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# Willows – Friend Or Foe? An Historical Perspective

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**SUMMARY:** The presence of willows along and in streams is currently a contentious issue in the Upper Murrumbidgee Catchment (as elsewhere). Many advocate the total removal of this tree species from rivers. Others, particularly landholders, oppose this view, promoting the value of willows for river management, stock fodder and other purposes. The role of willows needs to be placed in perspective so that a more balanced approach can be taken. One way of doing this is to examine the use of the species and its impact since introduction by European settlers in the 1830s.

Using early surveys and other records, anecdotal information and aerial photographs, the role of willows is examined in relation to stream changes that have occurred since European settlement. The effectiveness of willows in erosion reduction is analysed. Also considered is a decline in use that occurred at about the 1920s. Not only did use of the species decline but there was also a decline in the management of existing stands of trees. Reduced management resulted in problems related to channel colonisation. The relatively recent introduction of seeding willows and current and potential impact is examined. Current perceived values, including that of heritage significance are outlined.

**THE MAIN POINTS OF THIS PAPER**

- willow management is a complex issue, with there being valid cases for both removal from or retention in the riparian landscape.
- a knowledge of the benefits, problems and management of willows is essential to limit the adverse impacts of the species

## 1. INTRODUCTION

At the present time willows are possibly the most contentious issue in river management. There is a wide spectrum of views on the role of the species in riverine environments. There are those that advocate total removal. This view is being manifested in actions such as indiscriminate destruction on private lands by community groups without permission of landowners or appropriate advice or government agency authorisation. There are cases where stream stability is being compromised. These actions are inducing responses from those who value the species and argue that it has a place in our present day environment. Strategies are, however, being developed by which a balanced approach to willow management can be effected (ACT Environment Advisory Committee and Upper Murrumbidgee Catchment Coordinating Committee 1998).

To gain a better understanding of the role that willows have played, and continue to play in stream management, it is necessary to look at the history of the willow since European settlement.

## 2. WILLOWS AND STREAM MANAGEMENT

### 2.1. Willows Since European Settlement

Willows in various parts of Australia are believed to have originated from cuttings obtained from Weeping Willows (*Salix babylonica*) growing adjacent to Napoleon's grave on the island of St Helena. (Frankenberg 1995).

Anecdotal evidence indicates that willows have been part of the landscape of the upper Murrumbidgee River catchment area of New South Wales since shortly after European settlement in the 1820s (Starr *et al.* 1997). In 1851 the Rev W. B. Clarke observed a hut at Bredbo "*standing amongst willows*" (Clarke, 1860). To be large enough to provide a visual setting for the hut it is likely that these trees were at least ten years old. Their planting around the hut indicates an aesthetic purpose. The species soon, however, found a new purpose.

The streams of the upper Murrumbidgee River catchment underwent a dramatic change following European settlement (Wasson *et al.* in prep.). The tracks of sheep, cattle, horses, ploughs and carts disturbed vegetation that protected swampy meadows and chains-of-ponds, resulting in incision and the formation of continuous channels. The rivers of the area then responded to increased sediment incursion and also increased catchment water discharge. The latter was the result of increased efficiency of delivery via the recently incised channel system. Higher discharges from land surfaces were also generated by heavy grazing.

The widening and meandering that followed channel incision undermined fringing vegetation completing the destabilisation process.

Channel change and hillslope soil loss were triggered by a number of extreme localised storm events and major

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floods that occurred in the period between 1850 and 1870. Erosion that resulted was reported to be *"perfectly astounding"* by one witness (Clark 1860). The settler's ability to respond to the catastrophic changes was limited, but there is clear evidence that willows played a major role.

Aerial photos taken in 1944 show many evenly spaced, mature and senescent willows along incised major channels in the upper Murrumbidgee River catchment. The majority were located on the outside of bends, indicating planting for the purpose of erosion control. Other plantings are apparent, the majority being in clumps. These were most likely used for stock feed and shelter on the largely treeless valley floors. As willows on the Southern Tablelands senesce at about 80 years of age, it is likely that the willows evident in 1944 were planted in response to the 1850 to 1870 channel changes.

Willows provided stability, a fact evidenced by the lack of erosion along reaches that have had a continuous protection, in comparison to others of similar geomorphic features that have eroded since the species decline. The provision of stability may well have led to complacency, with the original reason for planting being forgotten over time. The early settlers, who planted the original willows, may have passed on the farm to their children. These new owners would have heard about the effects of stream bank erosion, but not have seen it first hand. To the next generation, the role of willows in stream bank stabilisation may have been lost altogether, as it would have been in the sale of a property to a new settler.

Inaction by government may have been a contributing factor to the decline in the use of willows for stream management. While the Soil Conservation Service of NSW had a dispersed network of advisory officers addressing the problem of hillslope erosion, the Water Conservation and Irrigation Commission was centralised and did not provide a proactive service for rural stream managers. The demarcation between the two agencies was well established, thus ensuring a concentration of effort to the hillslopes.

Photo 1: The top photo was taken in 1907 and the lower photo in 1995. The mature willows and poplars can be seen growing along the banks of the Numeralla River in the top photo, and there are only a few in the bottom photo. What caused this, was it complacency or "post-war settlers"? (Starr 1995).

Family photos (Photo 1, Starr 1995) and anecdotal evidence (J Pattrick pers. comm.) indicates that willow planting continued as a regular established management practice until the 1920s, but declined after that time. The reason for the decline in the practice is not clear but could have been the result of a number of factors.

In the upper Murrumbidgee River catchment a change in direction of catchment management effort for off-farm benefits commenced in the 1990s with an emphasis being placed on main channel erosion. This change in direction was partly the result of research which indicated that sediment and phosphorous sources were dominated by channel erosion (Wasson *et al.* 1998, Wasson *et al.* In prep.). Increased management of rivers was also a community (Landcare) response to flood events. The use of Weeping Willows (*Salix babylonica*) as a pioneering species in actively eroding sites became part of programs.

In summary, the original introduction of the willow was most probably for aesthetic purposes and bringing "a touch of Europe" to Australia. Their use very quickly turned to stream management, for which they are ideally suited. Their value for stock fodder was also recognised. As the use of willows started to decline and soil conservation management effort was directed away from the rivers towards the slopes and foothills, the scene was set for channel changes (Photo 1). As there has been a shift in the last decade back towards the management of streams, with an increase in the use of willows as a stream management tool, an examination of their advantages, and disadvantages, is opportune.

### 2.2. Advantages of Willows

Willows are well suited to stabilising eroding stream banks. A dense root system of fine roots provides both a surface mat and an efficient bond between a sand and gravel substrate and the soil of banks..

A major advantage of willows is the speed at which they grow. While native vegetation communities may take between one and two decades to establish sufficiently well to provide protection, willows in the cooler parts of southeast Australia do so within five years. Ease of establishment is also an advantage. The placement of a section of branch in a hole worked by a crowbar is all that is usually required. Aftercare is not required and where removal of stock from riverine corridors cannot be assured, fencing is not critical to establishment success. The planting of branches of sufficient height to prevent grazing damage negates the problem of stock damage.

Willows, being an introduced species, have few diseases and insect pests. Pest attack is usually limited to senescent trees.

Willows provide an excellent source of stock fodder, though the species is now used primarily during drought. An article titled, "*Benefits of willows not widely known*", appeared in the Cooma-Monaro Express in March 1998 and, in part, stated:.

*"A 12-year-old tree, 15 m high, yielded 200kgs of consumable fodder and about half a tonne of timber after being lopped to a height of about 2m to 3m in January. Some 12 weeks later this tree had produced a substantial amount of regrowth, which could have been lopped again if required."*

The article also expressed the views of a Delegate farmer who stated;

> *"We would not be weathering the present drought so well on this property if it were not for my lopping of our weeping willows for the sheep."*

The micro-climate of frost hollows of the upper Murrumbidgee has meant that there are many streams without native trees. In these localities willows provide a habitat opportunity for native fauna. While this opportunity did not exist in the pre-European situation, and therefore could be argued as being "unnatural", some compensation is provided for habitat losses resulting from adjacent land clearing

The heritage and cultural value of certain willows is recognised (ACT Environment Advisory Committee and Upper Murrumbidgee Catchment Coordinating Committee 1998). The dense canopy of the species provides shade, not only for stock but for recreation areas along rivers and around lakes and impoundments.

### 2.3. Disadvantages of Willows

The disadvantages of willows in Australian stream systems is well documented. The vigour and ease of growth of the species has meant domination of many riparian zone ecologies.

The introduction of willows that either produce seed directly or by crossing with other species has exacerbated the problem of monocultural dominance. Until 1993 it was generally believed that willows in Australia could only reproduce vegetatively (Cremer *et al.* 1995). Increasing awareness of seeding willows has revealed extensive populations that, although as yet only occupying 5% of their potential habitat (K Cremer, pers. comm.), represent possibly the greatest potential threat to streams in Australia. Where channel colonisation through vegetal reproduction may be managed, the fact that seedlings are all potential parent stock, means that the seeding willow problem is exponential.

Where willows dominate the riparian zone there will be impacts on stream ecology (Ladson *et al*, 1997). Adverse impacts of willows, ecological and morphological, include (adapted from Ladson *et al.* 1997):

- denser shade in summer;
- greater variation in shade between summer and winter;
- lack of understorey under willows;
- changes in timing of leaf fall;
- brief and excessive input of leaf litter;
- increased breakdown rates of leaf litter;
- increased breakdown rates of large woody debris;

- less insect fall into the stream;
- reduced dissolved oxygen concentrations;
- decreases in the size of bed material;
- reduced undercut banks and deep holes;
- decreased channel capacity;
- deflect erosive flows against banks;
- cause of avulsions;
- lack of food supply for native fauna; and
- lack of hollows or shelter for fauna.

With such a litany of detrimental impacts management is essential.

### 2.4. Management Options

While total removal of willows from Australian streams may be extremely difficult to achieve, there is a range of management activities that can reduce the impact of the species. These can be done in steps so that effort can be more effectively spread (Figure 1).

Removal of willows growing within the channel should of high priority and the first step of a program. This will restore the channel capacity, especially during higher flows, thus preventing channel relocation.

Large trees can be stem injected with smaller ones either pulled out or cut off at the base and painted with herbicide (both cut stem and base). Large trees must not be removed from within channels until dead. Removal of live trees will result in breakage of stem material and an increase in vegetal reproduction.

The second step of a program is the removal any limbs on the trees that are pointing upstream or across the channel. This reduces the chance of any flood debris being caught up in the trees, forming "rafts", and reducing channel capacity.

While all willows growing on a point bar on the inside of a bend should be removed, those growing on the outside of the bend are usually providing protection against erosion. Removal must therefore be carefully staged so that so that replacement vegetation has time to establish in the gaps made by removed willows.

Staging is also important where a channel has become choked by willows. Sediment entrapment often occurs in willow chokes. Total removal in a single operation may liberate a slug of sediment, with detrimental impacts both upstream and downstream. As a general guide, no more than two in five trees should be removed initially. Further removal should be delayed until a bankfull low event has occurred and the impact assessed. Costs will be reduced, and short term bed and bank stability ensured, if the basal butt and root systems are left intact when removing poisoned and dead willows from channels.

The once common practice of lopping willows for stock fodder or growth management has declined, the result being an increase in vegetal reproduction. Willows, especially *S. babylonica*, senesce from the main stem outwards. On old willows, a dry and brittle main trunk will usually be found supporting healthy, but heavy limbs. Removal of these limbs should be part of any program.

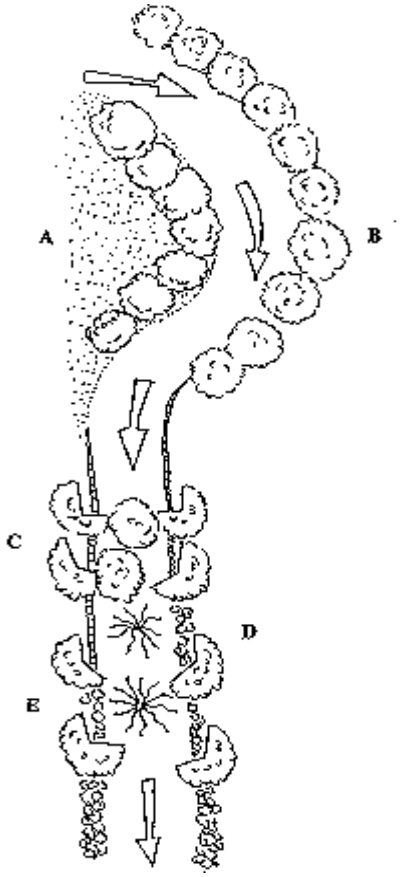


Figure 1: Removal and lopping of willows must be based on their location. A - remove all willows on the inside of bends. B - retain willows on the outside of bends. C - poison and/or remove limbs pointing upriver. D - poison willows growing in the channel. E - plant gaps with native shrubs (Starr *et al.* 1997).

#### 2.4.1 Seeding Willows

While there has been an awareness of seeding willows in Australia since the 1970s (J Gardiner pers. comm.) an examination of the full implications of their presence and then initiation of active removal programs has only occurred in the past five years.

In the upper Murrumbidgee River catchment a strategy has been developed and a Riparian Willow Project Officer appointed. Removal programs have been operational since 1993, with most effort being community group based.

Parent trees have been identified and poisoned, seedlings either poisoned, or, where small, removed by hand and an ongoing educational program established. All parent trees and seedlings are targeted for immediate poisoning and/or removal. Their potential impact on stream stability is considered to be of higher priority than any short term detrimental impacts of removal.

## 3. RECENT DEVELOPMENTS

Recently in New South Wales the Minister for Agriculture declared all but three willow species a noxious weed in the W4 category (R. Trounce pers. comm.). This means that those species declared noxious cannot be sold, propagated or intentionally distributed. The three species not declared were the Weeping Willow (*S. babylonica*), and two Pussy Willows (*S. x reichardtii* and *S. x calodendron*). These three species were determined by botanists at the Royal Botanical Gardens in Sydney to have the least problems of all the willow species present in New South Wales. They were identified as having very few problems with pollination or seeding or any problems with fragility (R. Trounce pers. comm.).

If it is proved that some willows are sterile or not fragile, such as a sterile form of the Purple Osier (*S. purpurea* 'Booth') (Ladson *et al.* 1997), these willows have the potential to be exempted from the W4 classification. Also if it is proved that some willows are a particular problem, such as the Black Willow (*S. nigra*), they can be placed in a more stringent category.

This situation has already occurred in the Maclean Shire on the north coast of New South Wales. The shire council has applied for the Black Willow (*S. nigra*) to be declared a noxious weed in the W2 category (R. Trounce pers. comm.). This means that the Black Willow must be removed by all landholders within the shire boundary.

## 4. CONCLUSION -WILLOWS - FRIEND OR FOE?

There are those who would see the total removal of willows as quickly as possible. The adverse impacts that willows have on riverine environments provide legitimacy to their stance. Willows also have their supporters, and benefits derived from use over the past century-and-a-half legitimises their view.

Whether or not the total removal or continued plantings of willows is warranted is still being debated by the community and academia. Whatever the eventual findings are the proper management of willows in the intervening time is required. Resources should also be allocated to investigating alternatives to willows for riparian revegetation programs. This has particular relevance in areas, such as frost hollows along streams in the southern highlands and tablelands area of New South Wales, where the growth rates of natives is severely limited by climatic conditions. Unless alternatives to the planting of willows for stream management purposes are found certain types of willows, such as the Weeping Willow (*Salix babylonica*), may still have an important role to play in the management of these streams.

This would be particularly timely as the New South Wales Minister for Agriculture recently declared all but three willow species (*S. babylonica, S. x reichardtii* and *S. x calodendron*) a noxious weed in the W4 category.

As the total removal of the species from our streams may be unachievable, willows will continue to be a part of our rivers. If willows are to be part of our riverine systems then their ongoing management must be ensured so that they don't adversely effect our streams.

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