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# Prevention and management of aquatic plant invasions in Australian rivers

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## The issue

Australian river systems are threatened by the severe effects of drought, bank erosion, sedimentation, pollutant inputs, urban development, and invasions by exotic aquatic plant species. Invasive aquatic plants are known to increase evaporative losses, reduce dissolved oxygen availability, slow flows, degrade habitat for native flora and fauna, compete with native vegetation, and disrupt recreational activities. Their impacts may go further than we know, as aquatic plant species tend to be under-studied in Australia. For example, it is thought that mat-forming floating species, like *Salvinia molesta* (floating) or *Cabomba caroliniana* (submerged), may provide habitat for disease vectors such as mosquitoes, but this hypothesis has not yet been studied.

Pictured below: *Egeria densa* (dense water weed) and *Salvinia molesta* (giant salvinia) on an oar in a dam near Brisbane. These aquatic weeds impede recreational activities.

CSIRO researcher Lauren Quinn counts aquatic weed species in a dam near Brisbane.

Currently, five aquatic or semi-aquatic species are listed as Weeds of National Significance (WoNS), and many others are considered noxious species in one or more states. Localised and severe outbreaks of these species occur in Australian river systems, requiring costly chemical, mechanical, and biological methods of removal. Chemical control is challenged by restrictions against contamination of drinking water supplies, so the range of available herbicides is smaller than in terrestrial systems. Where allowed, herbicides can achieve effective control, but often require repeated application. Also, large quantities of biomass decomposition following herbicide application can cause secondary problems that affect native fauna. Mechanical control methods are similarly challenged. Harvesting machinery can be prohibitively expensive, and manual removal is extremely labour-intensive. Because many invasive aquatic plant species spread by vegetative propagation and display extremely rapid growth rates, mechanical control often requires repeated effort. Finally, plant invasions are often merely symptomatic of larger environmental problems and unless the underlying issues are addressed, management efforts and expenditures become ineffective in the long term.

It is imperative that we provide better solutions for prevention and control of invasive aquatic plants. For example, if we can identify the environmental factors that correlate with their presence and abundance, we can predict the locations most susceptible to invasion and manage resources to prevent and limit invasive species in those locations. In the following pages, we provide critical results from our studies and literature review, and list management recommendations based on our science.

## Predicting invasions: knowing where to look

Large outbreaks of aquatic invasive plants receive high priority for management response, but some effort must be directed towards early detection of incipient invasions as well. Unfortunately, because aquatic plants tend to be patchily distributed in Australian rivers, new invasions can be difficult to detect. Because council weeds officers are often charged with monitoring large areas, it is imperative that their early detection efforts are concentrated where the risk of introduction and subsequent establishment is greatest.

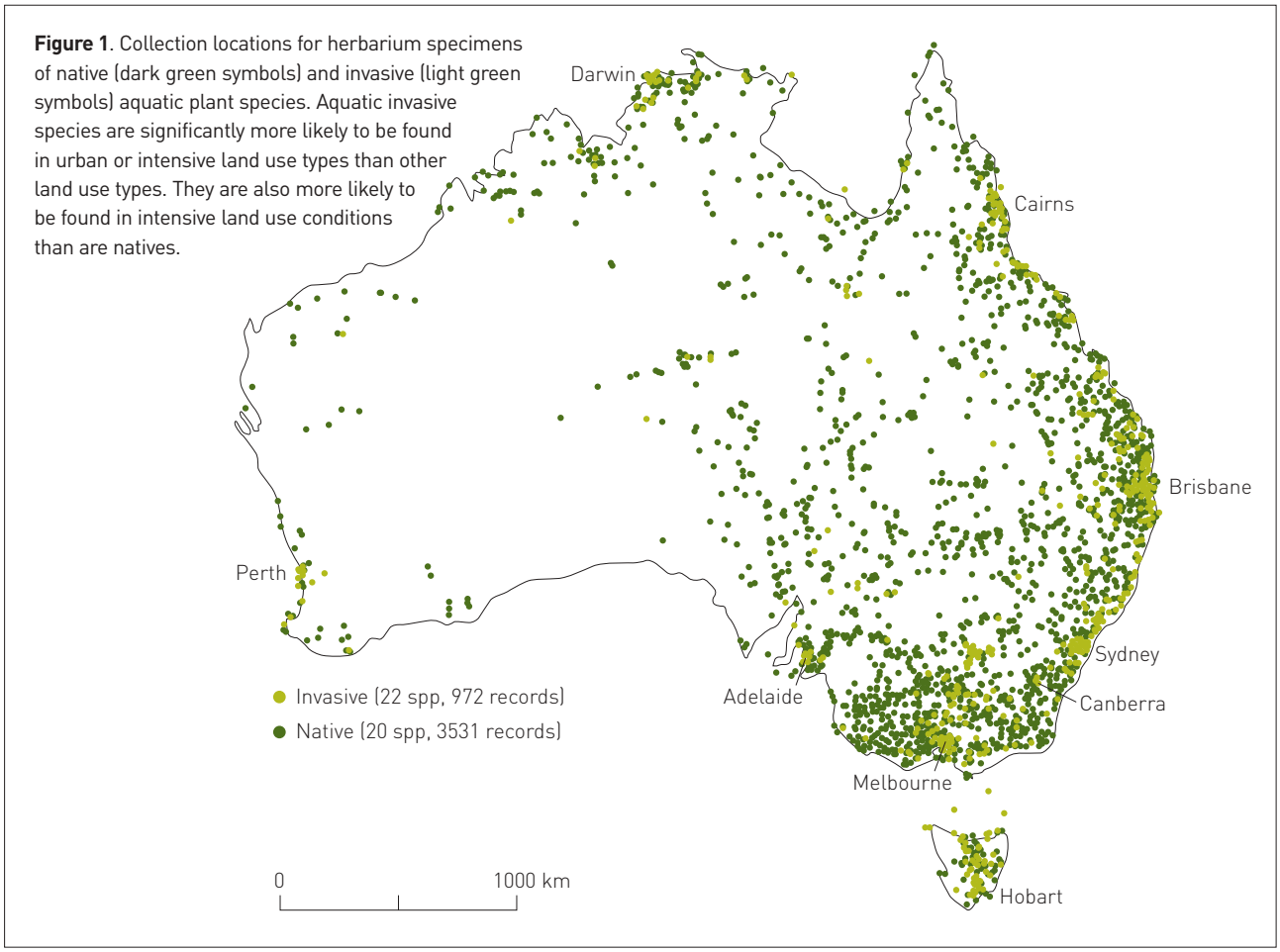



**Figure 1**. Collection locations for herbarium specimens of native (dark green symbols) and invasive (light green symbols) aquatic plant species. Aquatic invasive species are significantly more likely to be found in urban or intensive land use types than other land use types. They are also more likely to be found in intensive land use conditions than are natives.

Land use is relatively easy for managers to observe, and can act as a proxy for underlying environmental properties. Not surprisingly, distribution and abundance of invasive aquatic plant species is related to land use, with urban or intensive land uses hosting a greater abundance of these species. On a continental scale, most aquatic weeds can be found clustered within 10–25 km of urban city centres, and are more abundant in residential, commercial, and transport land uses (see figures 1 and 2). Aquatic weeds appear to prefer the environmental conditions typical of these intensive land use types, but it is also probable that these locations receive more propagule inputs than undisturbed areas. Invaders do, however, occasionally establish in relatively remote and undisturbed locations.

Targeting urban land use areas and selected sites in undisturbed areas in early detection programs may help limit new invasions.

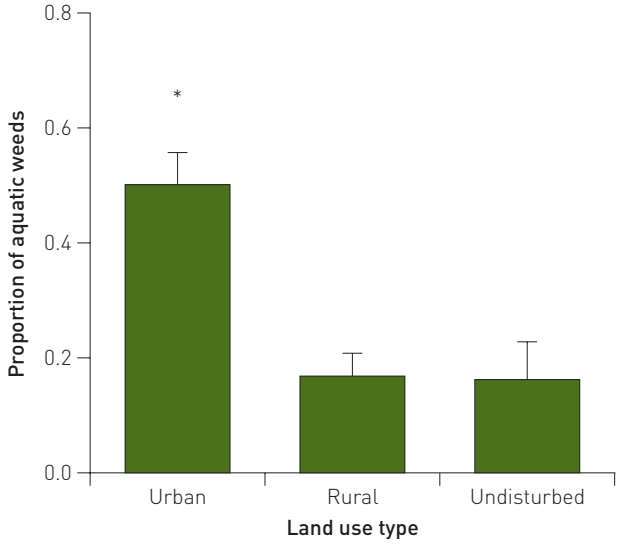



**Figure 2**. Proportion of the aquatic plant community that is made up of weed species. Mean values are shown for each of three land use types surveyed outside four Australian capital cities (Brisbane, Canberra, Hobart, and Melbourne). Urban sites had significantly greater proportions of weed species.

**Management recommendation 1: Managers should focus early detection efforts near city centres, but remain vigilant for spread into more distant locations.**

## Preventing invasions: managing the environment

In addition to large-scale land use patterns, we know that invasive aquatic plant species become more abundant in response to specific environmental factors, including high light intensity, warm water temperatures, and high levels of dissolved nutrients, especially phosphorus and nitrogen. If management plans include modification or removal of factors that favour invasions, long-term control becomes more efficient and effective.

Because riparian shading appears to discourage aquatic weed growth (see figure 3), riparian restoration should be prioritised on a catchment scale. Intact riparian forests reduce light intensity and water temperatures, especially in smaller streams where channels are relatively narrow. Riparian forests provide additional large-scale ecosystem services beyond their capacity to discourage aquatic weed growth. Restoring these forests could buffer nutrient pollutant inputs into streams, stabilise streambanks to reduce sediment flows, and provide habitat for native fauna.

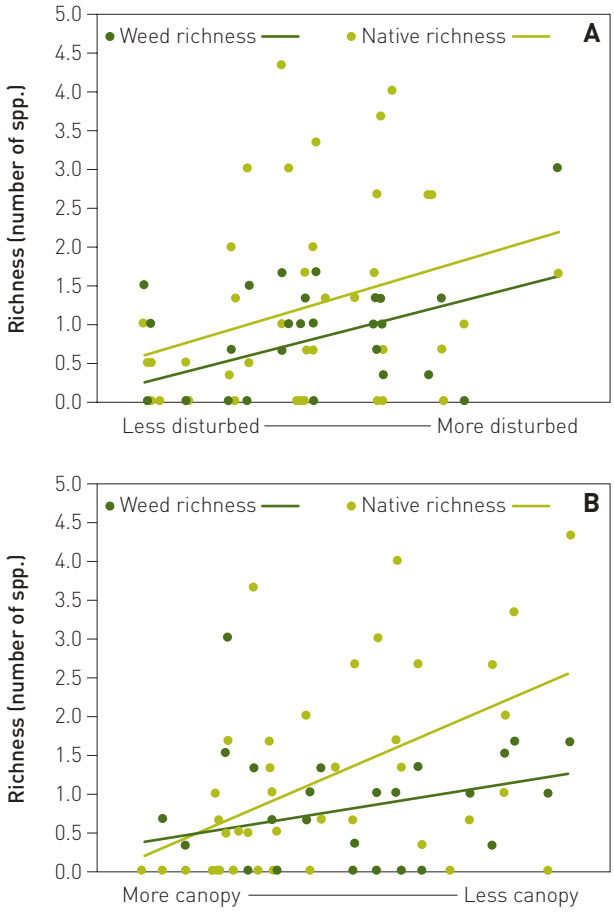



**Figure 3**. Aquatic plant community response to (A) anthropogenic disturbance and (B) shading from riparian canopies.

Below. A peri-urban sampling location near Melbourne. Many peri-urban sites have experienced similar reductions in riparian forest cover, which can result in proliferation of both aquatic and terrestrial invasive plant species.

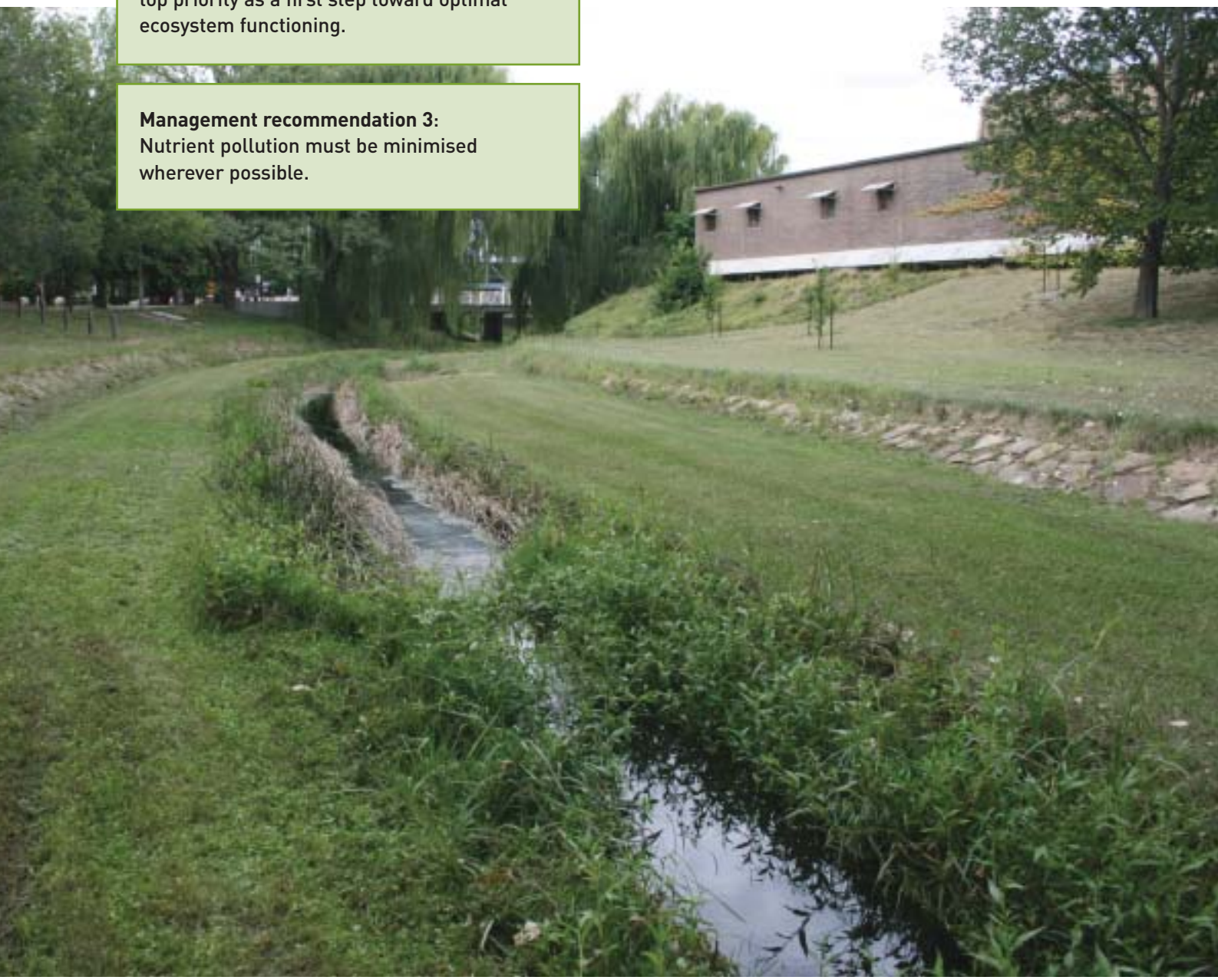
While restoration of riparian forests should result in reductions in nutrient pollutant inputs in the long term, sources of these inputs should be identified and managed in the near term. Non-point source pollution is difficult to manage, but known sources of nutrient inputs (e.g. farms, nurseries, feedlots) should be encouraged to better manage nutrient inputs and riparian erosion (e.g. more efficient fertiliser application, holding ponds for runoff, and fencing off of streambanks from stock).

**Management recommendation 2:**
**Riparian restoration should be given top priority as a first step toward optimal ecosystem functioning.**

**Management recommendation 3:**
**Nutrient pollution must be minimised wherever possible.**

## Management challenges and future work

Effective river management is challenged by the flowing and interconnected nature of these systems. If aquatic weeds are not managed throughout the catchment, upstream infestations will act as sources of viable propagules to localities susceptible to invasion downstream. For this reason, it is extremely important for managers to look outside their immediate jurisdictions to consider catchment-wide issues and solutions. This will require regional prioritisation of funding for large-scale revegetation projects and setting of policy with regards to agricultural practices.



An example of an urban sampling location. Many urban waterways have been heavily modified (in this case, channelised for stormwater drainage), which can result in optimal conditions for aquatic weed invasions.

Aquatic weed management is also challenged by the continued influx of new propagules. The aquarium trade has been implicated in introductions of aquatic weeds in local waterways, often as a result of the "humane" disposal of aquarium contents by individuals, but sometimes purposefully planted in natural areas for later sale to aquarium shops. The National Aquatic Weeds Coordinator works with nurseries to voluntarily curb the trade of particularly invasive aquatic species, but further action should be taken to educate consumers about which species are invasive prior to purchase and the proper disposal of aquarium material.

**Management recommendation 4:**
**Cooperation and coordination of management efforts should occur in adjacent council units throughout catchments. Control methods that are effective at large spatial scales (e.g. biocontrol) should be adopted wherever possible.**

**Management recommendation 5:**
**Aquatic plant retailers (nurseries, pet stores, web retailers) should be encouraged to distribute educational materials to consumers on the proper disposal of aquarium contents.**

## In conclusion

While invasive aquatic plants are a serious concern in Australia's waterways, we can target invasion-susceptible locations in early detection efforts and manage resources for long-term control. Because integration of effort is required on a catchment scale, coordination of policy must occur on a regional and, sometimes, interstate level. In this fact sheet we present five recommendations that will increase the effectiveness of regional management of aquatic weed species. Added benefits are improved water quality, the protection of habitat for endangered native aquatic species, increase in public amenity values, reduced risk of flooding and infrastructure damage, and possibly a reduced risk of vector borne diseases.

Small photo above Darwin Weed Management Branch.

Some aquatic plant species, like alligator weed (pictured), establish on stream banks and subsequently spread across water surfaces. Broken stem fragments can be washed downstream to establish new populations in other parts of the catchment. Photo Shon Schooler.

This fact sheet is based on the report "Effects of land use and peri-urban development on aquatic weeds" by Lauren D. Quinn, Shon S. Schooler, Rieks D. van Klinken. The full report is available from lwa.gov.au/weeds

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