



# Invasive species in Australia's aquatic environments

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## SYLLABUS LINKS

### Stage 5: Environmental change and management

Students investigate:

- human-induced environmental changes across a range of scales
- environmental management, including different worldviews and the management approaches of Aboriginal and Torres Strait Islander Peoples

Select ONE type of environment in Australia as the context for a comparative study with at least ONE other country

*(Inland / freshwater water environments are the selected option for this article)*

Students investigate:

- the causes, extent and consequences of the environmental change
- the management of the environmental change





# Invasive species in Australia's aquatic environments



A creek infested with alligator weed  
<http://www.scienceimage.csiro.au/image/784>

Invasive species are exotic or native species of animals, plants and other organisms introduced by humans to places they do not naturally belong. The introductions of pest species into aquatic environments can be:

- **Intentional** like the Asian water buffalo introduced into northern Australia as a meat supply, European Redfin Perch introduced into NSW for recreational fishing and the Nutria (swamp rat) brought to the USA for the fur trade.

OR

- **Accidental** such as the spread of South American alligator weed into 30 countries around the world through global trade and shipping and the escape of aquarium fish such as goldfish and Koi carp.

Once pest species invade inland water and marine environments such as riparian zones, floodplains, wetlands, rivers and estuaries they can cause environmental change to:

- Water flows
- Water quality
- Riverbank stability and soils
- Native biodiversity

These changes have economic and social consequences for agriculture, fishing, navigation and tourism industries and for traditional landowners and result in a loss of aesthetic, social and cultural environmental value.

## Australia's aquatic invaders

Nine invasive plant species are considered serious threats to Australia's inland water ecosystems including aquatic species such as alligator weed and salvinia and those that invade riparian zones and floodplains such as mimosa, blackberry and willow. Salvinia often covers entire water surfaces in a thick mat, reducing sunlight penetration and oxygen exchange resulting in stagnation and fish kills.

Exotic fish compete for food and space with native fish and frogs, prey on eggs and juveniles, alter food webs and change habitats. Over 25% of fish species in Southern Australian and New Zealand river systems are non-native and native fish face high risks of extinction making it an invasion hotspot.

*Aquatic pest species can establish in freshwater environments via deliberate stocking, recreational activities (live bait), stocked farm dams and aquarium escapees, or accidental transport.*

<http://wetlandinfo.ehp.qld.gov.au/resources/static/images/ecology/aquatic-ecosystems-natural/riverine/murray-darling/threats/wpbn-introduced-aquatic-fauna.png>

European Carp (Figure 1) are the dominant invasive species in the Murray Darling Basin and throughout NSW rivers (Figures 2 and 3) where their bottom feeding habit contributes to increased turbidity, nutrient levels and bank erosion resulting in aquatic plant loss, declining native fish numbers and algal blooms in response to eutrophication.



Carp in the Maribyrnong River, Avondale Heights, Victoria, Australia. 2007  
[https://commons.wikimedia.org/wiki/File:Carps\\_in\\_River.JPG](https://commons.wikimedia.org/wiki/File:Carps_in_River.JPG)

# Invasive species in Australia's aquatic environments

## Management of aquatic pests

The control or eradication of invasive species from Australia's inland water environments relies on the actions of individuals, community and industry groups, governments and Traditional landowners. Examples include The Northern Territory Department of land Resources, the Invasive Species Council, a not for profit charity (NGO) and the government funded CSIRO and Weeds Australia.

The aims of management are the prevention of new invaders and eradication or control of existing pests but opinions vary and conflict often occurs between stakeholders with different perspectives. The latest attempt to manage carp numbers in NSW centres on the introduction of a herpes virus that will kill the feral species without harming others but some believe this approach will only damage the aquatic environments further. Different perspectives on this issue are illustrated in **Figure 4**.

Successful management depends on the timing of action – once an infestation has occurred the effectiveness of strategies decreases while costs increase as shown in the table from the Invasive Species Council in **Figure 5**.

## Water buffalo, pigs and Arnhem wetlands

Originally introduced into the Northern Territory in the 1800's as working animals and a source of meat for early settlers, water buffalo (*Bubalus Bubalis*) populations have multiplied and the species has become a serious feral pest on the floodplains of Australia's top end. Despite past eradication and control attempts such as culling, game hunting and harvesting buffalo meat for pet food and a protein source for remote indigenous communities, water buffalo continue to cause serious environmental damage, particularly in Arnhem Land. See **Figures 6, 7 and 8**.

Water buffalo compact soil, inhibit plant growth and erode riverbanks, resulting in increased erosion and turbidity that impacts on aquatic species. Saltwater intrusion occurs through buffalo 'swim channels' impacting on freshwater species such as red water lilies that are valuable food sources for native animals such as Magpie Geese as well the traditional owners. The loss of paperbark forests on the Mary River floodplains and the spread of weeds such as mimosa are attributed to saltwater intrusion. Buffalo rubbing up against mimosa also help spread the seeds. The tuberculosis carried by buffalo is a biosecurity issue that threatens Australia's beef cattle industry and exports.



*Mimosa pudica* with mature seed pods on plant, growing at Cairns, Queensland, Australia. Feb 2014.

[https://commons.wikimedia.org/wiki/File:Mimosa\\_pudica\\_seed\\_pods.jpg](https://commons.wikimedia.org/wiki/File:Mimosa_pudica_seed_pods.jpg)

In 2015 the cull of feral water buffalo by rangers on the floodplains and wetlands of northern Arnhem Land was doubled to deal with an increase in buffalo numbers to almost 20,000. Traditional landowners, who today rely on the animals for protein, approved the increased cull to restore their damaged country and prevent further environmental change. Aerial and ground level culling is taking place year round to deal with the scale of the operation.

Pigs were originally introduced into Australia as domesticated farm animals. Their escape resulted in significant feral populations in inland environments where, like water buffalo, they compete with native species for food such as plant bulbs and expose riparian land and waterways to erosion and infestation by invasive noxious weeds such as mimosa.

## Willows, riparian health and water quality

Throughout Australia willow tree are declared noxious weeds and are being removed from riverbanks and other aquatic environments such as the Yarra River in Victoria and throughout the ACT. Once used to stabilise riverbanks and reduce erosion various species are now condemned for their impact on water volume, flow and quality, native habitats and biodiversity caused by:

- A dense canopy
- Invasive roots
- Autumn leaf fall
- Heavy water use

The removal of 230 ha of willows from rivers in Victoria and NSW is estimated to have returned 1200 megalitres of water to the rivers each year. Figures 9 and 10

The herb Lippia was an introduced as an ornamental 'no mow' lawn but is now is smothering Murray River floodplains, destroying habitats and reducing native biodiversity.



# Invasive species in Australia's aquatic environments



Murray River, Albury NSW. [https://commons.wikimedia.org/wiki/File:CSIRO\\_SciencImage\\_4568\\_Bridge\\_over\\_the\\_Murray\\_River\\_at\\_Albury\\_NSW\\_1989](https://commons.wikimedia.org/wiki/File:CSIRO_SciencImage_4568_Bridge_over_the_Murray_River_at_Albury_NSW_1989).

## STUDENT ACTIVITIES

1. Draw a flow diagram to illustrate one way an invasive species can cause environmental change.
2. Create a poster to educate people about the role they can play in minimising the number and impact of invasive species in Australia in the future.
3. Why was it important for the traditional landowners in Arnhem Land to play a role in water buffalo management?
4. Refer to **Figure 2**. Explain why carp numbers spiraled out of control in NSW rivers.
5. Refer to **Figure 3**:
  - a. When did carp become a major issue in the Murray Darling Basin?
  - b. Write an addition to the timeline for the introduction of the herpes virus.
6. Refer to **Figure 4**:
  - a. Mind map the different perspectives outlined in the article
  - b. Create an argument to support one point of view.
7. Comparative study: **Asian carp in USA waterways**
  - a. Read the information on the following website. – <http://www.watershedcouncil.org/detailed-timeline.html>
  - b. Develop an inquiry question that involves a comparison of invasive carp species in Australia and the USA.
  - c. Present your findings as an oral report supported with visual sources.
8. Refer to **Figure 5**:
  - a. When is the most effective time to introduce management strategies to eradicate invasive species?
  - b. What is the biggest barrier to the effective control

of invasive species in the proliferation and impact stages? Explain why?

- c. Do you think the statement "Prevention is better than cure" is relevant to managing invasive species? Explain.

9. Refer to **Figure 6**:

- a. Describe the change in feral buffalo densities between 1980 and 2015
- b. State when culling operations began.
- c. Suggest an explanation for the change since 2000.
- d. Explain how and why the graph will change after 2015?

10. Describe the damage caused by water buffalo to inland water environments in northern Australia with reference to Figures 7 and 8

11. Refer to **Figures 9 and 10**:

Contrast the four features of native trees and willows that make one a friend and the other a foe of inland water environments.

## Extension activities

Choose ONE of the following

1. Discuss the statement "When it comes to invasive species, prevention is much easier and cheaper than cure"
2. Use the conceptual diagram in **Figure 11** and the key on the associated website to write a report explaining the impact of introduced fauna on inland water environments.
3. Investigate the issue of invasive species in marine waters around Australia's coast

## Figure 1: European carp



<http://www.abc.net.au/news/image/7084670-3x2-940x627.jpg>

# Invasive species in Australia's aquatic environments

Figure 2: The problem with carp

## Is it really necessary to control carp in Australia?

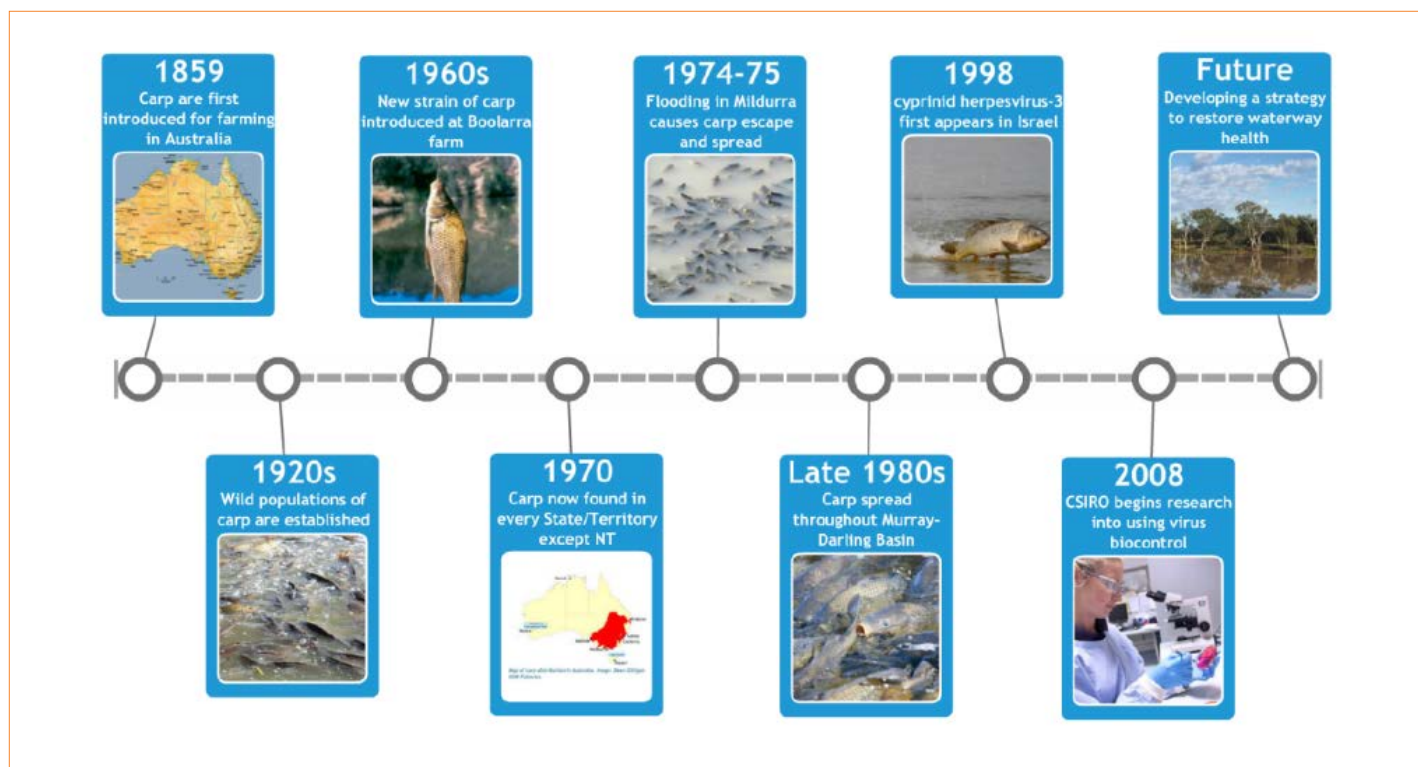
First introduced in Australia in 1859, carp became a major pest in the 1960s after the accidental release of a strain that had been adapted for fish farming. Within a few years they established themselves throughout the entire Murray-Darling Basin.

Carp now comprise up to 90% of the fish biomass in parts of the Basin. This is largely attributed to female carp producing up to a million eggs per year, and to the omnivorous fish's tolerance for a wide range of habitats including degraded water. While we may not be able to 'prove' that carp directly caused the degradation of our rivers, their dominance must certainly contribute to the problem. It is unlikely that the Murray-Darling Basin could ever return to its previous glory while carp remain in such high numbers.

Our views in Australia are supported by research from the US. This showed that carp muddy their waters resulting in flow-on effects on plants, invertebrates, bird-life and native fish in shallow lakes. Researchers concluded that common carp damage the ecology of shallow lakes, particularly when carp density reaches levels similar to those in parts of the Murray-Darling Basin.

This CSIRO blog explains how and why carp became an invasive species – <https://blog.csiro.au/reclaiming-our-rivers-from-feral-carp/>

Figure 3: Timeline showing the historical rise of carp as an environmental issue



<https://i0.wp.com/blog.csiro.au/wp-content/uploads/2016/01/carp-timeline-crop.png?resize=940%2C519&ssl=1>

# Invasive species in Australia's aquatic environments

Figure 4: Different perspectives

## **Carp herpes: Eradication program will damage environment, commercial fisherman warns**

*By Isabel Dayman, Thursday 5 May 2016*

*A dramatic plan to eradicate European carp from the Murray-Darling river system using a strain of the herpes virus may cause a pollution problem with dead fish littering waterways, a South Australian carp catcher has warned.*

*Key points:*

- *Federal Government project aims to eradicate 95 per cent of European carp*
- *Fisherman warns it will cause a huge pollution problem*
- *Tourism operators concerned it will affect business*

**Commercial carp fisherman** Garry Warrick said his biggest fear over the plan was the prospect of water pollution from the dead pest. "If the numbers of carp I know, which are around thousands of tonnes of them, if they died in quick succession, then there's going to be that many dead fish around there won't be enough people to clean it up," he said. "I know the fish factory that I supply, they won't take dead carp. So I don't know what's going to happen to them."

**Science Minister** Christopher Pyne said the Government would find a use for the dead fish, with the prospect of turning them into pet food. "We're going to either turn them into fertiliser, or pet food maybe, or dig enormous holes and put them in there," Mr Pyne said. "But the decision's been made, the herpes virus can be released, and we'll get rid of these noxious pests." Mr Warrick said the EPA did not allow large quantities of dead carp to be buried.

Yesterday the Government announced the \$15 million project that would see a strain of the herpes virus, which was discovered in Israel, released into the river system by the end of 2018. The virus only affects European carp and is expected to kill 95 per cent of the species of fish in the river system over the next 30 years. Mr Warrick was sceptical the project would see the 95 per cent success rate as touted by the Federal Government. He said the species' numbers in Israel had rebounded since the virus was released. "It's a different environment, different water. It's untested and unproven at the moment," Mr Warrick said. "Whether it works as it did in the laboratory, in the wild, we will have to wait and see."

**Houseboat operator** Robert Hughes was also concerned the dead carp could cause problems for tourism. "I think a river full of dead carp is not going to be fantastic for business," he said.

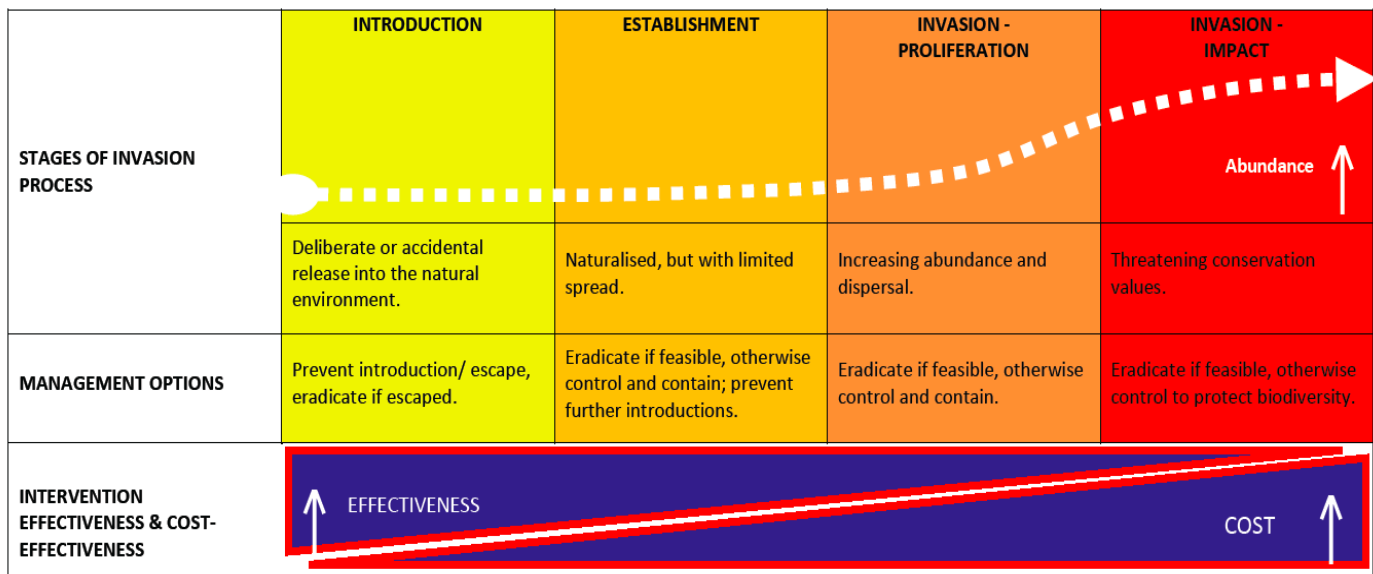
The **director of fertiliser company Charlie Carp**, Harold Clapham, said he would be able to put the many tonnes of dead carp to good use once the eradication program was rolled out. "It won't damage the long-term prospects of our business — we think it will probably only enhance opportunities for our business," he said. "There are a huge amount of logistical and practical issues that have to be dealt with [but] we can use dead carp."

ABC NEWS – <http://www.abc.net.au/news/2016-05-02/carp-eradication-program-could-cause-pollution-problems/7374658>



# Invasive species in Australia's aquatic environments

Figure 5: Management of invasive species



Invasive Species Council – <https://invasives.org.au/strategy-invasive-species-australia/>

Figure 6: Feral Water Buffalo in Arnhem Land

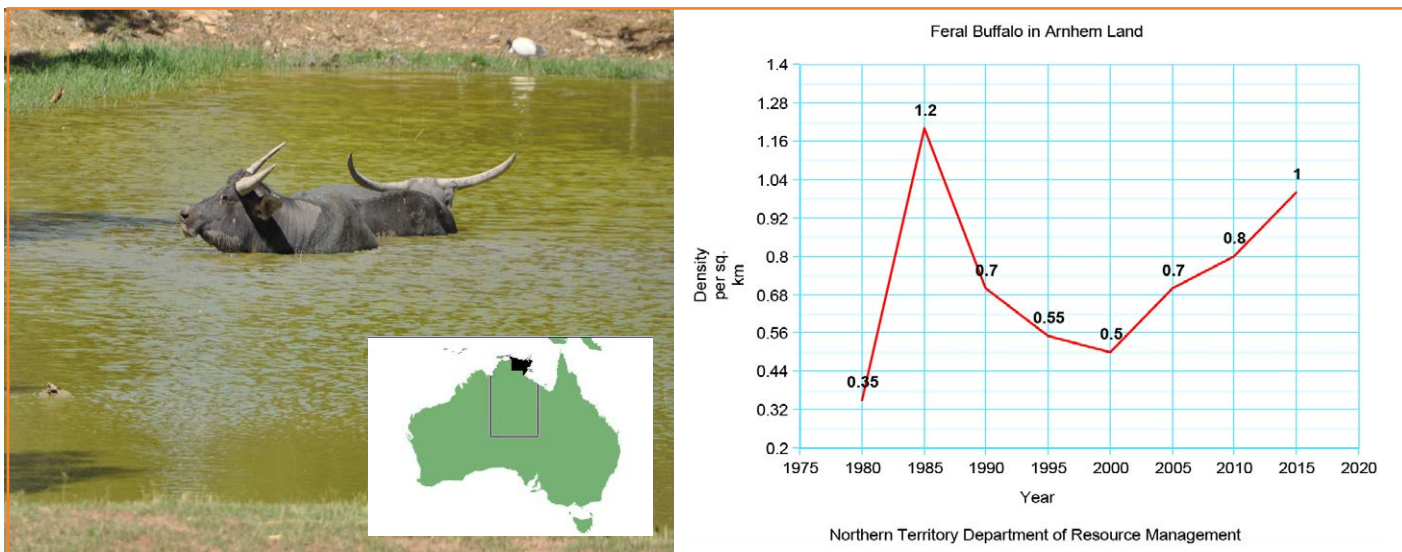


Photo and graph L Chaffer  
 Data for graph from NT Department of Land Resource Management – <http://www.lrm.nt.gov.au/feral/buffalo>  
 Graph created using kidszone@ed.gov



Figure 7: The impact of water buffalo

Water buffalo create compacted channels and destroy native vegetation

<http://www.abc.net.au/news/2015-08-22/arnhem-land-djulk-rangers-ambitious-feral-water-buffalo-cull/6710380>



# Invasive species in Australia's aquatic environments



Figure 8: The impact of water buffalo

Water buffalo wallow in muddy riparian zones and wetlands

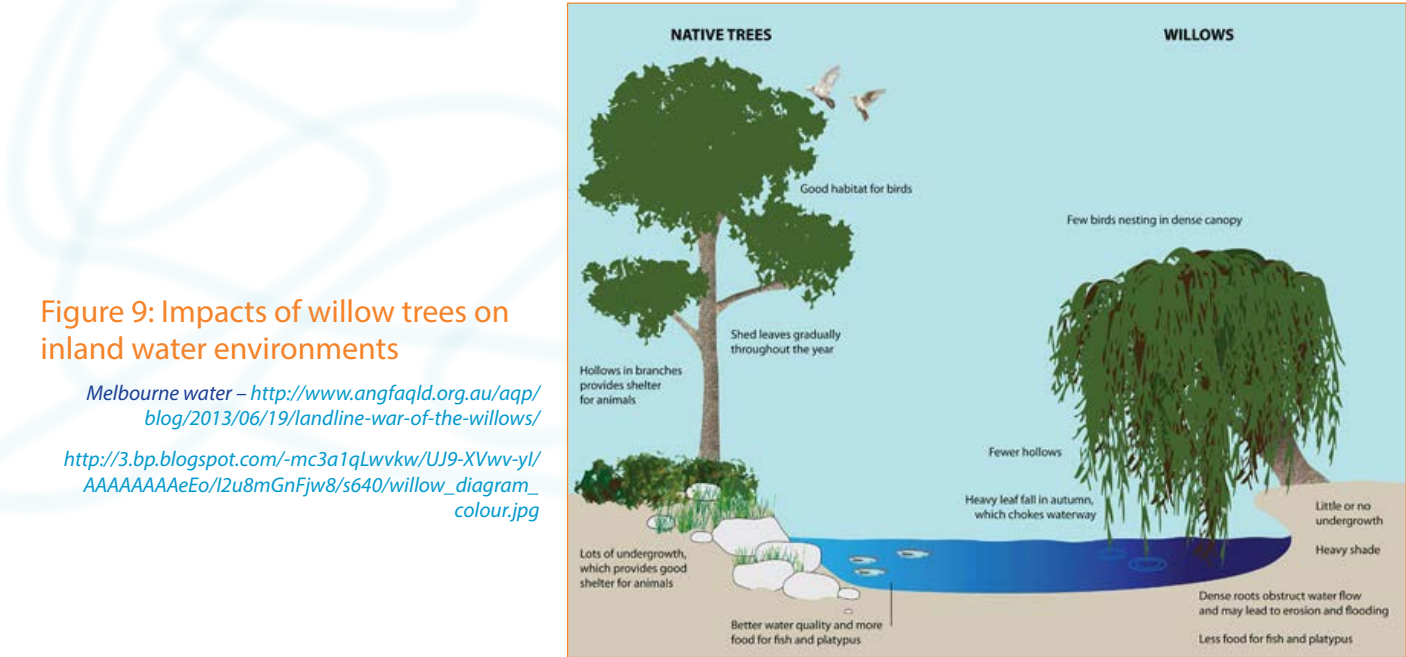
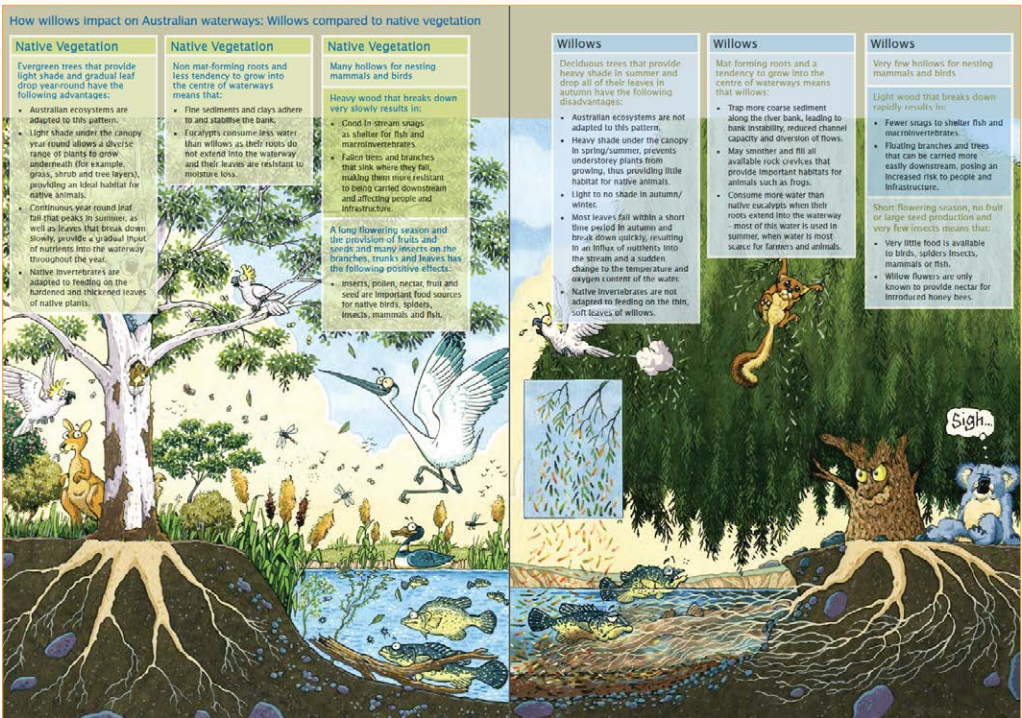


Figure 9: Impacts of willow trees on inland water environments

Melbourne water – <http://www.angfaqlid.org.au/aqp/blog/2013/06/19/landline-war-of-the-willows/>

[http://3.bp.blogspot.com/-mc3a1qLwvkw/UJ9-XVwv-yI/AAAAAAAEo/I2u8mGnFjw8/s640/willow\\_diagram\\_colour.jpg](http://3.bp.blogspot.com/-mc3a1qLwvkw/UJ9-XVwv-yI/AAAAAAAEo/I2u8mGnFjw8/s640/willow_diagram_colour.jpg)

Figure 10: Impacts of willow trees on inland water environments



Weeds Australia – <http://www.weeds.org.au/about.htm>

Archived resource "National Willows management Guide" – [http://pandora.nla.gov.au/pan/64168/20080620-0000/www.weeds.crc.org.au/documents/wmg\\_willow.pdf](http://pandora.nla.gov.au/pan/64168/20080620-0000/www.weeds.crc.org.au/documents/wmg_willow.pdf)



# Invasive species in Australia's aquatic environments

Figure 11: Introduced fauna in the riparian zone

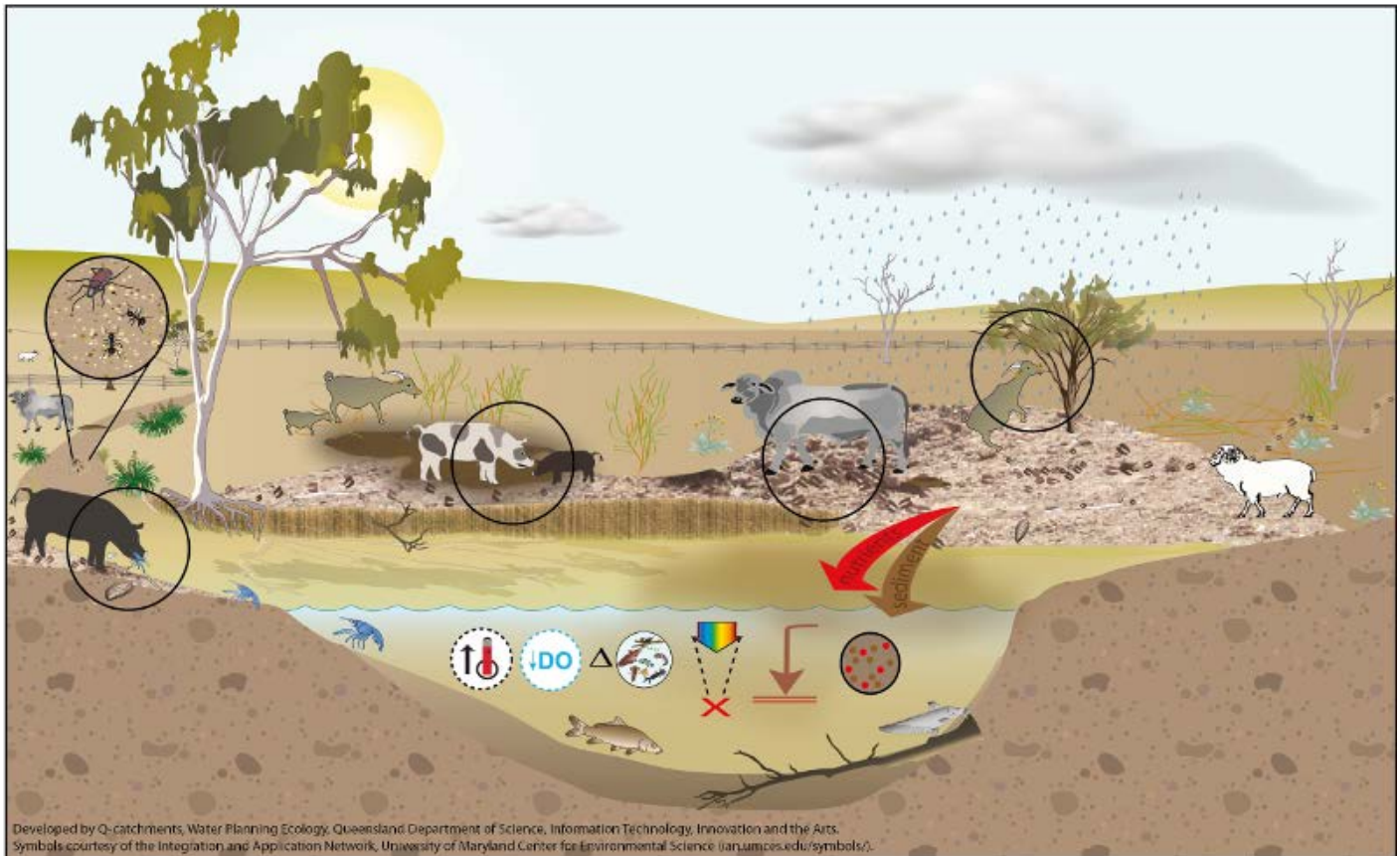


Figure 11. Introduced fauna in the riparian zone

<http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/riverine/murray-darling/rfauna.html>

## WEBLINKS

The feral water buffalo

<http://cbhsyearfivehistory.weebly.com/water-buffalo.html>

ABC video: Buffalo cull

<http://www.abc.net.au/news/2015-08-22/buffalo-cull-in-arnhem-land/6717268>

Arnhem land buffalo cull

<http://www.abc.net.au/news/2015-08-22/arnhem-land-djulk-rangers-ambitious-feral-water-buffalo-cull/6710380>

Curbing the carp

<http://splash.abc.net.au/home#!/media/30051/curbing-the-carp-population>

Landline: war of the willows

<http://www.abc.net.au/landline/content/2013/s3782459.htm>

NT Buffalo pamphlet (graph and map)

[http://www.lrm.nt.gov.au/\\_\\_data/assets/pdf\\_file/0006/355803/Buffero-survey-Arnhem-Land-2014-pamphlet.pdf](http://www.lrm.nt.gov.au/__data/assets/pdf_file/0006/355803/Buffero-survey-Arnhem-Land-2014-pamphlet.pdf)

Willows Friend or Foe brochure

[http://www.weeds.org.au/WoNS/willows/docs/Willows\\_Friend\\_or\\_Foe\\_web\\_260609.pdf](http://www.weeds.org.au/WoNS/willows/docs/Willows_Friend_or_Foe_web_260609.pdf)

WWF: Threat of Invasive species in the Murray -Darling

[http://wwf.panda.org/about\\_our\\_earth/about\\_freshwater/freshwater\\_problems/river\\_decline/10\\_rivers\\_risk/murray\\_darling/murray\\_threats/](http://wwf.panda.org/about_our_earth/about_freshwater/freshwater_problems/river_decline/10_rivers_risk/murray_darling/murray_threats/)

Giant Goldfish

<http://www.abc.net.au/news/2016-08-16/giant-goldfish-found-in-wa-rivers/7747824>



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