



Background




- One potential way to manage weeds is to stop their *spread*.
- Many pathways of weed spread - anything that moves or is moved.
- Pathways risk assessment has been advocated as a means of reducing weed spread into and within Australia.

Background



- **Detection** is first step in weed control.
- No national knowledge of weed surveillance practices amongst landholders or weeds inspectors.
- 80% of graziers check for weeds; 10% record or mark them.
- Information on current detection practices is needed before developing and extending better methods for surveying and managing emerging weeds.

Aims



The purpose of this research was to:

- assess the relative risks of sources and pathways of weed spread within Australia;
- identify ways to reduce these risks;
- assess current weed surveillance levels and practices amongst landholders and weeds inspectors; and
- identify ways to improve weed detection by these groups on-ground.

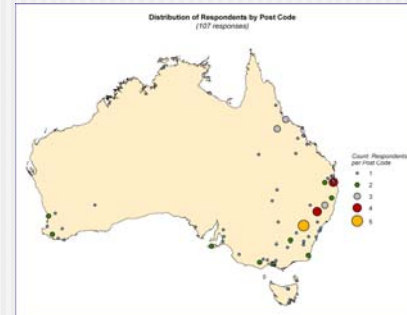
Methods



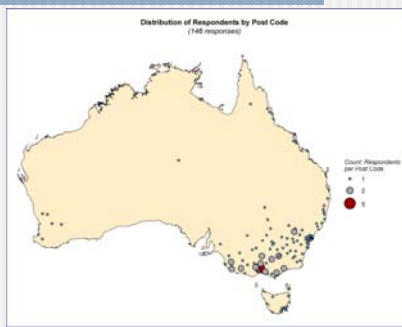
- Review of literature on weed spread and detection.
- Landholder and weed inspector focus groups scoping the issues surrounding weed detection strategies on-farm.
- Information on the roles, responsibilities and practices of weed inspectors through the administering bodies in each state and territory of Australia.
- 3 national surveys
 - 107 weed experts
 - 600 landholders
 - 146 weed inspectors



Weed experts



Weed inspectors



Farmers

Type of property	Proportion of respondents in State or Territory (%)							Total
	Qld	NSW	Vic	Tas	SA	WA	NT	
Mainly commercial grazing	43.2	37.3	55.6	45.5	28.6	26.7	100.0	41.4
Commercial mixed cropping and livestock	27.2	37.3	27.1	36.4	49.2	61.7	0.0	36.3
Mainly commercial cropping	19.2	11.2	2.3	0.0	11.1	6.7	0.0	9.9
Hobby farm or rural retreat	5.6	4.3	11.3	13.6	6.3	3.3	0.0	6.7
Mainly commercial horticulture	4.8	9.9	3.8	4.5	4.8	1.7	0.0	5.6

n = 568, *chiq* = 103.394, *df* = 24, *p* < 0.0005.

How do weeds spread in Australia?

- Seventeen *pathways* (the means by which weed propagules are moved): deliberate spread by humans, accidental spread by humans, and natural spread.
- The number and wide diversity of potential sources and pathways demonstrates the difficulty of the task of preventing weed spread altogether.



Weed spread



- Most weeds have been introduced to Australia deliberately.
- The same pathways may be important in spreading weeds within Australia.
- High risk of naturalisation (overcome natural barriers, variety of release sites, large numbers of propagules, foster populations).
- Conflicts of interest because of beneficial attributes of invasive species (economic, aesthetic, environmental).

Weed status by industry sector of exotic plant species introduced to Australia (source: Virtue *et al.* 2004)

Industry sector	No. species introduced (<i>I</i>)	No. naturalised	Naturalised (% of <i>I</i>)
Food crops	221	85	38
Pasture	1,086	349	32
Forestry	633	149	24
Gardening	25,360	1,831	7
Accidental	207	186	90

Deliberate spread: gardening industry

- A well-documented pathway.
- Represents post-border risks. Some statistics (from Groves *et al.* 2005):
 - > In 2004, 54.6% of invasive garden plants were available for sale.
 - > 40.4% of invasive garden plants declared noxious in one or more states were available for sale in others.
 - > States and territories have a poor record of prohibiting invasive species for within their own jurisdiction.

Photo: Lantana by Colin Wilson

Deliberate spread: agriculture and forestry

The weed threat of these industries has also been documented but in less detail than the trade in ornamental plants.

Weedy plants continue to be grown for:

- Culinary purposes e.g. European olive, *Olea europaea*.
- Livestock grazing e.g. Buffel grass, *Cenchrus ciliaris* (featured in background).
- Forestry and revegetation e.g. exotic pines, such as *Pinus radiata* and native species, such as golden wattle (*Acacia saligna*).

Photo: Buffel grass by Rick Davies

Accidental spread

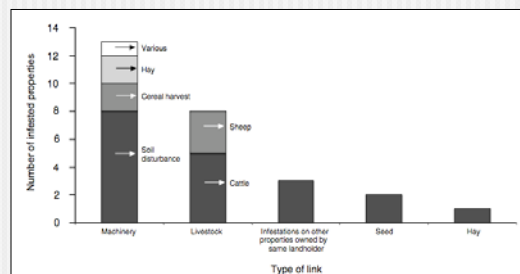
- Most weeds can be spread accidentally.
- Capable of long distance dispersal.
- Capable of delivering weeds into a variety of environments, including high conservation areas (e.g. by tourism into national parks).
- A wide range of accidental pathways have been documented and verified as risks.

Photo: Tiger pear by Les Tanner

Some examples of documented accidental pathways:

- Human apparel (shoes, socks, velcro closures).
- Machinery and vehicles (passenger, farm and construction).
- Construction and landscaping materials (e.g. mulch, gravel).
- Agricultural produce (e.g. hay, seed, and grain).
- Livestock (on hides, in hooves and manure).
- Waste (esp. uncomposted garden waste).
- Escape from research facilities (e.g. plumerillo, *Jarava plumosa*).

Example: Secomb (2002) traced the movement of potential vectors for the branched broomrape (*Orobanche ramosa*)

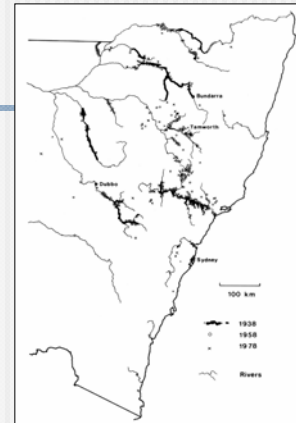


Dispersal by natural agents

Research has verified role of natural agents in weed dispersal. Some examples are:

- Pond apple (*Annona glabra*) is dispersed by feral pigs and the native cassowary (Setter *et al.* 2002).
- Birds. In one study as many as 38 bird species were observed feeding on 28 weed species (Stansbury and Vivian-Smith 2003).
- Wind. Tumbling parent plants of kochia, *Bassia scoparia* can spread seeds up to 3km (Dodd and Randall 2002).

Water: river systems have transported tiger pear (*Opuntia aurantiaca*) over long-distances in eastern NSW (Auld *et al.* 1982).

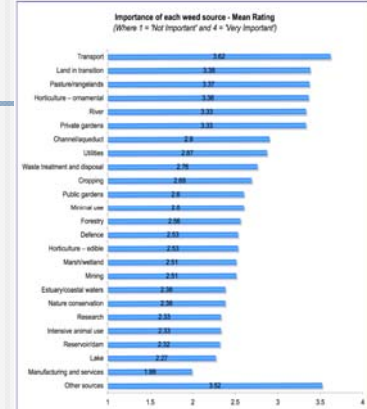


Natural spread

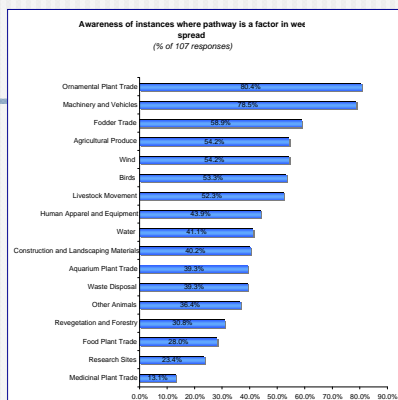


- Spread by natural agents has received less focus in discussion of national weed spread prevention than human-mediated spread.
- However, better understanding the role of natural agents can be beneficial:
 - Predicting dispersal patterns helps to target search and control actions.
 - Avoiding negative impacts on native birds and animals when a weed is an important food plant.
 - Helping industry and gardeners to know where to avoid planting invasive species (e.g. away from rivers and sensitive habitats) and what species to select (e.g. avoid exotic fleshy fruited species).

Sources



Pathways



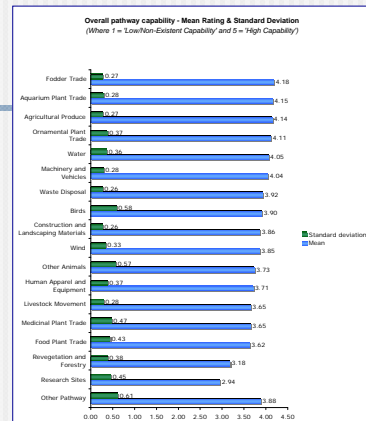
Likelihood of weed spread – weed inspectors

	Tasmania	National
Birds	1.2	1.4
Machinery	1.4	1.4
Wind	1.6	1.5
Water	1.4	1.5
Fodder trade	2.0	1.7
Other animals	1.6	1.7
Construction/landscaping	1.2	1.7
Livestock movement	1.8	1.8
Ornamental plant trade	1.6	2.1
Waste disposal	1.2	2.1
Aquarium plant trade	1.8	2.2

Likelihood of weed spread – farmers (%)

	Tasmania	National
Birds	36.0	28.2
Wind	31.4	27.5
Water	12.8	27.5
Vehicles	3.5	21.0
Livestock movement	10.5	19.2
Fodder movement	17.4	15.7
Machinery	17.4	14.8
Wildlife/vermin	5.8	13.6

Risk



Changing risks

- Most pathways will remain stable or increase in importance.
- Water increase - climatic variability (dry times followed by floods), conduciveness for weeds, increased focus on water resources, and the declining number of herbicides available for use in waterways.
- Fodder trade and Agricultural produce pathways increase - increasing droughts and need to grow hardy fodder crops and transport more fodder.
- Machinery and vehicles increase - increasing traffic movements, use of contractors and fragmentation of landscapes.
- Ornamental plant trade increase – growing industry, peri-urban sprawl taking ornamental plants into rural areas, and public demanding drought adapted species for dry gardening.

Regulation



Risk management

- All pathways inadequately controlled - most pronounced with the deliberate human spread pathways.
- Apart from Water, high-risk pathways did not feature highly in ability to avoid prevention and management strategies - **regulatory** and **management** strategies likely to impact on pathways involving either deliberate or accidental spread.
- Suggestions for individual pathways, though natural pathways generally difficult to regulate or manage.
- Education, extension and publicity was the most common positive approach for improving regulatory effectiveness and management for many of the pathways covered by the survey.

Farmer surveillance for new weeds

- The great majority of interviewees overall (84.3%) check for weeds on a regular basis.
- When checking for weeds: the majority (65.3%) combine weed checking with other on-farm tasks, while a further 23.8 per cent adopt a combined approach *as well as* undertaking specific weed inspection activity.

Farmer surveillance for new weeds

- 61.3% of interviewees nationally believe that declaration of weeds makes no difference to their checking for weeds (compared with 53.8% of inspectors).
- Only 4.9% of respondents indicated that the impending visit of an inspector makes them change their weed checking activity (compared with 76.9% of inspectors).
- Focus of weed authorities should be on provision of information for landholders (43.4%) vs encouraging reporting of new weeds (16.1%). 28.5% said both.

Weeds of most concern to farmers (%)

	Tasmania	National
Perennial broadleaves	23.3	29.0
Annual broadleaves	9.3	24.6
Thistles	57.0	23.1
Woody weeds	18.6	18.1
Blackberry	20.9	12.9
Capeweed	22.1	9.0
Ragwort	29.1	4.8
Gorse	39.5	3.9

Weed distribution information

- Overall, 65.3% indicated that they believe weed distribution information on private property should be made publicly available. However, NSW interviewees were less likely to agree with this than their counterparts, especially those in Queensland. Inspectors 45.8% in favour.
- 'Popular' reasons for making the information available included that it made landholders better informed and was in the community interest, while a relatively high proportion suggested that it was an invasion of privacy.

Weed outbreaks

- The majority of interviewees (67%) believe there are particular areas of the property on which new weeds are regularly found. Commonly indicated areas included water courses (41.3% nationally but only 14.3% in Tas), boundaries and traffic areas.
- Livestock feeding areas and difficult terrain were considered more important in Tas than nationally.

Surveillance level

- 80.2% of interviewees check for weeds on average every three months or less.
- Overall, 90.9% of a property is said to be checked for weeds.
- Just over half believe their strategy is 'mostly effective' while nearly 48% said it was 'very effective'.
- The highest proportion of interviewees overall check when weeds are likely to be growing rapidly, particularly after rain.

Surveillance timing

Month when regularly check for weeds	Proportion of respondents in State or Territory (%)							
	Qld	NSW	Vic	Tas	SA	WA	NT	Total
January	60.9	65.6	31.7	31.9	34.3	22.9	52.4	46.0
November	56.5	65.6	31.7	38.3	32.9	27.1	42.9	45.7
October	50.0	54.1	38.1	46.8	35.7	44.3	19.0	45.4
September	39.1	45.9	41.3	55.3	47.1	55.7	9.5	44.9
December	54.3	63.9	30.2	38.3	35.7	20.0	66.7	44.1
February	56.5	62.3	23.8	31.9	25.7	22.9	61.9	41.3
May	21.7	26.2	33.3	21.3	45.7	68.6	19.0	34.7
March	45.7	41.0	25.4	23.4	22.9	18.6	66.7	32.4
April	23.9	29.5	38.1	27.7	31.4	31.4	38.1	31.1
June	21.7	16.4	20.6	12.8	37.1	58.6	9.5	26.1
August	23.9	18.0	17.5	29.8	30.0	54.3	9.5	25.1
July	21.7	16.4	12.7	10.6	25.7	54.3	9.5	21.9
<i>n</i> = 378								

Weed identification/reporting

- 74.8% ask a local professional for identification advice and 26.6% look the weed up in a book. Sending the weed away for ID is unusual behaviour.
- All of these (+ internet) are regarded highly by inspectors.
- Primary motivation for having weed identified is curiosity (41.9%).
- Factors making landholders reluctant to report weeds – cost of eradication, fear of legal action and worry what neighbours will think.

Landholder commitment

Landholder types less likely to check	Proportion of respondents in property type (%)					Total
	Grazing	Mixed cropping and livestock	Cropping	Hort	Hobby farm or rural retreat	
Hobby farmers/rural retreaters	41.0	31.9	15.6	37.6	56.0	35.9
Absentee owners	24.0	24.0	21.7	36.4	23.5	24.4
Graziers	17.4	16.5	34.9	0.0	8.5	17.4
Landholders with large properties	7.3	10.6	8.6	8.7	7.7	8.8
Lazy/uncommitted landholders	6.6	8.8	20.0	0.0	5.8	8.3
New/inexperienced farmers	7.6	3.1	3.4	0.0	7.7	5.1
Government owners	5.1	4.0	7.1	3.4	6.8	4.9
Croppers	4.7	5.4	4.4	0.0	0.0	4.4
Other	21.6	23.0	21.6	59.2	32.0	24.7

n = 406

Government commitment

Level of commitment of government agencies to detecting and controlling new weed outbreaks	Proportion of respondents in State or Territory (%)							
	Qld	NSW	Vic	Tas	SA	WA	NT	Total
Low	45.6	49.1	72.4	68.2	41.9	50.8	66.7	54.0
Medium	37.6	40.5	19.4	22.7	30.6	33.9	33.3	32.4
High	8.8	9.2	6.0	4.5	17.7	11.9	0.0	9.3
Unsure	8.0	1.2	2.2	4.5	9.7	3.4	0.0	4.2

n = 568, *chiq* = 46.795, *df* = 18, *p* < 0.0005.

Incentives and improvements for on-ground detection

- Factors mentioned by interviewees included subsidising costs e.g. spray (17.1%), awareness and advertising (16.4%) and research and publicity into weed cost and impact (14.8%).
- The relatively high proportion of respondents indicating education and awareness campaigns and improved communication between weeds authorities and landholders suggests that many farmers feel inadequately informed with regard to weed control.
- Updated local information, particularly amongst non-croppers.

Conclusions



- Weeds are *spread* within Australia by a large number of pathways and most have relatively high risks associated with them and most will increase in importance in the future, particularly water, fodder and ornamental plant trade, and machinery and vehicles.
- Not all are readily amenable to management or regulation and in these cases *sources* of weed spread need to be targeted.
- The most important *sources* are transport sites, land in transition, pasture, gardens and rivers.



Conclusions



- People have an important role in mediating dispersal, even by natural agents; extension and education are critical.
- Farmers are generally a committed group of weed detectors; they require encouragement in this role.
- The legally sanctioned surveillance of weeds by inspectors complements the voluntary approach.
- Results on detection and reporting varied between states and landholder types. Research and extension needs to target specific groups appropriately.

Conclusions



- Government has poor image with regard to commitment to weed detection.
- Weeds are only ever rarely eradicated from an area. Those weeds that have been eradicated have been detected early in their spread. EARLY detection is vital!

Acknowledgements

- LWA on behalf of the Australian Government Department of Agriculture, Fisheries and Forestry and the Department of the Environment and Water Resources.
- All the organisations and individuals who provided information resulting from their own work and who participated in the surveys.

Further information

- Full reports and *Weed Detection on Farms: A Guide for Landholders* available at www.ruralfutures.une.edu.au

