G Maintaining in-stream health

Objective

To manage riparian lands so that in-stream life is healthy and diverse.

Recommended management approach

Native riparian vegetation shades waterways, decreasing the amount of direct and dappled sunlight reaching the water surface, and reducing daily and seasonal extremes of water temperature. Research has found that the temperature in waterways where there is no riparian vegetation is 3-5°C warmer than in nearby vegetated sites, and the daily fluctuation in temperature is at least three times greater. Figure 10 presents data on fluctuations in water temperature and shows the difference between grazed unshaded sites and restored protected sites.

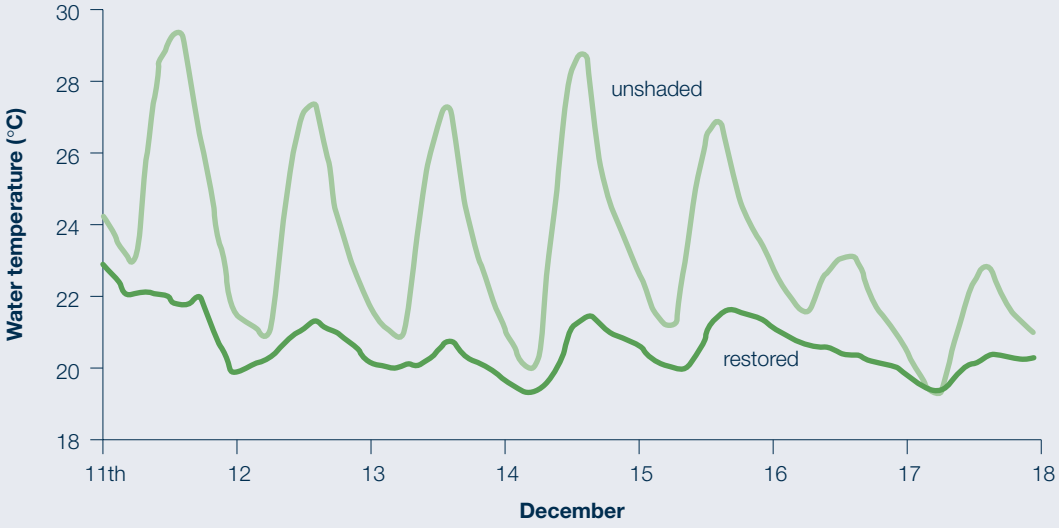

Figure 10: Predicted temperatures in Echidna Creek, south-east Queensland. Predictions assume average flow. Source: Rutherford unpublished data.

Temperature increases of 3-5°C may seem small, but they can have large effects on the health of in-stream plant and animal communities. The growth and development of most in-stream organisms, such as algae, fish, reptiles and frogs, are in part temperature-dependent, and high temperatures can slow or halt development and result in death. Hatching of eggs, larvae and other stages in an animal's life-cycle are often triggered by precise temperature sequences, and research has shown that many in-stream plants and animals need specific temperature requirements to survive. In addition, oxygen concentrations decrease as water temperature increases, and this can limit plant and animal life and possibly contribute to fish deaths. Increased water temperature also elevates rates of bacterial breakdown of plant material and this further decreases the amount of available oxygen.

Shade is required to maintain the natural water temperatures that are essential for healthy and productive streams. The temperature within a waterway is directly related to its orientation to the sun's trajectory as well as to the thickness and mix of riparian vegetation. Riparian vegetation has a greater shading effect in the infrared/red end of the solar spectrum, which is responsible for most of the heating of surface water. Several factors are involved in this process — for example, canopy height, vegetation thickness, channel width, channel orientation, valley topography, latitude and season. Figure 11 shows how riparian vegetation can work to shade the stream from the sun at different orientations.

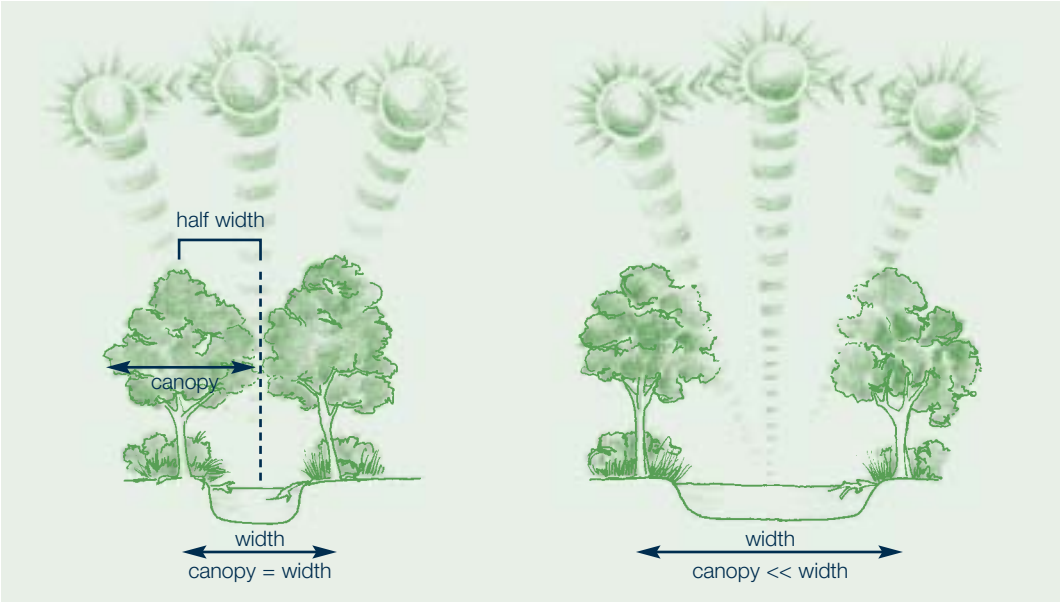

Figure 11: Influence of channel width on cover. A small stream could be completely shaded if the active channel width was equal to or less than the width of the tree canopy. As channel dimensions increase, and vegetation height and width remain relatively uniform, riparian shading of the channel becomes less effective.

Shade from riparian vegetation is also essential to keep natural light levels in waterways. Some nuisance in-stream plants, including algae, need higher light levels before they can flourish and dominate in-stream systems. Under natural conditions with shading from native riparian vegetation, their growth is restricted by lack of light.

Riparian vegetation also provides the leaves, fruits and insects that support in-stream food webs. Tree roots in the water and undercut banks provide important habitat, access to food sources, and protection from predators. Woody material, such as branches and whole trunks that fall in from the riparian land, are important for in-stream bacteria, fungi and some specialised animals which, in turn, are a valuable food source for other in-stream life. Wood forms complex three-dimensional structures in the water column that provide a number of different-sized spaces or habitats. The small spaces formed by sticks, twigs and other debris trapped against larger material provide refuge and feeding areas for small and juvenile fish, as well as invertebrates such as yabbies. The larger branches and logs provide space for bigger species. Hollow logs provide essential habitat for such fish, and branches that extend into the water column and above its surface provide habitat at different water levels. Woody material also influences water flow, producing a range of flow speeds used by different animals to feed or rest.

Namoi River with healthy riparian vegetation on right hand side and disturbed with erosion on left hand side of river. Photo Guy Roth.

It has been thought that woody material in waterways reduces flow capacity and increases flooding and, as a result, many waterways have been 'de-snagged'. However, research has shown that woody material would need to occupy at least 10% of the cross-section of the channel before having much effect on flooding.

In undisturbed river systems woody material protects the riverbank as well as providing vital habitat for instream plants and animals. Photo Ian Rutherfurd.

In-stream health is also strongly influenced by water flow, which includes: the total annual volume; flow levels at critical seasons; and, the rate of change in flow and water levels. Together, these factors make up the flow regime. There have been significant changes to the flow regime of rivers in cotton-growing districts, many of which are now regulated. The construction of dams and storages, both public and private, have changed the total annual river flow in many cases. Water that previously moved through the river system is now lost, with seasonal flows disrupted as releases are timed in late summer or autumn in order to meet irrigation requirements.

A further problem is that water released from the bottom of large dams is usually cold and lacks oxygen, and this places further stress on in-stream life. The map below shows the location and scale of probable cold water (thermal pollution) impacts within the Murray-Darling Basin. It is generally very expensive to re-engineer large storage dams for multi-level offtakes; an alternative is to construct a detention pond near the water release site so that deep water can be retained and provide an opportunity for it to warm up and become re-oxygenated. This is an important issue for further consideration by public and private water agencies and storage managers.

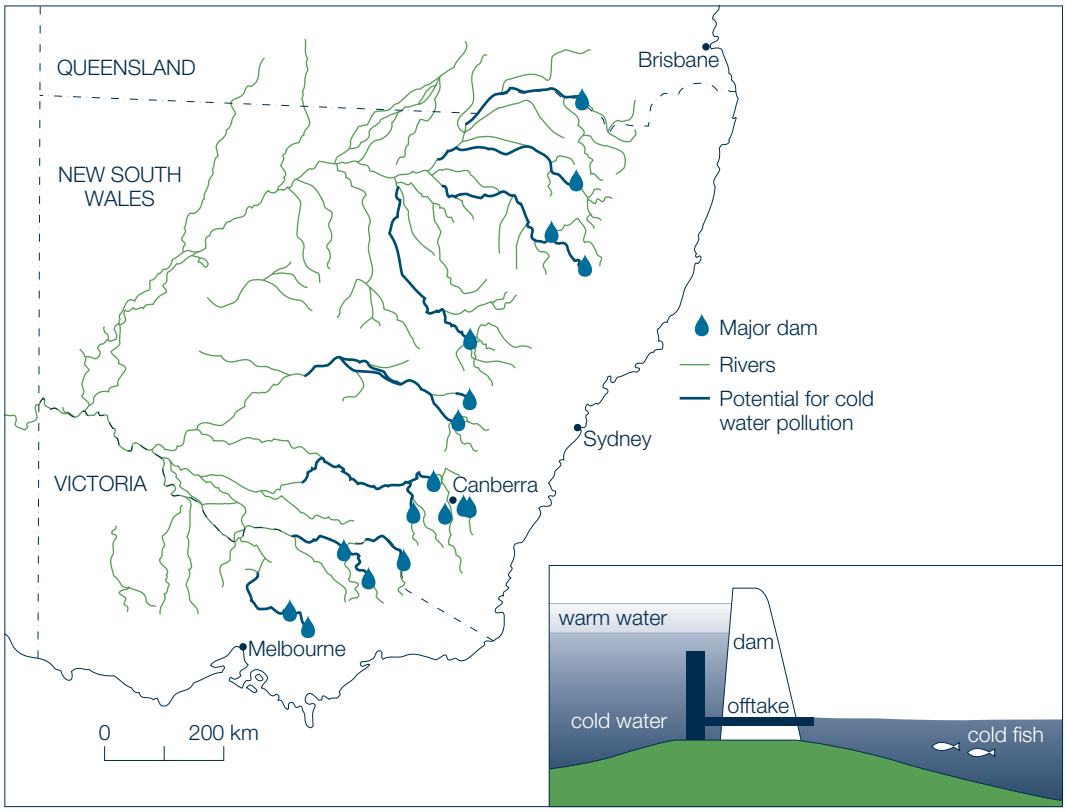

Figure 12: Cold water pollution is caused by bottom release of water from dams.
Source: NSW Fisheries.

An important aim of the catchment and water-sharing plans being developed in cotton districts in both NSW and Queensland is to try to reduce these negative in-stream impacts. Providing environmental flows at critical times of year (e.g. to support breeding cycles of native fish) is one example of the measures that can be used to improve conditions for in-stream plants and animals. Minimising the impacts of storage, diversion and pump structures through careful siting and operation, better management of river flow and storage volumes, monitoring and reporting of water quality, and removal of barriers to fish passage, are other actions that may be included in catchment plans.

Assessment of riparian lands in most catchments shows that riparian lands and in-stream health have suffered as a result of land and water management practices. The following recommended management approaches will assist cotton growers to improve in-stream life on their farms.

1. Map all waterways and wetlands, even intermittent ephemeral creeks on the farm plan. Ensure that natural riparian vegetation is kept in these areas during farm or paddock development. The aim should be to retain full natural shade along the waterway. Depending on the type of vegetation, a 25 metre strip will usually be sufficient to ensure that tall trees can survive through natural regeneration. Native species that grow down as well as along the bank, and have a spreading but dense habit, are especially valuable in providing stream shade. Where the natural riparian vegetation has been disturbed and the canopy opened up, replanting should be undertaken to return to natural shade levels.

2. When rehabilitating a stretch of waterway, visit undeveloped and natural areas in the local district, and compare the mix of riparian vegetation there with what is present on the farm. Information on revegetation of riparian areas is provided in Section F of this guide. For smaller waterways, up to 10 metres wide and oriented east–west, the northern bank is particularly important for vegetation retention or replanting, as it will provide the maximum amount of shade for the waterway.

3. Keep wood in waterways so that it can provide habitat for in-stream life. In situations where large pieces of wood are a problem, they can be dragged back against the banks at an angle of 40°, where they have little effect in diverting water flow onto the banks.

Figure 13: The best location to position snags is on the outside and downstream of bends. Illustration Carolyn Brooks.

Best management practice is to only shift or remove logs in streams when a thorough survey has demonstrated that they are having a significant effect on flood level or frequency — in summary, **let sleeping logs lie**.

4. Make sure works on waterways, e.g. for diversions or pumping stations are approved or licensed by the relevant agency. The siting and design of these structures must take into account potential consequences on riverine systems.

5. Be aware of the catchment and water-sharing plans being developed in the local region and contribute to them. Many of these plans will include targets that cotton growers will need to meet, for example 'by 2012 key water quality indicators meet the requirements of the *New South Wales Interim Water Quality and River Flow Objectives, 1999*'.

Self-assessment

Cotton growers can check progress in improving in-stream health by using some of the following techniques:

- visiting the rehabilitation site and using photographs to monitor the success of revegetation and the degree of shade being provided to the waterway;
- comparing the revegetated site with an area of natural vegetation to see how shading is affecting the stream. This can be done by visual comparison or use of light meters; and,
- participating in community-based monitoring programs (Waterwatch in Queensland and Streamwatch in NSW) to detect changes in water quality in waterways. Catchment coordinators can provide advice on the use of meters to measure changes in salinity and pH, as well as information sheets that will help in the identification of in-stream insects and other animals that are indicators of water quality.

The Gwydir River being tested for water quality and in-stream life. Photo Guy Roth.

Protecting and promoting biodiversity on-farm

Betsy and David Turner — 'Macintyre Downs', Goondiwindi

By Anne Sullivan

Betsy and David Turner of Macintyre Downs have lived on the banks of the Macintyre River for the past 21 years. In this time, they have fenced off the river and provided off-river watering points for stock so that they do not require access to the riparian zone. In total, 37 kilometres of fencing has been completed and this has protected the heavily timbered riparian zones and the native plants that thrive within them. Because David and Betsy protected their riparian zone from stock, they have focused tree planting efforts on other parts of their farm. Buffer zones have been planted to capture spray drift, protect crops from wind and create habitat for wildlife.

The riparian areas on the property include wetlands that fill after heavy rainfall and flood events. David and Betsy regard these areas as highly sensitive and manage them prudently to protect the birds, animals and plants that live in them. Evan Cleland conducts Bird Atlas surveys on three sites in the Macintyre Downs riparian corridor. Evan comments that the vegetation in the fenced riparian area is remarkable for its natural integrity and absence of exotic weeds, and that the bird life is rated 'normal' (of high conservation value). In the conditions imposed by survey rules, the area has a species rich strike rate with 68 species recorded in seven surveys averaging 21 species each. He reports that after two decades of careful management, the Macintyre Downs riparian zone is "in pristine condition, vegetatively superior than at any previous time of human occupation".

CASE STUDY G chapter three

One of the riparian areas on-farm that has been protected for its biodiversity and aesthetic values. Photos Anne Sullivan.

Above: Natural regeneration since stock has been excluded.
Right: Betsy and David Turner. Photos Anne Sullivan.

Betsy and David have worked with their neighbours to protect their riparian areas, and there is an informal 'No Spray' policy between Macintyre Downs and the properties around it when the wind is blowing towards the river. This policy was initially implemented to protect the homesteads but it is now expanded to include riparian lands. Macintyre Downs also has a farm plan that contains all tail water on farm surge areas so that none of it leaves the property.

Buffer paddocks have also been developed between riparian areas and cropping country, with stock grazing these areas. These paddocks have no chemical inputs, and on the farming country, David and Betsy have begun trailing a biological farming program that seeks to further minimise chemical inputs. Employees on Macintyre Downs are required to undertake Farm Safe and Chemical Accreditation courses so that they understand how to safely use pesticides.

A final word...

"Everyone here on Macintyre Downs loves the river, loves fishing — it is their environment, their home — and they are very protective of it. We are all much better off in the long run by looking after our riparian zones." David and Betsy Turner