarantine service, invasions will continue via accidental and illegal introductions and also by approved routes because of the difficulty of predicting invasive species. Changes in land use, for instance, will create new habitats that may favour particular species that might otherwise have remained benign. However as noted above, the rate of invasion of exotic species to Australia has been roughly linear while in Japan it has been logarithmic.

In Japan, quarantine laws address insects, soil, plant diseases and parasitic plants. There are no restrictions on the importation of exotic plants *per se*. Thus there will be a continuing influx of deliberately introduced exotics for ornamental and other purposes as well as contaminants of crop seeds and fodder. Japan imports in excess of 15 million tonnes of fodder and 2.5 million tonnes of roughage per annum from all over the world. A study of the contaminants of fodder crop imports at Kashima port from September 1993 to November 1994 has been reported by Enomoto (1999) and Nishida and Shimizu (1999). Of 105 samples from 10 different countries, only one sample contained no weed seeds. Among the other 104 samples there were 1482 different forms of seeds. One sample of rye from Finland contained 39 weed species and a sample of buckwheat from China contained 36 weed species (Nishida and Shimizu 1999).

These findings make a strong case for quarantine laws to restrict the incursion of unwanted exotic plants in Japan (Ecological Society of Japan, 2002). Moreover, the threat that some species, already in Japan, may pose to the Japanese landscape should be considered.

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Appendix 1. Invading plant species (mostly regarded as weeds) common to Japan and eastern Australia that are exotic to both countries.

*Species that are widespread in both countries are marked with an asterisk. These generally occur over more than 4 degrees of latitude, may occur in more than one habitat type and are often locally abundant in at least one habitat in both countries.

Amaranthaceae
Alternanthera philoxeroides (Mart.) Griseb.
Amaranthus albus L.
**Amaranthus hybridus* L.
**Amaranthus retroflexus* L.
**Amaranthus spinosus* L.
**Amaranthus viridis* L.
Gomphrena celosioides Mart.

Apiaceae
Ammi majus L.
**Cyclospermum leptophyllum* (Pers.)Sprague ex Britton & P.Wilson *(Apium leptophyllum* (Pers.) F.Muell. ex Benth.)
Conium maculatum L.

Araceae
Pistia stratiotes L.

Asteraceae
**Achillea millefolium* L.
Ageratum conyzoides L.
Ambrosia artemisiifolia L.
Ambrosia psilostachya DC.
**Anthemis cotula* L.
Arctotheca calendula (L.) Levyns
Aster novi-belgii L.
**Aster subulatus* Michx.
**Bidens pilosa* L.
Centaurea calcitrapa L.
Cichorium intybus L.
Cirsium arvense (L.) Scop.
**Cirsium vulgare* (Savi) Ten.
**Conyza sumatrensis* (Retz.) Walker *(C. albida* Willd. ex Spreng.)
**Conyza bonariensis* (L.) Cronquist
Conyza canadensis (L.) Cronquist
**Coreopsis lanceolata* L.
Facelis retusa (Lam.) Sch.Bip.
**Galinsoga parviflora* Cav.
**Gamochaeta calviceps* (Fernald) Cabrera
Gamochaeta pensylvanicum (Willd.) Cabrera
Gamochaeta spicata (Lam.) Cabrera (syn. *Gnaphaluim coarctatum* (Willd.) Cabrera)

Helianthus tuberosus L.
**Hypochoeris radicata* L.
**Leucanthemum vulgare* Lam.
Pseudognaphalium luteo-album (L.) Hillard & B.L. Burtt
Schkuhria pinnata (Lam.) Kuntze ex Thell. var. *abrotanoides* (Roth) Cabrera
Senecio madagascariensis Poir.
Senecio vulgaris L.
Silybum marianum (L.) Gaertn.
Solidago altissima L.
Solidago canadensis L.
**Sonchus asper* (L.) Hill
Tagetes minuta L.
**Taraxacum officinale* Webber ex F.H. Wigg. agg.
*Tragopogon porrifolius L.
Xanthium italicum Moretti
**Xanthium occidentale* Bertol.
Xanthium spinosum L.

Boraginaceae
Amsinckia lycopsoides Lehm.
Buglossoides arvense (L.) I.M.Johnst.
Echium plantagineum L.
Heliotropum indicum L.

Brassicaceae
**Brassica juncea* (L.) Czern.
Cakile edentula (Bigelow) Hook.
Cardamine hirsuta L.
**Lepidium bonariense* L.
Lepidium campestre (L.) R.Br.
Lepidium draba L. *(Cardaria draba* (L.) Desv.)
**Lepidium didymum* L. *(Coronopus didymus* (L.) Sm.)
Raphanus raphanistrum L.
Sinapis alba L.
Sisymbrium irio L.
**Sisymbrium officinale* (L.) Scop.
**Sisymbrium orientale* L.
Thlaspi arvense L.

Caryophyllaceae
**Cerastium glomeratum* Thuill.
Petrorhagia nanteuilii (Burnat) P.W.Ball & Heywood
**Polycarpon tetraphyllum* (L.) L.
**Sagina procumbens* L.
Saponaria officinalis L.
**Silene gallica* L. var. *quinquevulnera* (L.) Koch
Silene vulgaris (Moench) Garcke
**Spergula arvensis* L.
**Stellaria media* (L.) Vill.
Vaccaria hispanica (Mill.) Rauschert

Chenopodiaceae
**Chenopodium album* L.
**Chenopodium ambrosioides* L.
Chenopodium murale L.

Clusiaceae
**Hypericum perforatum* L.

Convolvulaceae
**Convolvulus arvensis* L.
Cuscuta campestris Yunck.
Ipomoea cairica (L.) Sweet
Ipomoea purpurea (L.) Roth
Ipomoea triloba L.

Cyperaceae
**Cyperus eragrostis* Lam.
**Cyperus esculentus* L.

Euphorbiaceae
Euphorbia peplus L.

Fabaceae
**Lotus corniculatus* L.
Lotus uliginosus Schkuhr
Medicago arabica (L.) Huds.
**Medicago lupulina* L.
Medicago minima (L.) Bartal.
**Medicago polymorpha* L.
**Medicago sativa* L.
Melilotus albus Medik.
Melilotus indicus (L.) All.
Melilotus officinalis (L.) Lam.
Robinia pseudoacacia L.
Trifolium angustifolium L.
Trifolium arvense L.
**Trifolium campestre* Schreb.
**Trifolium dubium* Sibth.
Trifolium fragiferum L.
Trifolium glomeratum L.
Trifolium hybridum L.
**Trifolium pratense* L.
**Trifolium repens* L.

Fumariaceae
Fumaria officinalis L.

Gentianaceae
Centaurium erythraea Raf.

Geraniaceae
**Erodium cicutarium* (L.) L'Hér.
Erodium moschatum (L.) L'Hér.

Lamiaceae
Salvia reflexa Hornem.
Stachys arvensis (L.) L.

Liliaceae
Lilium formosanum Wallace

Lythraceae
Lythrum hyssopifolia L.

Malvaceae
Hibiscus trionum L.
**Malva parviflora* L.
Modiola caroliniana (L.) G.Don
Sida acuta Burm.f.
Sida rhombifolia L.
Sida spinosa L.

Nyctaginaceae
Mirabilis jalapa L.

Onagraceae
Oenothera stricta Ledeb. ex Link

Orobanchaceae
Orobanche minor Sm.

Oxalidaceae
Oxalis bowiei Aiton ex G. Lodd. *(O. bowieana* G.Lodd.)
Oxalis brasiliensis G.Lodd.
**Oxalis debilis* Kunth *var. corymbosa* (DC.) Lourteig (*O. corymbosa* DC.)
Oxalis pes-caprae L.

Papavaceae
Papaver dubium L.

Passifloraceae
Passiflora foetida L.

Phytolaccaceae
Phytolacca americana L.

Plataginaceae
**Plantago lanceolata* L.
Plantago major L.

Poaceae
**Elymus repens* (L.) Gould *(Agropyron repens* (L.) P.Beauv.)
**Andropogon virginicus* L.
**Anthoxanthum odoratum* L.
Arrhenatherum elatius (L.) J.&C. Presl
**Avena fatua* L.
Briza maxima L.
Briza minor L.
**Bromus catharticus* Vahl
Bromus hordeaceus (L.) ssp. *molliformis* (Jn.Llyod ex Godr.) Maire & Weille
Bromus rigidus Roth
Bromus rubens L.
Cenchrus echinatus L.
Chloris gayana Kunth
Chloris virgata Sw.
Cortaderia selloana (Schult. & Schult.f.) Asch. & Graebn.
**Dactylis glomerata* L.
**Eragrostis curvula* (Schrad.) Nees
**Holcus lanatus* L.
Lolium multiflorum Lam.
Lolium perenne L.
Lolium rigidum Gaudin
Melinis repens (Willd.) Zizka (*Rhynchelytrum repens* (Willd.) C.E.Hubb.)
Panicum maximum Jacq.
Paspalum conjugatum P.J.Bergius
**Paspalum dilatatum* Poir.
**Paspalum distichum* L.
**Paspalum urvillei* Steud.
Pennisetum purpureum Schumach.
Phalaris canariensis L.
Phalaris minor Retz.
Phalaris paradoxa L.
Poa bulbosa L.
**Sorghum halepense* (L.) Pers.
**Vulpia myuros* (L.) C.C.Gmel.

Polygonaceae
**Acetosella vulgaris* Fourr.
Persicaria capitata (Buch.-Ham. ex D.Don) H.Gross
**Rumex conglomeratus* Murray
**Rumex crispus* L.
**Rumex obtusifolius* L.

Pontederiaceae
Eichhornia crassipes (Mart.) Solms

Ranunculaceae
**Ranunculus muricatus* L.

Rosaceae
Rubus fruticosus L. agg.

Scrophulariaceae
**Verbascum thapsus* L.
Verbascum virgatum Stokes
**Veronica arvensis* L.
**Veronica persica* Poir.

Solanaceae
Datura ferox L.
**Datura stramonium* L.
**Nicandra physalodes* (L.) Gaertn.
Solanum rostratum Dunal

Verbenaceae
Verbena bonariensis L.
Verbena litoralis Kunth