

## **River Management Arising From Willow Removal (Where There's A Willow There's A Way).**

*Christopher Bobbi*<sup>1</sup>

**Summary:** Following the greater availability of funds for on-ground works through the Natural Heritage Trust, community groups in Tasmania have made it clear that the number one river management issue is the control and management of willow infestation of the riparian zone. Crack Willow (*Salix fragilis*) was introduced last century to help control stream bank erosion, and in more recent times has risen to become the dominant species inhabiting the riparian zone in agricultural regions of Tasmania. The effects of their vigorous growth and propagation include increased flooding, reduced summer flows, loss of habitat for flora and fauna and low dissolved oxygen which limits aquatic life. However their removal poses several environmental risks in terms of decreased habitat and increased erosion. Minimising these risks is one of the major challenges for Rivercare in Tasmania. To help with this, 'Rivercare Guidelines' have been prepared which aim to assist and guide community groups in their endeavours and is supported by technical expertise from the Tasmanian State Government. It is hoped that this approach will both help to educate the community on the environmental implications of their work and also ensure that any risks which are taken are minimised.

### **THE MAIN POINTS OF THIS PAPER**

- Willows impact on stream ecology, water quality, hydrology and agriculture
- There are many benefits and hazards involved with their removal
- Good planning and a broader approach is recommended when looking to manage willows

### **1. INTRODUCTION**

Through the advent of the National Landcare Program (NLP) and more recently the Natural Heritage Trust (NHT), the Tasmanian community has become increasingly aware of the possibilities for remediation of the river corridor. The rural community in Tasmania has long been left to manage riparian and aquatic systems with minimal or no help from Government agencies involved in environmental or resource management. As the funds available for community based river works increase, this situation is rapidly changing. For the first time in decades, community groups can now access significant funds which they can use to bring about changes to riverine systems. In Tasmania this most commonly involves dealing with willow infestation and the problems they cause.

Crack willow (*Salix fragilis*) is an introduced plant which was first used to control riverbank erosion following clearing of fertile riverflat land, when native species were removed to permit maximum use of what in Tasmania is a valuable resource. This species of willow proved eminently suitable as it grows extremely quickly, is easily grown vegetatively and has a thick root mat which withstands high water velocities and is therefore able to protect banks that have been cleared of vegetation. However it is recognised that willows have had an impact on channel morphology and river behaviour (Ladson and Gerrish, 1996).

The success with which willows have adapted to Tasmanian rivers and streams is clearly seen in aerial photographs. Crack willow is now present in virtually every Tasmanian lowland river and stream where land clearing has taken place. Where it has become the only vegetation on small streams, its vigorous growth has meant that no other vegetation can become established along that stream. In the majority of these cases it actually invades the stream bed to some degree. There are many small rivers in Tasmania which now have a bed consisting mostly of willow roots, fine sediment and organic material resulting from willow leaf-fall. Some of the ecological and environmental effects of this 'invasion' have been investigated in recent Tasmanian studies and will be presented in this paper.

Due to the increasing interest in removing willows from rivers, Landcare Tasmania produced a booklet titled 'Willow Management Guidelines' (Parker & Bower, 1996) which sought to help groups plan and undertake willow removal. Its purpose was to provide a variety of options for the physical and chemical treatment and removal of willow, and to date has been an invaluable document. It has also provided a means of classifying and prioritising actions based on the severity of infestation. However as greater funds have become available through the NHT's 'Rivercare Programme', groups are considering works on a larger scale (ie bigger

<sup>1</sup>Chris Bobbi, Department of Primary Industries, Water and Environment.  
13 St Johns Ave., New Town, TAS 7008 ph (03) 6233 8455 fax (03) 6233 6881 email:chris.bobbi@dpiwe.tas.gov.au

rivers and longer stretches). This has resulted in a greater risk of environmental damage and has increased the need for more detailed planning and technical input before works are carried out.

As a result of the increased environmental risk and other concerns including future maintenance and public review, Tasmania has developed a system whereby expert technical advice is provided directly to groups seeking to carry out major works on streams. In addition to providing technical support directly to groups, 'Rivercare Planning Guidelines' have been developed which make clear to groups exactly what planning should be undertaken before commencing works. This process aims to encourage greater awareness of the consequences of willow removal as well as ensuring environmental benefits are gained from the works.

**2. THE PROBLEMS CAUSED BY WILLOWS**

The environmental effects of willows on rivers and streams in Australia and New Zealand are seen as many, though there is only a limited amount of published information about their effects on riparian ecology and in-stream habitat. It is widely recognised that being a deciduous tree it contributes large amounts of organic material to streams over a relatively short period (Lester, 1992), which is very different to native species which have a more continuous leaf fall. This has a magnified effect in smaller streams, where the willow root mass covers the stream bed and acts to trap fine sediments as well as a portion of this organic material, reducing aquatic habitat and stimulating bacterial activity (Suter, 1990).

Recent studies on a small Tasmanian stream severely infested with willows (Bobbi, et. al., 1997) showed how very low dissolved oxygen concentrations developed within willow stands during low summer flows, compared to an upstream site with a healthy native riparian strip (see Figure 1).

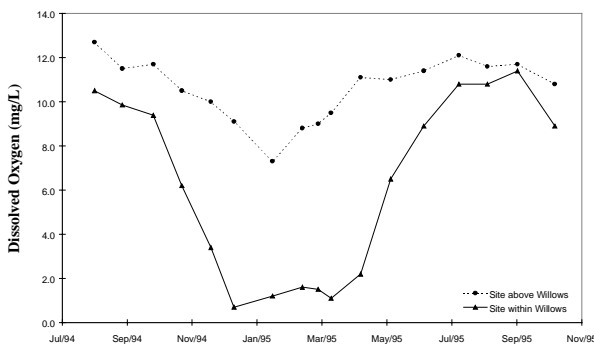


Figure 1: Dissolved oxygen upstream and within a willow infested area on Quamby Brook, northern Tasmania.

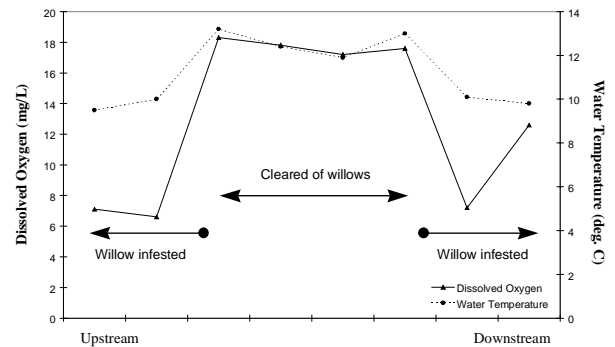


Figure 2: Comparison of dissolved oxygen and water temperature between an area infested by willows with one that has been cleared of willows. (Quamby Brook, northern Tasmania).

It was suggested that bacterial breakdown of the organic material within the willowed site was the primary cause. The low dissolved oxygen level within the willows would also have been assisted by total canopy cover limiting any photosynthetic activity within the stream. Nutrient levels were also found to be higher within the area, as retention of sediments and organic material encouraged storage of most nutrients. Where willows had been cleared from the infested site, photosynthesis by algae and aquatic plants dramatically boosted oxygen concentrations during daylight hours (Figure 2), causing oxygen supersaturation. Water temperature also increased by more than 2 °C, despite the small stretch of willows cleared.

Alteration of the invertebrate community by willows is also significant. Bobbi, et. al., (1997) found evidence that community composition and overall abundance was greatly reduced within the densely willowed stand, compared to the site upstream. The community was dominated by organisms indicative of organic enrichment (snails, worms and mosquito larvae). A more recent study comparing faunal communities in willow affected streams with those having a more intact native riparian strip (Read and Barmuta, in review) has also found that taxon richness was significantly lower in willow affected reaches during summer.

Willows also out compete native species and the total canopy cover created by willows tends to exclude germination of any other plant species. Where willows have invaded a stream bank cleared of vegetation, the result is often a monoculture consisting of only willow.

Other effects of willows on rivers and streams are reduced drainage as willows block smaller inflowing tributaries and drains. In smaller streams, where willows are able to invade the main channel, there is increased stream migration and subsequent streambank erosion (Ladson and Gerrish, 1996). Older trees also

tend to fall over and re-sprout, collecting debris and creating log jams (Russell, 1994) which increases flood levels. Ultimately all these factors combine to create streams which are shallower and wider, increase flood levels and residence times, and impact seriously on agricultural activities in the floodplain.

### 2.1 Benefits of Willow Removal

The benefits of removing willows from in and around streams would therefore seem to be great. To the rural community, improved drainage and the subsequent lowering of flood levels and flood residence times is seen as the most significant benefit. Flood risk to crops is lessened and inconveniences caused by water-logging are reduced. In some areas, the amount of land which is recovered by removal of large willow clumps can also be a significant benefit (ie. increased area for production). The potential environmental benefits of removing willows are less clear if no effort is made to replace the willows with other riparian vegetation. Although dissolved oxygen levels appear to increase, the changes to the environment due to the increased light levels creates a system which is not stable. Algal growth tends to dramatically increase, leading to associated water quality problems. Hence, revegetation of areas cleared of willows is paramount to successful restoration of a stream.

### 2.2 Hazards of Willow Removal

One of the greatest risks posed by the removal of willows is the creation of pastured stream banks with no other forms of vegetation. As has been shown, one impact of removing willows is dramatically increased light levels in the stream, causing blooms of aquatic plants and algae which can result in supersaturation of dissolved oxygen during the day. Other effects of the increased light levels in the stream are higher water temperature and invasion by other weeds such as cumbungi (*Typha* spp.), parrots feather (*Myriophyllum* spp.) or canadian pond weed (*Elodea* spp.), which create new management problems. In streams where remnant native vegetation is still present, this effect would be much less.

Another concern is increased risk of sediment and nutrient movement, as fine silts and soil previously bound on-site by the willows become exposed to erosion. This risk is greatest in the time between willow removal and covering of banks with grass or other vegetation. The results of sediment movement can be the smothering of downstream systems and greater potential for algal blooms. Managing and reducing this risk is seen as a major challenge when planning willow removal in most agricultural areas.

Management of the heavy equipment required to undertake willow removal is also a challenge as there is often a temptation to remove all instream obstructions, including native debris which provides vital habitat for aquatic organisms. Where there is a lack of adequate supervision, some groups have also been tempted to

modify the stream channel, which can result in straightened streams and increased velocities during higher flows. The end result of this is generally erosion



Figure 3: An example of a recommended method for removal of willows from river banks - the 'cut stump method'.

as the stream reacts to restore its gradient. It is important that good leadership is displayed by those managing the project so that appropriate supervision of instream works is undertaken. This is often critical to the long term success of such projects.

In areas where there is some remnant native vegetation remaining, preserving this during heavy machinery operations is also seen as challenge, as the drive to clear the stream within budgetary constraints encourages operators to work quickly. Retention of remnant native vegetation is always preferable to re-establishing new vegetation as it reduces the costs and effort of revegetation and is often an invaluable seed bank when it comes to revegetation of the area.

## 3. TASMANIA'S ANSWERS - TECHNICAL SUPPORT

Partly in response to the increased demand for support and guidance in these works and partly due to concerns that environmental benefits needed to be achieved, the principal agency involved in this area, the Department of Primary Industry, Water and Environment (DPIWE) has joined with Landcare to develop 'Rivercare Guidelines' which help community groups to better plan their river management activities. As part of this, they can access technical expertise in the areas of aquatic ecology, riparian vegetation management, river engineering, water quality and hydrology. It has also been recognised that geomorphological input to the process is necessary in some cases, and resources for providing this expertise are currently being examined.

During the application and approval process for NHT funds, groups proposing major river works are being asked to prepare 'Rivercare' plans which involved undertaking several activities. These are listed below (Table 1) and are suggested to guide groups through the

process so that adequate information is gathered and sufficient planning is carried out so that projects have a clear and public process for implementation.

During preparation of all plans, groups are being asked to seek technical support and advice from the areas of

expertise outlined above. This condition has been imposed to ensure that adequate evaluation of methods for willow removal, river works and revegetation are undertaken and that best practice is carried out. Another important aspect of the guidelines is the

Table 1. Tasmanian Rivercare Planning Guidelines - a brief outline.

<b>Vision for the River</b>	Establish a 'vision' of what river the group wants
<b>Objectives Setting</b>	Set objectives for achieving the vision.
<b>River Condition Survey</b>	Carry out a survey of the present condition of the river.
<b>Technical Advice</b>	Receive advice from experienced technical personnel.
<b>Works Schedule</b>	Establish a works program
<b>Monitoring and Maintenance</b>	Determine how the program is to be monitored and what long term maintenance is required.
<b>Plan Preparation</b>	Prepare the final 'Rivercare Plan' including maps and information.
<b>Public Consultation</b>	Plan is displayed locally for public comment.

implementation of a process for ensuring maintenance and monitoring of works into the future. It is seen as crucial to the long term success of projects that an agreed maintenance schedule is implemented which protects and builds on the initial works. Ensuring funds for this future work is fundamental to this component.

The Tasmanian 'Rivercare Planning Guidelines' is considered a living document and it is expected that as new or more successful methods become available, this document will be updated to incorporate this new information. While it is fundamentally a tool for planning, it also aims to encourage interest groups to think more broadly about the potential environmental and social impacts of their works. Attempts have been made to increase this awareness by holding workshops on remediation of river corridors and organising field days to examine and discuss the major issues being dealt with by 'Rivercare' projects. These are also seen as important sessions where issues and solutions to particular problems can be discussed openly and freely by all interested parties.

**4. COMMUNITY RESPONSE**

As this has only been implemented since January 1998, the process is still undergoing some evolution. However the response to the process by community groups has been generally good though there are some who have reacted negatively at first. A large proportion have seen technical assistance as valuable, recognising the shortcomings in their own understanding of in-stream processes and the need for technical advice which can help them limit the environmental damage of their activities and maximise the benefits. Many have commented that this assistance has not been so easy to access in the past and are keen to receive some input. However, some groups are less positive, seeing 'so-called experts' as bureaucrats imposing restrictions upon them and not allowing them to do what they want. In many cases, the restriction imposed by funding timescales is seen as a factor making works less 'environmentally friendly' (eg. Excavator work in river done all at once rather than several smaller visits). In

most cases, groups find that the three year funding period imposed by NHT is major driver of this, as well as having access to 2:1 funding only in their first year. This fact alone often make best practice methods very difficult to implement.

Another factor causing some difficulties is the need to ensure maintenance of the works into the future, which is inextricably linked to the raising of revenue. This has led to the need for Local Government involvement as it has generally been found that the most effective way of ensuring long term maintenance will be by raising of revenue through the rating process. While some councils have been receptive to this, others have seen possible legal dangers if things go wrong. These issues are currently being examined and where they cannot be overcome alternatives may need to be proposed.

There has also been some discussion about conflict in advice received by groups. Although a multi-disciplinary approach has many benefits, not least of which is a broader level of understanding, it has led to some confusion about best methods to adopt. Advice concerning willow removal given by a drainage engineer is often different to advice given by ecologists who might be more concerned with minimising disturbance and damage to remnant habitat. This situation has highlighted the need for better communication and coordination between the State government agencies involved in this area and better ways of achieving this are currently being examined.

**5. CONCLUSION**

Prior to the relatively recent changes in funding of Landcare activities, instream river works in Tasmania were not widespread. Under NHT this situation has changed, as funding for 'on ground' works has become readily available. Willows have long been seen as a considerable problem by the rural community, and many rural groups are now seeking funds to remove them. Managing this increased activity has become a major challenge in Tasmania. The development of 'Rivercare Planning Guidelines' have assisted with this

management and proved a useful tool for broadening the awareness of impacts and issues arising from willow removal. Where the tendency of community groups in the past has been to focus solely on willow removal, the guidelines and the support structures which have been put in place have resulted in better and more strategic planning. The result is an increased awareness of the options open to groups to achieve their objectives while minimising the environmental and social impacts of their works. While this approach has been taken as a result of increased funding for instream works, it is seen as a useful planning tool for the better management of rivers in Tasmania.

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