Southern Rivers Catchment Management Authority

Willow management approach

Adopted Policy

1. Introduction

Introduced willows (*Salix* spp) have been planted widely in the southern half of Australia for erosion control, shade and shelter, stock feed and aesthetic values. They are often important riparian trees where native vegetation has been cleared or is difficult to regenerate. There is now a well documented concern about the spread of willows along waterways and wetlands from branches and by seed. Primary concerns relate to the multitudes of willow stems that obstruct and divert river flows into river banks and threaten infrastructure, displace native vegetation and impact biodiversity. Recent assessments of the current distribution of willows suggest that it is only a fraction of the potential geographic range that they could occupy in temperate Australia (Thorp and Lynch 2000).

Willows were used extensively for erosion control in waterways from the 1950's to 1970's. By the late 1980's advancements in river management techniques meant that the use of willows as a tool in stream stabilisation diminished. Willows are declared Weeds of National Significance (*Salix* spp). In New South Wales there is a regional declaration of willows as a Class 5 noxious weed. This provision prohibits the sale or planting of most Salix species. Landholders are not obliged to remove willows but it is illegal to plant or propagate them or for nurseries to sell them (Agriculture and Resource Management Council 2001).

In the past, the approach to willow management has largely been to deal with problems as they arise in limited stretches of streams. However recognition of the importance of managing willow populations sustainably through balancing the need for broad-scale willow removal and willow retention in certain situations is increasing. This document outlines the current approach taken for willow management for the Southern Rivers Catchment Management Authority.

2. Willow biology overview

Until recently, the ability of willows to produce viable seed, and thus spread, was underestimated. However, recent evidence shows that willows are capable of reproducing by seed (as well as vegetative means) which is causing major environmental damage to rivers in NSW. As an example, CSIRO research indicates that in 1993 some two million seedlings became established from seed germinating in the Bega River (Far South Coast Willow Task Force/DLWC 1997). Some willows reproduce almost exclusively by seed (e.g. black or pussy willow) or vegetative means (e.g. crack willow) but more commonly as part of a sexual and vegetative reproductive strategy.

Willows are deciduous trees or shrubs that in habitat permanently or seasonally wet, inundated or waterlogged sites. Plants are either usually male or female. Spread by seed occurs through bees pollinating flowers along catkins. Flowering occurs in spring and typically only for two to three weeks. Seeds are small and ripen about 3-4 weeks later and are dispersed by wind or water, sometimes over hundreds of kilometres. Seed viability is only about two weeks and needs to be lodged on suitable bare or wet soils or other substrates to survive. Germination typically occurs within 24 hours. Hybridisation of willows occurs if flowering occurs simultaneously, trees are within bee pollinating distance and of the same subgenus (i.e. trees or shrubs).

Reproduction by vegetative means occurs by twigs breaking off in winds and floods, or by trunks of willows collapsing whilst retaining their root system. The more 'fragile' or brittle a willows branches are the greater its ability is to spread invasively by vegetative means. Willow species with brittle branches like the crack willow have a strong ability to spread by small branches falling into the stream.

3. Disadvantages and advantages of willows

Currently, there is not total agreement on the need to control willows. While a number of river managers may take the view that the advantages of willows have now been outweighed by the problems they cause, the community is not unanimous on the subject. Approaches under Natural Sequence Farming systems have recently suggested the benefits that willows can have in agricultural

landscapes (Andrews 2006) and the SRCMA has recently supported the Mulloon Creek Natural Farms demonstration site. Willows can also have a social significance to some local communities. Therefore, for effective management it is important to recognise the impacts that willows can have on waterways, as well as acknowledging that willows can be beneficial in certain situations and landscapes. The possible benefits and disadvantages of willows have been described in a number of publications and are summarised below. The possible benefits include:

- their ease to propagate and establish dense root masses that stabilise stream banks and mitigate erosion in degraded catchments;
- their aesthetic appeal as they provide an alternative appearance to the landscape;
- in heavily cleared farmland they may be the only remaining source of shade and shelter for stock, and habitat and organic inputs for aquatic fauna;
- provision of a short term source of feed for stock in times of drought; and
- their role in suppressing other weeds under dense canopy, e.g. blackberry.

The aggressive growth habit of willows and their ability to colonise river and stream beds by vegetative and sexual reproduction has been shown to cause significant problems on the riparian and aquatic health of streams, and on the morphology of the bed and banks. Detrimental impacts include:

- modification of stream morphology, hydrology and stability causing blockages/diversions, avulsion, increased bank erosion and decreased flood capacity;
- accumulation of fine silt in the bed around root masses, including smothering of cobble and gravel bars, riffles and pools which may reduce habitat availability for aquatic bugs and fish;
- increased water use where willow growth habit results in significant infestations in the stream bed. Preliminary studies on transpiration rates between willows on the stream bed compared to willows and native trees on stream banks indicated a large difference in water uptake (maximum daily transpiration 15.2 mm recorded for willows in the permanently inundated stream bed compared to only 2.3 mm for willows and 1.6 mm for river red gums on banks) (Doody et al 2006);
- damage to infrastructure where willow debris obstructs stream channels during floods (for example, loss of bridges);
- alterations to ecological processes, including:
    - changes to nutrient cycling due to their deciduous nature;
    - water temperature modifications, particularly impacting on shading on fish and bugs during summer
    - changes in water quality by anoxic conditions (dissolved oxygen demand) produced during breakdown of massed autumn leaf fall;
- suppression of native vegetation by intense shading, including exclusion of understorey;
- reduction in amenity values, for example reduced access for canoeists and swimming holes along infested reaches; and
- loss of biodiversity when willows invade and displace native vegetation in riparian areas.

4. SRCMA strategy for willow management

Recognising that in the right place willows can be valuable, total eradication of willows is generally not the preferred approach for effective management. However, strategic measures which sustainably manage the spread of willows threatening river health and associated assets are supported by the SRCMA.

In order to achieve a balance between willow retention and removal, the management approach taken by the SRCMA is based on the following and in accordance with the DNR guideline for the clearing of exotic trees and dead native trees on State Protected Land (April 2006):

4.1 No further planting of willows

In accordance with the National Willow Strategy (weeds of national significance) no further planting or introduction of willow varieties is encouraged. Suitable alternative native species should be planted to reduce the risk of the establishment of willows that aggressively colonise rivers and surrounding environments. Some native plants that may be considered as a replacement for willows in riparian zones include:

- rushes – *Lomandra longifolia, Carex appressa or gaudichaudiana spp, Phragmites australis, Tyhpa orientali and Juncus usitatus*;
- shrubs – *Melaleuca ericifolia spp, Leptospermum lanigerum or grandifolium* (Tablelands only) *or obovatum or emarginatum spp, Acacia floribunda, Acacia elongata, Acacia longifolia* (largely coastal species) *and A. mearnsii* (largely Tablelands);
- small trees – *Tristaniopsis laurina*; and
- larger trees – *Casuarina cunningharmma and Casuarina glauca* (mainly in salt swamp areas on the coast).

4.2 Undertake control programs that aim to work holistically

The SRCMA seeks to improve the health of waterways in the region. Willow invasion and colonisation are a threat to long-term river health. In order to achieve effective willow control, management strategies that apply at a catchment or sub-catchment scale are utilsed. Also, as the headwaters of many catchments still retain good river health and to reduce the potential for reinfestation, it is desirable that willow management strategies focus wherever possible in the upper reaches and progressively work downstream. Willow control in reaches with a good riparian environment (e.g. streams in national parks or headwater reaches) is also important as protection of intact waterways is much less costly than rehabilitating degraded environments.

Recognising that willow cross pollination and seed distribution can occur across significant distances, it may be important to also assess the broader riparian / farm / sub catchment area for problem trees where willow seeding is evident, or suspected, along a river system.

4.3 Invasive trees that threaten to spread excessively should be removed/eradicated

Of the naturalised willow taxa in Australia several are outstandingly invasive because of their reproductive ability. These include:

- *Salix cinerea* (Grey sallow willow)
- *Salix reichardtii* (Pussy willow)
- *Salix fragilis (*Crack willow)
- *Salix rubens* (Basket willow)
- *Salix nigra* (Black willow)

Black and pussy willows reproduce vigorously by seed whereas the fragile nature of branches of the crack willow enables this species to spread readily vegetatively. Basket willow, a hybrid between the golden upright willow and crack willow reproduces vigorously by seed and also spreads rapidly vegetatively (Agricultural and Resource Management Council 2001). Removal of these species is a priority for willow control, particularly willow seedlings which have the potential to further increase willow infestations. If geomorphic integrity is threatened following removal, assessments of likely impacts and a staged approach combined with alternative stabilisation works will be undertaken.

Retained willows should have a low risk of spreading either by seed or vegetatively, for example true, early flowering female weeping willows. Landholders will be encouraged to control seed and vegetative spread from retained trees. The CMA should develop a memorandum of understanding with local councils to ensure control of contamination from retained trees is the responsibility of the landholder retaining the willows (where the contamination source can be reasonably attributed to those trees).

For willow types that are not easily identified, willow surveys undertaken during catkin emergence in early spring can accurately identify willow species and sex. This may still be difficult in some localities where there are large numbers of seeding willows and established hybrid forms.

4.4 Willows that threaten the stream stability and assets should be controlled

Willows can have a number of impacts on geomorphic and ecological processes as well as impacts on assets. Willow control programs must involve site specific considerations to assess these impacts. General guidelines applied to willow management to prevent stream bank instability, erosion and asset protection include:

- *Instream willows*

The growth habit of willows (dense stands of trees/shrubs with thick root mats growing instream as well as on river banks) means channel blockages leading to bank instability and erosion is common in infested streams. Native vegetation types that can establish instream (e.g. Casuarinas) are mostly pliant shrub species that will be pushed over during high flows and do not normally create channel blockages or bank erosion. Therefore removal of instream willows is a priority to prevent blockages, erosion (and subsequent ecological impacts) and also to remove potential seed producers. Where willows may be playing a role in bed stability (for example, in the Upper Shoalhaven catchment), a staged approach to removal combined with alternative stabilisation works can be utilised.

Removal of in-stream seedlings while they are still young is also a priority as larger trees are harder to control and have a greater risk of impacting on stream stability and downstream infrastructure should a blockage occur.

- *Willows colonising gravel and sand bars*

Control of large willows from in-stream sand and gravel bars should wherever possible be undertaken using chemical control only due to the potential for downstream sediment mobilisation and alignment problems following mechanical removal. A staged approach to allow native vegetation (regenerated or replanted) to establish may be required if substantial areas of the bed have aggraded.

- *Willows on the outside of bends*

In the past, willows were often planted on the outside of bends to reduce erosion and meander movement. Willow removal at these sites has potential to exacerbate erosion. If outside bends are vegetated by non-seeding varieties removal may not be necessary. If stabilised by seeding willows, removal of the seed source should occur in stages, following-up with installation of alternative stabilisation works and revegetation.

- *Asset protection*

Widespread willow planting occurred in the past to protect bridges and other assets where the threat of stream avulsion was considered likely. Willow infestations now threatening assets should be controlled and removal should be followed up using hard structures such as rock protection works and/or native vegetation planting. If willows are not threatening assets they should be maintained until the site is stabilised using other alternatives.

4.5 Replace willows with suitable alternative native vegetation

Large scale, uncontrolled willow removal can lead to stream bank and bed instability. Their removal may also lead to the loss or destruction of native habitat. Thus, where these impacts are likely willow control must be undertaken in conjunction with a native vegetation replacement program. Similarly, in degraded agricultural streams where willows may form the only riparian habitat and native vegetation recovery alone is likely to be low, willow removal will generally necessitate a native vegetation re-establishment program. A staged approach that retains ecological and geomorphic values provided by willows while native vegetation establishes can be important in these situations.

The principles for revegetation following willow removal are consistent with those adopted by the CMA when undertaking native revegetation programs in riparian areas:

- revegetate with suitable local native vegetation first;
- select plants suitable for site conditions; and
- avoid planting species which create (or have the potential to create) weed problems that spread off the site.

Replacement with native vegetation species should be considered in relation to the function it will need to provide in the channel or riparian location. For example, grasses, rushes, reeds and pliant shrubs are suitable in stream and on the bank to trap sediment and create in-stream habitat and biodiversity. Native trees will provide more appropriate riparian habitat while providing shade and bank stability, and should be planted on the bank and in the wider riparian area.

In harsher climates where native vegetation may take 4-5 years to establish, additional structural works may also need to be considered to prevent short-term instability and sediment mobilisation.

4.6 Determine willow control and debris management methods in relation to best practice and risk management issues.

A number of methods of control have been successfully employed throughout Australia. These techniques are typically mechanical or chemical based. Mechanical removal of willows from streams that have not been killed first is rarely justifiable because willows can easily propagate from broken live branches taking root at, and downstream of the site.

Principles adopted by the SRCMA for control are in line with the best practice guidelines for willow control. The adopted general principles include:

- clearing of willows will only be undertaken using one or more of the following methods: hand removal, cut and paint stump, hand removal of juveniles less than 1m in height, foliar spraying and stem injection (to be an appropriately licensed herbicide when used in proximity to water); and
- the general clearing process will involve killing each willow, waiting to ensure death and where necessary removal of the dead tree and/or revegetation.

Management of debris is an important part of willow control. A risk assessment should be undertaken to determine whether debris needs to be managed in relation to:

- potential blockages from debris in flood prone areas;
- asset protection (e.g. bridge, pipe or culvert);
- the risk of dead trees falling on passers by (public liability); or
- the debris is impacting on geomorphic processes (i.e. from bulk fallen timber/short term woody debris blockages)

Poisoning and leaving in-situ, partial removal, full removal or staged removal should be all considered in relation to the risk assessment. Removal of debris should also occur if considered a priority by landholders/community groups.

4.7 Where willows are to be retained, definitive identification of individual trees and strategies and responsibilities for control of future spread are to be determined.

Where a take-all willow control program is not possible or intended, or willows have social/cultural or aesthetic values to local communities, it is important that strategically important trees, i.e. seed producing or brittle trees are identified and control of these trees prioritised. Raising awareness of the potential threats is important, and strategies that encourage control of invasive species, yet retain non-invasive trees with aesthetic/utilitarian values are utilised. Where communities are unanimous that willows are the best tree for the job, invasive species should be replaced with non-invasive species (sterile cultivators to avoid reproduction) and a management strategy prepared.

If a landholder/community wishes to retain brittle or seed producing trees within a willow control project area, landholder/community responsibility for the control of any subsequent spread from these trees is a priority and management agreements for maintenance should be negotiated.

Source Material, References and Further Reading

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