Early intervention of new and emerging weeds

South Australian resources

Government of South Australia

Department of Primary Industries and Regions

Early Intervention Handbook Resources

Information current as of January 2021

All Enquiries

Department of Primary Industries and Regions

GPO Box 1671 Adelaide SA 5001

Phone: 08 8303 9620

Email: PIRSA.InvasiveSpecies@sa.gov.au

Website: pir.sa.gov.au/weeds

Regional Landscape boards

For local weed information and assistance, contact your local Landscape Board.

Contents

Resource 1 – Information sources and tools

Below are some information sources and tools available to assist in determining what weed could be focused on, along with existing priorities that can help narrow the search.

Declared plants

Declared plants are weeds that are regulated under the *Landscape South Australia Act 2019* (the Act) due to their threat to primary industry, the natural environment or public safety.

The Minister for Environment and Water can declare plants are declared under various provisions of the Act relating to their movement, sale, notification and control.

Landscape boards oversee control programs for declared plants in each region.

Alert weeds

Some plants declared under the Act have also been placed on the state alert list because they are not yet established in South Australia and pose a serious threat. Early detection is important so these plants can be destroyed before they become established.

Since these species are all declared as notifiable under section 190 of the Act, land owners must report any alert weed on their property to their regional Landscape SA office. Reports by any member of the public of alert weeds on public land are strongly encouraged by the Department of Primary Industries and Regions.

Record the location where you saw the plant so that it can be found again. If possible, collect a sample of the plant. Otherwise, take a photograph including the leaves, flowers and fruit, or provide a detailed description of the plant so that it can be identified.

There are currently 24 alert weeds. Identification notes on each one can be found at pir.sa.gov.au/biosecurity/weeds_and_pest_animals/weeds_in_sa/alert_weeds

Report suspected new weeds or pests to:

- Department of Primary Industries and Regions Invasive Species Unit (08) 8303 9620
- National Pest Alert Hotline, free call 1800 084 881

Other priority weeds

Opuntioid Cacti

Opuntioid cacti are major weed threats to South Australia's livestock industry, and environment. The Managing Opuntioid Cacti in Australia manual provides best practice information for managing these pests.

- Managing Opuntioid Cacti in Australia manual (PDF 22.2 MB)
- Opuntioid Cacti Management Guide (PDF 4.8 MB) - 12 page summary of the manual.
- State Opuntioid Cacti Management Plan (PDF 2.5 MB) - provides further information.

Weeds of National Significance (WONS)

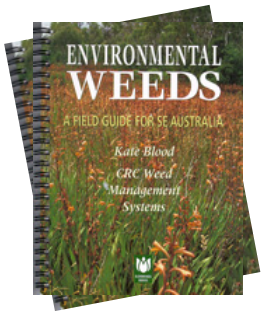
Weeds of National Significance (WONS) cause negative impacts to many of Australia's natural and productive landscapes. Collaborative national action can help to reduce the impacts and prevent further spread of these weeds. Some of the WONS currently occurring in South Australia are widespread and some WONS do not currently occur in our state and have the potential to invade and spread. For information on the 32 WONS, their distribution, identification and management, visit weeds.org.au

Field guides

Bush invaders of South-East Australia: a guide to the identification and control of environmental weeds found in South-East Australia.

Author: Adam Muyt
Publisher: R. G. & F. J. Richardson.
Publication date: 2001.

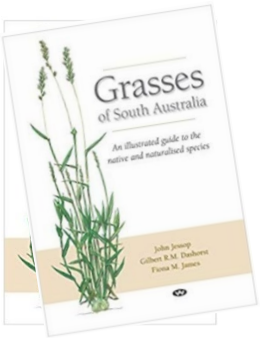
Contains colour photographs, diagnostic features for identification, how they spread, similar looking plants and management information.



Environmental weeds: a field guide for SE Australia.

Author: Kate Blood
Publisher: Bloomings Books, Melbourne.
Publication date: 2001.

Contains colour photographs, descriptions for identification, look-alikes, how they spread, ecology, reporting sheet to copy and distribution maps.



Grasses of South Australia: An illustrated guide to the native and naturalised species

Author: John Jessop
Publisher: Wakefield Press.
Publication date: 2006.

Contains black and white colour sketches, detailed descriptions for identification, locations.

Waterplants in Australia: A field guide, Fourth edition

Author: Sainty, G. R. and Jacobs, S. W. L.
Publisher: Bloomings Books, Melbourne
Publication date: 2003.

Contains 150 water plants Including potential weeds and common native species.

Weeds of the south-east: an identification guide for Australia (2nd edn).

Authors: F. J. Richardson, R. G. Richardson & R. C. H. Shepherd.
Publisher: R. G. and F. J. Richardson.
Publication date: 2011.

Contains colour photographs and includes brief descriptions and summary distribution information.

Online information

Often the best information is nearby, especially regarding when weeds arrived and where they occur in the area. Tap into the knowledge of people by contacting them directly. Ask local Landscape SA officers, local governments, consultants and contractors and the Department of Primary Industries and Regions. Tap into local community networks, including field naturalists, friends groups, Landcare groups, conservation groups, Weed Management Society of South Australia, garden clubs and horticultural groups etc.

Connect with others through social media e.g. Facebook, Twitter, Instagram, and your agency's internal social media. Try search terms and hashtags such as #invasivespecies #invasiveplants #weeds (but be prepared for drug related material) #weedid #plantid #I_SPEI (see below).

There are internet-based networks of weed practitioners such as:

Enviroweeds

The ENVIROWEEDS listserver was created by the Cooperative Research Centre for Australian Weed Management (Weeds CRC) to help distribute and discuss information on the management of environmental weeds in natural ecosystems mainly in Australia. The Weeds CRC no longer exists but the listserver is still hosted by the University of New England. Participants have the opportunity to share information, ask questions, participate in discussions and respond to the queries of others.

The audience is those who are managing natural ecosystems, whether on private or public land and water, or those working with environmental weed information.

You can subscribe for free at mail.une.edu.au/lists/cgi-bin/listinfo/enviroweeds

ALIENS-L

ALIENS-L is the mailing list of the Invasive Species Specialist Group (ISSG) (issg.org) of the International Union for Conservation of Nature (IUCN) Species Survival Commission. The group aims to "reduce the threats posed by invasive species to natural ecosystems and their native species, through increasing awareness of invasive species and means of controlling or eradicating them". This list is a contribution to that mission. It allows users to freely seek and share information on invasive species and the threats which they pose to the biodiversity of our planet.

The ISSG is a worldwide network of experts on the conservation impacts of invasive species. Membership is by invitation, but it is not necessary to be a full member of the group to contribute to the cause of reducing conservation threats posed by invasive species.

ISSG provides advice on threats from invasive species and control or eradication methods to IUCN members, conservation practitioners, and policy makers. The group concentrates on reducing or preventing the adverse effects of alien invasions on conservation values.

The list homepage: list.auckland.ac.nz/sympa/info/aliens-l

Plant Identification and information

Weeds in Australia (Federal Government) environment.gov.au/biodiversity/invasive/weeds/

Weed information notes, declaration status and other related information – Department of Primary Industries and Regions: pir.sa.gov.au/biosecurity/weeds_and_pest_animals/weeds_in_sa

Various keys including weeds at Lucid: keys.lucidcentral.org/

Weeds Australia - National Portal, Interactive weed identification and management tool: weeds.org.au/

South Australia Herbarium - Identification and information services. Herbarium specimens and records viewable through AVH & ALA otherwise by appointment with the Herbarium: environment.sa.gov.au/Science/Science_research/State_Herbarium

Flora of South Australia 5th edition - the definitive online resource to the plants of SA, including weeds: environment.sa.gov.au/Science/Science_research/State_Herbarium/Resources/Publications/Flora_of_SA

Local Government Resources - Use your favourite search engine to search for local government brochures and field guides.

Weed lists and distribution

Census of South Australian Plants, Algae and Fungi: flora.sa.gov.au/census.shtml

Australasian Virtual Herbarium (AVH) avh.chah.org.au/

Atlas of Living Australia (ALA): ala.org.au

Flora Information System (FIS) - available from Viridans Pty Ltd.

Global Biodiversity Information Facility (GBIF): gbif.org

Names and nomenclature

Census of South Australian Plants, Algae and Fungi: flora.sa.gov.au/census.shtml

Australian Plant Name Index (APNI): anbg.gov.au/apni/

Australian Plant Census (APC): anbg.gov.au/chah/apc/

The Plant List: theplantlist.org/

Grass information

Grassbase the Online World Grass Flora: kew.org/data/grasses-db.html

AusGrass2: ausgrass2.myspecies.info/

Other resources

Global compendium of weeds (3rd edition) has over 3,000 pages and there are several sources of this document:

cabi.org/isc/FullTextPDF/2017/20173071957.pdf

dpaw.wa.gov.au/images/documents/plants-animals/plants/weeds/Compendium_3rd_Edition_2017.pdf

nla.gov.au/nla.obj-512788350/view

Resource 2 – High Risk Species for South Australia

Based on the results of comprehensive Weed Risk Assessment the following species have been identified as high risk for South Australia. They are all potentially new and emerging species for the state. Note this list includes 'Alert' weeds. Alert weeds are declared plants not yet established in South Australia and pose a serious threat. Landowners must report alert weeds found on their property. Early detection is important so the plant can be destroyed before it becomes a problem. The Department of Primary Industries and Regions website has more information on Alert weeds, what they look like and how they can be reported.

Botanical name	Common name	Category
Alisma lanceolatum	Alisma	
Alternanthera philoxeroides	alligator weed	Alert Weed
Alternanthera pungens	khaki weed	
***Ambrosia* spp.**	perennial ragweed	
Amelichloa brachychaeta	espartillo	Alert Weed
Amelichloa caudata	broad-kernel espartillo	Alert Weed
Bassia scoparia	Kochia	
Cabomba caroliniana	Cabomba	
Chorispora tenella	blue mustard	Alert Weed
Cirsium arvense	perennial thistle	
Cortaderia richardii	toe toe	Alert Weed
***Cuscuta* spp.**	dodder	Alert Weed
Egeria densa	leafy elodea	Alert Weed
Eichhornia crassipes	water hyacinth	Alert Weed
Elodea canadensis	Elodea	
***Equisetum* spp.**	horsetails	Alert Weed
Gymnocoronis spilanthoides	Senegal tea plant	Alert Weed
Hydrocotyle ranunculoides	Hydrocotyle	Alert Weed
Jarava plumosa	Plumerillo	Alert Weed
Lagarosiphon major	Lagarosiphon	Alert Weed
Ludwigia peruviana	primrose willow	Alert Weed
Myriophyllum aquaticum	parrot feather	
Myriophyllum spicatum	Eurasian water-milfoil	Alert Weed
Nassella neesiana	Chilean needlegrass	
Nassella hyalina	cane needlegrass	Alert Weed
Nassella leucotricha	Texas needlegrass	
Nassella tenuissima	Mexican feathergrass	Alert Weed

Nassella trichotoma	serrated tussock	Alert Weed
***Orobanche* spp.**	broomrapes	Alert Weed
Parkinsonia aculeata	Parkinsonia	Alert Weed
Parthenium hysterophorus	Parthenium weed	Alert Weed
***Prosopis* spp.**	mesquite	Alert Weed
Ranunculus sceleratus	poison buttercup	
Rubus laudatus	Bundy blackberry	
Sagittaria montevidensis	giant arrowhead	Alert Weed
Sagittaria platyphylla	Sagittaria	
***Salvinia* spp.**	Salvinia	Alert Weed
Senecio madagascariensis	fireweed	
***Striga* spp.**	witchweeds	
Trachyandra divaricata	dune onionweed	

Resource 3 – Weed sources and pathways in Australia

Vectors or pathways

How the weed got there

- wind dispersal (consider wind direction and local topographic influences)
- people dumping garden waste
- water e.g. flood, drainage lines
- wildlife including birds, kangaroos, bats
- livestock
- pest animals e.g. fox, deer, pigs
- roadside and maintenance equipment e.g. slashers or graders
- vehicles e.g. 4WDs, trail bikes, farm equipment
- horses (including recreational riding)
- contaminated hay and fodder
- contaminated soil
- recreational and camping equipment
- people (i.e. footwear, clothing, contractors)
- boats and trailers, caravans etc.
- fishing nets and equipment
- companion dogs (i.e. being walked)
- weed surveyors and weed management activities
- emergency vehicles and equipment.

Locations – within the survey area

Places the weed is more likely to establish

- when in fragmented landscapes, focus first on edges
- when in large areas of continuous vegetation, focus first on pathways of spread into and through the areas, and then the edges
- coastal dunes, especially where close to gardens and if rehabilitated using non-local species
- places modified by humans e.g. railways, quarries, disused agricultural land, old homesteads
- rabbit and other animal diggings
- track and road edges and formal and informal parking areas
- earth works
- sites where road and track making materials are stored
- riparian areas
- dumping sites for garden waste etc.
- along pathways of animal movement e.g. deer, foxes, wild pigs, stock routes
- under prominent perch trees and fence lines
- after a wildfire or flood event
- feed lots/where hay and fodder are stored and distributed.

Sources – outside the survey area

Where the weed is likely to have come from

- nursery and propagation trade
- garden cultivation
- deliberate planting nearby
- camp sites/grounds
- old rehabilitation sites e.g. sand dunes
- garden waste dumping – look along secluded tracks, car parks, across the street and over back fences
- places modified by humans e.g. railways, quarries, disused agricultural land, old homesteads.
- historic landmarks e.g. mine sites, township sites
- arboreta, street trees
- cemeteries and memorial sites
- drainage lines
- drain outlets
- dams
- bridge crossings
- four-wheel drive or quad bike tracks.

Resource 4 – Search frequency

Both the rate at which a weed establishes and spreads, and its detectability at a new site, are both functions of:

- the weed's arrival rate at the site and its inherent biological capacity for growth and spread
- the habitat type the weed is invading
- the degree of disturbance at the site(s)
- the weed's growth form.

Harris et al. (2001) developed a guide to determine search frequency for different vegetation types and different growth forms based on studies conducted in New Zealand. A summary of these data is provided in Table 8, based on a 95 percent certainty of detection. The greater the interval between searches, the larger the infestation and the greater the cost of eradication. Note that these data are specific to New Zealand and have been included here simply to illustrate the need to consider different search intervals based on habitat type and weed growth form. However, Victoria has broad habitat types comparable to those included in Table 8, and shares many common weed problems with New Zealand, so this table could be used as a rough guide when designing searches, in combination with local expert knowledge or studies.

Table 8 - Example of search frequency based on habitat type and weed growth form for New Zealand, modified from Harris et al. (2001). Intervals shown give a 95 percent certainty of finding a new weed infestation if it is present, while eradication is still considered feasible.

Habitat type	Growth form	Surveillance interval (Years)
Forest	Climbing vine	1
	Ground creeper	1 - 4
	Shade tolerant shrub/tree	3 - 6
Shrubland	Vine	1 - 5
	Shrub/tree	1 - 5
Short vegetation	Short weed	1 - 3
	Shrub/tree	3 - 6
Wetland	Short weed	1 - 4
	Shrub	6 - 10
	Tree	10
Open habitats	Short weed	1 - 3
	Taller weed	2 - 5

Resource 5 – Wellbeing, safety and hygiene for field work

Wellbeing and safety

The organisation you undertake weed management for, whether your own farm, a government agency or community group will have their own Occupational Health and Safety (OH&S) requirements for you to follow. Additional personal protective equipment and safety requirements items that should be considered include:

- first-aid kit and snake bite kit
- personal protective equipment
- satellite phone and emergency position-indicating radio beacon (EPIRB) if in remote locations.

Consider these points when you are planning and conducting field work:

- avoid sun damage to skin – wear appropriate clothing, broad-brimmed hat, gloves, sunscreen, and sunglasses
- avoid field work on days of extreme fire danger
- be aware of flood and other emergency and weather warnings for the area and take appropriate precautions
- have a safety plan and reporting procedure in place for working remotely (refer to your organisation's OH&S guidelines)
- when working near roadsides, park safely and wear high visibility clothing such as a reflective vest
- wear gaiters and carry a snake bite kit and know how to use it
- Wear appropriate protective clothing when handling weeds. Be aware of plants which have:
    - spines or barbs that may have sheaths, toxins or irritants. Avoid stick injuries and treat punctures immediately
    - sap that can cause skin irritation immediately or after exposure to sunlight
    - fine hairs that can cause skin irritation and become lodged in clothing
    - pollen and perfumes that can cause allergic reactions including respiratory irritation and hayfever.
- if working with cacti, carry pliers to remove cacti spines from footwear. Always check the back of boots before crouching down. Some cacti have spines with sheaths that remain in the body when the spine is removed
- seek prompt medical advice if reactions, injuries or infections occur.

Hygiene

It is very important not to spread weeds, pests, wildlife diseases, soil-borne and plant-borne diseases between and within sites. Examples of things that may be spread, other than weeds, include soil and plant-borne pathogens such as phytophthora, myrtle rust, chytrid fungus of frogs, and crazy ants.

Consider these hygiene points when you are planning and conducting field work and check your organisation's hygiene protocols:

- carry a hygiene cleaning kit with instructions in vehicles, and a sealable container (e.g. plastic bottle with screw-top lid) in which to place loose seeds or seeds removed from clothing for later safe disposal
- wear cotton clothing that seeds do not readily adhere to and avoid cuffs on trousers and shorts
- wear gaiters over socks and boots
- clean footwear and clothing including seeds in laces and socks, and soil on soles before and immediately after a site visit
- avoid placing carry bags and packs on weeds that are in seed
- regularly check camera bags and clothing pockets for seeds
- Plastic sample bags can build up static electricity to which weed seeds can readily adhere
- avoid driving vehicles into weed infestations and check and clean the vehicle regularly including within the cabin and boot or tray
- ensure other staff and contractors conducting field work are following appropriate hygiene standards
- be aware that the transportation of plant propagules of declared weeds without a permit is prohibited
- companion dogs readily pick up and spread weed seeds on their coat and between their toes
- consider using a footbath before entering and leaving wetland areas to reduce the risk of spreading root rot (*Phytophthora cinnamomi*) or frog disease, chytrid fungus (*Batrachochytrium dendrobatidis*).

Support

It is important that weed management personnel are well supported if feeling anxious or struggling to cope. Check in with your workplace support service or contact the Family and Business Support Program (FaBS) for more information.

Resource 6 – Tips on how to improve walking surveys for delimitation

These simple practices can be used to improve the ability of walking surveys at finding invading species:

- survey speed should not be increased as plants become either more or less visible, as more attention is given to walking than to looking for the plant
- “contouring” which involves walking parallel to imaginary elevation contour lines and by using landmarks to prevent overlapping or creating gaps on successive sweeps, helping to ensure complete coverage
- GPS units are highly effective at ensuring complete coverage is achieved
- shifting positions in the sequence of surveyors in sweeps alleviates monotony and maintains concentration. Using several survey methods also will increase accuracy and dependability (Zamora et al. 1989)
- initial searching should involve systematic and intensive surveys in the local vicinity of known occurrences and other areas selected, based on dispersal behaviour of the weed and potential pathways of spread
- presence and absence data should be collected which can be used to improve future survey designs (Lawes and Panetta 2004)
- surveys usually work progressively outward from the centre of the infestation and along dispersal pathways (Robison et al. 2013). The search area can be narrowed by identifying the invading plant's habitat type and plant associations
- thorough surveys require pessimism and training. Pessimism is assuming that an infestation is larger than expected and expanding the search area around the initial sighting
- the amount to expand the survey depends on the plant's potential dispersal distance. A useful rule of thumb is to expand the survey to a geographical border or the limits of the habitat
- using multiple search images in a survey improves concentration by preventing the surveyors from fixating on one image. Use multiple images of the plant's various forms, distinctive characteristics such as colours or silhouettes, habitat(s), and plant associations (Zamora et al. 1989)
- trained sniffer dogs are proving to be highly effective at locating hard to locate plants. Dogs are more accurate than humans, especially for detection of small plants, and from greater distances. Invasive plant monitoring using detection dogs can provide greater overall accuracy of plant detection (Goodwin et al. 2010).

Resource 7– Methods for data recording

Paper-based recording

Use a field notebook with tabulated worksheets and fields that correspond to those of the spreadsheet or database that the data will be stored in. Care must be taken to ensure that data entry errors are avoided when transferring hand written raw data into electronic databases. An incorrect number in the coordinates could prevent the weed being located at future site visits. Scanning the original hand written sheets and storing them electronically can provide a source of information that can be checked if there may be errors in the data entry. Consider using a field recording template (template 3 or 4).

Smart phones

There are many GPS equipped, map-based smart phone applications (apps) (Figure 27) that allow you to work off-line, record data directly and later export or email the data. These are particularly useful for remote locations and reduce data entry errors. An example of a useful app is Avenza Maps: avenzamaps.com.

Personal Digital Assistants (PDA) and hand-held computers

A PDA or hand-held computer equipped with GPS can be programmed to function as an electronic form. Pre-programmed fields capture all the information a surveyor needs in relation to each field observation and any samples collected. The information can then be uploaded to a database in a computer upon return from the search.

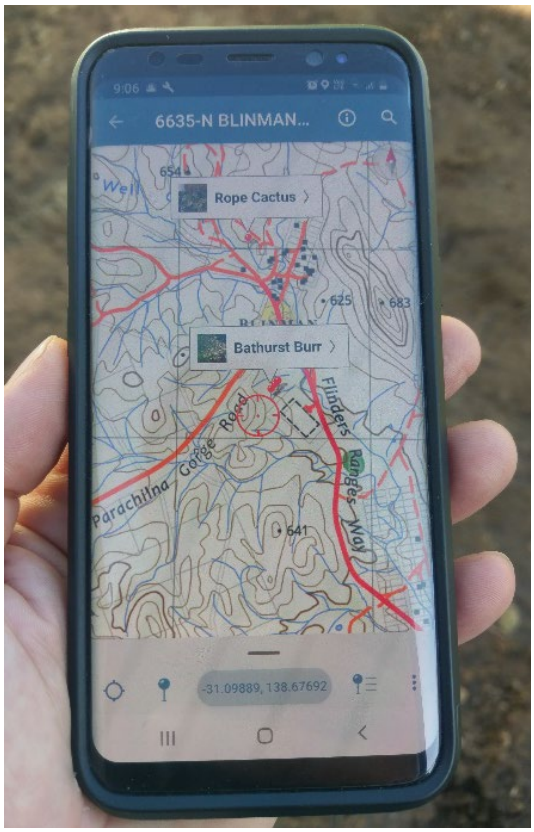


Figure 27 - Smart phone applications can help with navigation in the field. Photo: Troy Bowman, Department of Primary Industries and Regions

Resource 8 – Equipment required for undertaking a field search

These are the items that could be carried in your vehicle so you can collect the information and material you need if you find a potential weed at the early stage of invasion. Keep a field kit in an easy-to-lift plastic box(es) ready for quick deployment. Adapt for your own purposes.

- hand-held GPS and spare batteries or charger
- maps or pre-loaded maps & search polygons on the GPS
- native plant and weed identification books/pamphlets/mobile device applications (apps) etc.
- recording equipment such as clipboard, notebook, datasheets, pen, pencil or electronic device
- camera with spare batteries and capacity
- materials for marking infestations (i.e. bright coloured survey ribbon)
- recording sheets (see Appendices 4 & 6)
- hygiene equipment to reduce weed and soil-borne disease spread
- plastic bags, secateurs
- gloves and BBQ tongs for handling prickly plants
- plant press – collecting plant specimens is easy if you follow a few simple but important steps
- hand lens
- relevant permits and access permission documentation.

Refer to your agency's Occupational Health and Safety requirements for personal protective equipment and safety requirements. Items that should be considered include:

- first-aid kit and snake bite kit
- personal protective equipment
- satellite phone and emergency position-indicating radio beacon (EPIRB) if in remote locations.

Resource 9 – Photographing and videoing weeds

Being able to photograph or video plants (including weeds) is a useful skill, especially if you can do it well. It allows you to record the plants in the area you manage, can be shared with others to seek help with identification, and can be used to help teach others about your patch.

There are advantages and disadvantages with both still photos (single static images) and video clips (moving images). An advantage of video over still photos is that the plant can be walked around to give a more three-dimensional-like perspective of the plant. Still images can be published in printed material. Both can be used on electronic media, viewed on the internet and be attached to emails. Video clips may take up more storage and require more skill to edit and manipulate.

Images and video clips can be useful in hard copy or electronically for:

- identification purposes
- accompany specimens to the Herbarium
- training and presentations
- awareness raising
- publications including brochures and information sheets
- displays and signs
- social media
- video clips on agency internal and external website.

Equipment options

With the recent development in digital technology, digital photography and filming is more accessible than ever. The devices and images referred to here will be assumed to be digital (electronic-based) rather than analogue (film-based).

There are a number of devices that can be used in different ways to capture images of weeds:

- smart phones – stills and video – are readily accessible and are carried by staff most of the time. Digital image and video quality is improving all the time with phone development. Poor quality images may limit reproduction quality in printed publications or viewing on larger screen resolutions
- digital cameras – single lens reflex (SLR) cameras can give higher quality images and can give more flexibility with interchangeable lenses (see notes on lenses below). Smaller digital cameras can be easier and lighter to carry in the field but may not give as good a quality image for publication
- digital video cameras – smaller video cameras e.g. Handycam, Camcorders, make use in the field more feasible and convenient. They can produce higher quality footage for editing for various purposes, including training videos and agency external web site viewing. More skill and software is required to edit raw footage to create quality video clips
- digital microscopes – Universal Serial Bus (USB) microscopes plug directly into a computer USB and can be viewed on the computer screen or projected through a data projector or large screen television for an audience. This is useful for plant identification training and taking screen shots

- digital document camera attached to a data projector – allows plants to be projected onto a larger screen and looked at by an audience. This is useful for plant identification training
- webcam – a plant can be viewed in real-time through a camera attached to an internet feed such as Skype or FaceTime. This allows the plant to be viewed by another person at another location with access to the same software through a live feed. This can be useful when seeking advice from a remote person for identification
- webcam or digital camera at fixed field points – these could be established in the field to monitor remote location infestations in a similar way to their use for monitoring wildlife and invasive animals. A remote video camera could be turned on at daily or weekly intervals to see if a plant is, for example, flowering, in order to trigger field inspections or to monitor vectors or pollinators. They could also be used as photo points to monitor change over time with treatment
- webcam or digital camera attached to unmanned aerial vehicles (UAVs) or drones – aerial videoing, e.g. through the use of remote controlled rotocopters, could assist with scoping where delimiting surveys should be extended to. They could assist with delimiting surveys over water bodies or other areas where access is difficult. Digital cameras for this use could include, for example, an adventure camera such as a GoPro. Familiarise yourself with current laws for the use of UAV since they are changing rapidly
- satellite imagery – can be used for assistance with delimiting infestations. This requires more technical skill
- scanner/Photocopier – plant samples and specimens can be placed on a scanner/photocopier bed and be scanned/copied. Scanned digital images can be viewed or sent via email and other electronic media. Photocopied images are printed on paper (hard copy).

There is lots of scope for adaptation and experimental use of digital equipment and vehicles to carry them.

No matter what your skill level is with a camera, most people can take useful photographs. With the wide use of digital photography, especially with cameras in smart phones, it doesn't matter if you take lots of photos of the same subject – eventually you should get one that works. Keep trying different angles and light conditions until you get a couple you are happy with; delete the rest. You can rely on the automatic settings of the camera to do most of the work for you.

Figure 28 - Good quality images can be very helpful for identification and awareness raising. This *Opuntia tomentosa* was photographed with an SLR camera. The flowers and buds can be easily seen. Photo: Bob Chinnock, State Herbarium of South Australia.

Preparing for the field

Make the most of your field trips by being prepared:

- think about the purpose of the photographs/videos and where/how they will be used – plan the images/footage you need to take
- ensure all equipment is working, batteries (including spares) are charged and you have sufficient storage capacity on your equipment before going out into the field. Do you have a car charger?
- clean lenses and maintain equipment
- make sure you are familiar with the full range of features on your equipment – read the manual or watch video clips on the web and try features you haven't used before
- if videoing, prepare a story board before going into the field to make most efficient use of videoing time – plan what footage is needed e.g. close-ups of plants and people, and wide shots of landscapes
- if videoing, prepare a script or dot points before-hand to keep the filmed person on track and avoid long-winded rambling dialogue
- research suitable sites and where the weed you want to photograph occurs. Check the weather and possible light conditions you will encounter

- if you are planning to photograph a particular weed or group of weeds, familiarise yourself with their diagnostic features so you can capture what is needed
- always have permission from people being photographed/videoed e.g. ask them at the start of videoing and record them saying “yes”. Check the Department advice on how to record permission and have the forms you need to record written permission with you in your camera bag
- there is lots of photography and videoing advice on the internet.

Figure 29 - Photographing and videoing weeds is a great way to record them, learn about them and teach others. Photo: Shannon Robertson, Department of Primary Industries and Regions.

Field equipment

In the field several bits of equipment can be useful to have in your kit:

- camera lens cloth for cleaning smudges and specks off lenses. A small photographer’s hand blower can be useful for removing dust
- camera bag – try and keep it light and convenient. Avoid putting the bag on the ground as it will collect weed seeds and soil. A comfortable shoulder strap or belt loop will help
- tripod or monopod – tripod (three legs) for free-standing mounting of camera/video equipment. A monopod is a single leg used to steady the camera while being held. This is especially useful in low-light or windy conditions, and when interviewing people or panning across landscapes. Investing in a good quality tripod will be worth it in the long run. Small flexible magnetic tripods for mobile devices can also be useful

- reflector for more advanced photography – can be used to reflect sunlight onto weeds in shade for better illumination or can be used to shade weeds in strong sun light. Circular reflectors are available in a variety of sizes and can be folded up into a compact bag. Improvising with foil over a piece of card or an Eski lid can achieve similar results
- plastic bag to keep camera equipment dry during rain.

Hygiene of photographic equipment

Camera bags and equipment can become carriers of weed seeds and plant parts. Make sure they are cleaned regularly and remove soil from tripod or monopod legs before moving onto a new site. Do the same with footwear and clothing.

Geotagging images

Geotagged photographs and video allow images to be associated with a geographical location by geotagging (reference accessed on-line 12/1/2021: en.wikipedia.org/wiki/Geocoded_photo). This is especially useful for weeds at the early stage of invasion, where they may be difficult to locate. It is as simple as turning on the GPS feature on your camera equipment, including mobile devices. Spatial data are automatically attached to the image.

Photographing tips for the field

Here are some tips on taking weed photographs:

- if photographing a plant to help with identification, take a range of photos of different aspects of the plant to gather as many of the diagnostic features as possible. Knowing the diagnostic features makes the most efficient use of your time. Once in the field, you can use a mobile device to access diagnostic information on the internet
- plant detail images may include flowers, buds, fruit, seed, leaves, how the leaves are attached and arranged on the stem, bark, the plant base, and roots or underground storage organs if the plant is lifted out of the soil. A diagram of the plant parts labelled will help
- take some shots of the plant in its landscape, as well as close-ups of plant detail
- include a ruler or object to indicate size of the plant or plant parts
- you can experiment with the panorama setting on your camera or smart phone if available. This can help take more expansive landscape views for context
- photograph the soil and surrounding ground flora and vegetation, including confusing look-alikes
- if there is evidence of how a weed has been introduced or carried to the site, photograph this, and possible nearby sources
- ensure the detail you are wanting to capture is in focus in the view finder and check images after you have taken them so you can capture them again if they are not in focus or too dark/light
- when using a smart phone, carefully selecting where to focus can adjust light levels to make a more useful image
- composition - Consider what you frame within the photo you are about to take. Move the camera around what you are looking at until you are happy with the framing of the image. It wants to be

aesthetically pleasing and achieve the purpose of why you are taking it. Avoid including items that distract from your image

- check to make sure your shadow is not in the frame if the sun is behind you and you don't have flaring when the camera is facing the sun
- keep good records of when and where photographs were taken and geotag where possible.

Videoing tips for the field

A bit of preparation before filming can make a big difference to the quality of the video clip produced.

If videoing people, ensure their faces can be seen with sufficient light and if videoing up close, the microphone/camera should be arm's length from the person being interviewed. Ask the interviewee to look at the person holding the camera, not at the camera. Ensure the microphone is turned on and use headphones (if available) when videoing to monitor sound quality.

If recording sound in windy conditions, use the wind setting on the microphone if available, and try to shield the microphone using your body, tree or other structure.

Consider how you frame the image to improve aesthetic considerations.

Keep good records of when and where footage is videoed and geotag where possible.

More advanced photography tips

If you are a skilled photographer and have a camera with many settings, you can manipulate the camera to make the most of the conditions available, especially by using the manual settings.

Best photographic conditions

- Early morning or late afternoon light often produce better plant images, especially in summer where strong mid-day sun can wash-out images.
- If the sun is low in the sky, and the weed is between the sun and you, good images can be taken using back-light. This illuminates fine features of the weed, such as hairs, spines and awns on grasses - particularly useful for some grasses and spiny cacti. You may need to shade the lens to avoid flaring and avoid looking or pointing the camera directly at the sun.
- It can be difficult to have sufficient light to take good photographs of weeds that grow under the canopy of other plants, including trees. Manipulating the camera settings can compensate for low light. You may need to use a tripod/monopod, or come back to the site when light conditions or the orientation of the sun has changed.
- In windy conditions it can be difficult to get good close-up images of plants. You can hold the weed with one hand and photograph with the other, use your body as a shield, or tie the plant to another object. Being patient can sometimes result in the weed being still during a brief break in the wind. Manipulating the camera settings to take a faster photo will help.

Camera use and attachments

Depth of field

The camera will focus on a single point and the amount of the image in front and behind that point that is also in focus is the depth of field. For weed images that are being used for identification purposes, it may be important to have a larger depth of field i.e. more of the image in focus. This can be manipulated on an SLR camera by adjusting the settings. The smaller the aperture (i.e. the higher f numbers e.g. f22 and f16), the greater the depth of field will be. See your camera manual for more information.

Where to focus

focus on the part of the weed that is important for the image you are trying to capture e.g. if you are taking an image of a flower, you would generally focus on the centre of the flower. This may require focussing on the spot, holding that focus and then moving the camera to the side to frame the wider picture as needed.

Lens hood

When photographing towards the sun, especially when it is low in the sky, flaring can occur in the image. A hood for an SLR camera can be useful if correctly fitted. If using a smart phone camera, use a hand, hat or some other object to achieve the same effect.

Flash

a flash can be useful in low light conditions for subjects within 5 m of the camera, but often results in a less than adequate image. Skilful manipulation of a flash held to the side or a reflector can improve the image. In windy conditions, it may be necessary to use a flash to capture a moving weed close-up.

SLR camera equipment

There are advantages of using a single lens reflex (SLR) camera, as it uses an internal mirror so you can see the same image as the camera is taking. Higher quality lenses also mean the image may be of higher quality, which is especially important for publication.

For portraits of weeds, a standard SLR camera with 35 mm lens would be suitable. For close-up images of weed details, a macro lens would be suitable. For more advanced work, a wide angle or telephoto lens is appropriate for landscape and vista shots of weeds. However, a more flexible option could be a zoom lens e.g. 28-80 mm range. Zoom and telephoto lenses can be useful if you are unable to get close to the weed to pick up its detail. Unless you are taking many images of high quality for a particular weed project, investing in multiple expensive lenses that are heavy to carry in the field is not necessary. A macro zoom could be a good alternative to multiple lenses for field work

A polarising filter attached to the front of all lenses used on a 35 mm SLR camera can remove unwanted glare and protect the glass of the lens from scratches and smudges. It is easier to replace a filter than have the lens repaired.

Storage of photos and video footage

Be ruthless, culling images that are poor and out of focus to reduce storage requirements and time to view them in the future.

Photographs should be clear and of sufficient resolution (e.g. at least 300 dpi) to be viewed on a large computer screen. Check the auto settings on your camera/device for image size.

Image storage typically follows for print publication (high resolution; file format raw, tif or jpeg) and for web and data show publishing (low resolution; file format raw, tif or jpeg). The disadvantage of using jpeg files is that every time you open or resave the image, it reduces in file size and pixels are lost, reducing the image quality.

It is recommended that you establish consistent file naming conventions, including an abbreviation of the weed's botanical name and location. Geotag the image so it can be linked electronically with GIS spatial layers and databases.

Download images from your camera and devices regularly and store appropriately into consistently named folders so others can understand when and where they were photographed. Tag images if possible including the name of people in the images.

Back up your image storage regularly, preferably off-site. As cloud storage becomes more widely used consider backing up images remotely.

If leaving your role in your organisation ensure others know where your images are stored and have access to them.

Videoing checklist

Equipment

- ☐ Camera, video or still, charged
- ☐ Charger & spare battery
- ☐ Headphones
- ☐ Microphone (camera mounted)
- ☐ Lapel mic & extender cord
- ☐ Spare AAA batteries
- ☐ Memory disks
- ☐ Tripod
- ☐ Spirit level (small)
- ☐ Monopod
- ☐ Laptop & charger
- ☐ Laptop mouse
- ☐ External hard drive
- ☐ Extension cord
- ☐ Power box
- ☐ Leads & cables
- ☐ Reflector
- ☐ Gaffer tape
- ☐ Lens cloth

Information

- ☐ Story board planning sheet
- ☐ Script for voice-over
- ☐ Vox pop questions
- ☐ Cheat/fact sheet
- ☐ Filming logging sheet
- ☐ Talent contact details
- ☐ Field guides
- ☐ Set up folders on laptop
- ☐ Phone numbers of talent

Personal

- ☐ Hat
- ☐ Sunscreen
- ☐ Coat, umbrella
- ☐ Glasses
- ☐ Notepad & pens
- ☐ Water bottle
- ☐ Food
- ☐ Plastic bags
- ☐ Avoid wearing white or stripes or flappy clothes
- ☐ Mobile phone (on silent)

Resource 10 – Weed specimens

Weed samples

Samples of live plant material are often collected when plants are found in the field. They can be taken back to the office for closer inspection and to assist with identification. Often, they are left on the seat or dashboard of the vehicle or on a desk to shrivel and dry and eventually be binned. If samples are collected, they should be put straight into a sealable plastic bag and kept in the cool shade until they can be looked at again. A cooler box is a useful tool to have in the vehicle for this purpose.

Once you have finished with a sample, it should be carefully disposed of (see below) to ensure that weed seeds and plant parts cannot escape and spread.

Weed specimens

Weed specimens are carefully collected plant material with the purpose of making a pressed and dried sample submitted to the State Herbarium of South Australia.

Herbarium specimens provide a permanent record validating the occurrence of a species at a particular locality and time. Specimens and the associated label data also provide a verifiable and invaluable source of information such as distribution, ecological preferences and associated species. See the field recording template for opportunistic sightings and Herbarium specimens (Template 4).

Due to the risk of seeds and plant parts escaping from specimens, only trained and experienced people should collect them. It is very time consuming to collect quality specimens and accompanying information.

Rare and threatened plants have been collected mistakenly as weeds, putting at risk valuable plant populations in the wild.

Once a specimen has been submitted to the Herbarium, it will be pressed and dried, and stored until it can be identified and lodged by a botanist. The specimen will be mounted on a special large archival card, photographed and the written information accompanying it entered into the Herbarium database. The specimen will be stored in special cupboards and preserved. The image and information will then be shared with the Australasian Virtual Herbarium, where it can be seen by others.

Specimens can also be preserved in other ways, such as in fluid in containers, if they cannot be pressed and dried.

Permits to collect samples or specimens

If you have collected a specimen that you believe is a declared weed, the first contact is your regional Landscape board. They may be able to confirm the identity, or will pass it on to the State Herbarium. If you want to collect weeds or other plants in a National Park or other protected area, please contact the Department for Environment and Water on 8124 4856 about the need for a research permit.

Disposal of samples or specimens

Ensure samples and specimens are disposed of appropriately to avoid weed spread e.g. in a sealed plastic bag inside another sealed plastic bag (i.e. double bagged) for deep burial at a tip site or autoclaving (applying heat to sterilise). Do not dispose of weed samples with green waste (i.e. the green bin) or in a compost bin.

Resource 11 – Writing weed names

Here are some basic tips on writing weed and plant names based on the standards used by the State Herbarium of South Australia and the Flora of South Australia (Jessop & Toelken 1986). "Plant names: A guide to botanical nomenclature" (Spencer et al. 2007) provides lots of further detail on understanding plant names.

Common names

Many weeds have multiple common names. It is recommended that common names are spelled with lowercase letters except where they contain a proper noun (person or place), but conventions about this may differ between jurisdictions:

salvation Jane

Texas needlegrass

Many weeds have more than one common name in English, and still more in other languages. The same common name can be used for different weeds. This can be confusing when searching for information in books or on the internet.

Botanical names

The two words that make up the species name (genus and specific epithet) are written in italics. The first word (genus) is written starting with a capital, and the second word (specific epithet) is written in lower case, for example:

Arundo donax

The name of the author who first published the genus or species may be written in roman after the plant name in italics. This removes any ambiguity about how the name is being used. Many botanists' names have standard abbreviations, e.g.

Setaria P. Beauv.	(abbreviation of A. M. Palisot, Baron de Beauvois)
Romulea minutiflora Klatt	(abbreviation of Friedrich Wilhelm Klatt)

A species can sometimes be broken into smaller categories: subspecies, variety or form. Some weeds that have escaped from cultivation e.g. escaped garden plants, may be cultivated varieties which are called cultivars. These are written as examples shown here:

subspecies (shortened to subsp. or ssp.)

Crepis foetida subsp. *foetida*; or

Crepis foetida ssp. *foetida*

variety (shortened to var.)

Watsonia meriana var. *bulbillifera*

When a species is known to be a hybrid, the name is sometimes written with a multiplication sign (i.e. a cross) between the generic name and the specific epithet e.g.

Crocosmia × *crocosmiiflora*

Cultivar. a type of plant produced in cultivation is written in roman starting each word with capitals and is enclosed by single quotation marks

cultivars may sit within a species, e.g.

Zantedeschia aethiopica ‘Green Goddess’

or they may be within a genus, having been bred from more than one species, e.g.

Rosa ‘Cecile Brunner’

Synonyms

Synonyms (shortened to syn.) are altenative or formerly-used botanical names and are often included after the current name within brackets, for example:

Alstroemeria aurea (syn. *Alstroemeria aurantiaca*) - i.e. *Alstroemeria aurantiaca* is the ‘incorrect’ name.

It is common for weeds to have many synonyms, which can be very confusing.

Uncertain names

If unsure of the correct botanic name, this can be indicated by using a question mark in front of the component of the relevant part. If unsure of the correct identification, place a question mark in front of the whole name, for example:

?*Cylindropuntia pallida*

If you know the genus, but are unsure about the specific epithet, follow this example:

Cotoneaster ?*corniculatus*

If you know the genus, but not the specific epithet (use species shortened to sp.), follow this example:

Cotoneaster sp.