F Managing riparian vegetation

Objective

To maintain and improve the health and diversity of riparian vegetation on cotton farms.

Recommended management approach

The vegetation of riparian land is often more diverse and productive than in other parts of the landscape. This is because soils are richer in nutrients than further upslope, and there is a greater availability of water, shade and shelter. Riparian soils receive nutrients from both land and water. Minerals, nutrients and sediments from upland areas are transported to lower-lying riparian lands by surface runoff after rain, while nutrients and silt may be deposited along waterways during floods. Periodic flooding is particularly important in contributing to the enrichment of floodplain riparian soils along large, lowland rivers.

Riparian vegetation at a particular site reflects past flood or other climatic events, as well as different landforms, soils, and land uses that exist along the waterway. As a result, riparian vegetation is often complex, with increased species diversity. Some riparian plant species occur only along waterways as they require the better soils and increased moisture for survival and reproduction.

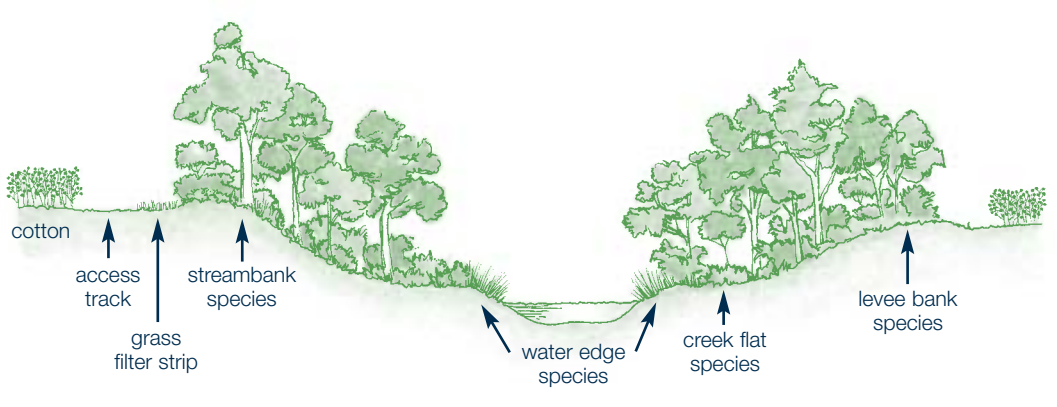


Figure 9: Different vegetation types on a cross section of bank. Illustration Carolyn Brooks.

Naturally healthy or rehabilitated riparian vegetation can be used for a number of purposes:

- providing shade and shelter for stock;
- lowering groundwater levels adjacent to streams;
- stabilising banks (Section B);
- forming windbreaks to prevent cotton lint blowing around cotton gins;
- trapping sediment and nutrients (Section A);

- shading waterways for reduced light and temperature (Section G);
- providing wildlife habitat (Section F);
- increasing property values;
- providing fodder in times of drought;
- growing high value timbers for harvesting (providing harvesting operations do not damage the surrounding riparian land);
- harvesting of native fruits and seeds; and,
- improving aquatic biodiversity which helps to maintain fish stocks.

For these reasons, the management of riparian lands on cotton farms can be designed to optimise productivity and environmental outcomes. In this section, recommended management approaches are provided to address some of the processes threatening riparian vegetation health on cotton farms.

Tree with hollows ike this one provide important habitat for wildlife. Photo Guy Roth.

Managing riparian lands as a different, but integrated part of farming operations

Riparian lands on cotton farms require a different set of management strategies to other parts of the property if they are to perform the functions listed above. On established farms, all the waterways running through or adjacent to their property should be surveyed so that their status and condition can be recorded. There are several assessment methods available to help in this, and the list of contacts at the back of this guideline can assist cotton growers to complete this task. This on-site survey will identify opportunities for improved management of existing riparian vegetation or, in many cases, rehabilitation through replanting of riparian lands with local plant species. This activity may be undertaken with neighbours as part of a whole-community approach to waterway and riparian management, but individual landholders can also plan and implement restoration projects on their own property. Once riparian lands have been identified the following management approaches are recommended.

1. When developing new land for cotton production, riparian lands should be clearly identified and steps taken to protect these areas during paddock development and cropping operations. Consideration should be given to improving the vegetation by planting to fill obvious gaps or to expand the width to gain further benefits. Maintaining or enhancing the degree of connectivity with other native vegetation should be a primary goal.

2. Farm layouts should be planned to keep riparian vegetation in an intact and healthy state. On dryland farms, furrows should not be constructed to drain directly into riparian vegetation, but rather, direct the water through a channel or detention pond system. Irrigated farms are already required to retain tailwaters.

3. Healthy riparian vegetation should not be cleared to provide headlands or turning areas for equipment; these should be established well clear of the riparian land, preferably with a grass filter of at least 6 metres in between.

4. Farming operations should be carried out in a way that minimises any potential for movement of herbicide, other chemicals or nutrients into adjacent riparian vegetation. Maintaining a grass filter strip between the crop paddock and the riparian vegetation will help to achieve this aim.

The grower is rehabilitating the riparian zone as an effective buffer against spray drift, as well as trapping any runoff from cotton paddocks. Photo Guy Roth.

Rehabilitation following over-clearing

In many cotton districts, the natural riparian vegetation has been extensively altered, largely through grazing by domestic stock and clearing. In many places, scattered large trees remain, but there is little natural understorey and native grasses have been replaced by annual and exotic species, including weeds. Many of the native trees are old and where riparian areas are grazed, there are no new trees to replace them. Research has shown that these changes, combined with catchment development for intensive cropping, can result in large amounts of soil being washed into stream channels. This can cause problems, as it often blocks the channel, reduces water quality and harms in-stream life. At the same time, increased light levels and water temperatures favour the growth of nuisance weeds and algae, particularly when nutrients from surrounding areas have been carried into the waterway. The result is that many waterways in cotton districts are in poor ecological condition. When rehabilitating riparian lands, the following recommended management approaches can be used.

The trees on this stretch of the Namoi River are all of the same age and grazing has prevented any understorey or young trees surviving. When these trees die there will be nothing to replace them and the riverbank will be eroded away. Photo Guy Roth.

1. Determine which part of the waterway is going to be the focus of rehabilitation. The time and resources required to rehabilitate riparian vegetation means that if you are replanting it is best to replant one section of a waterway each year over several years, beginning in the uppermost reaches and gradually working downstream.

2. Consult local experts, for example Greening Australia, river planners or government agencies, to develop a plan for riparian rehabilitation. Where native species remain on the farm and are in sufficient health to flower and produce viable seed, natural regeneration is the best way to revegetate. Growers should check to see whether seed is present either on plants or in the soil, and then aim to remove grazing for at least two years to give new plants time to establish and grow to a stage where they can survive the return of stock. Some site preparation may be required, for example hand removal or spot-spraying of weeds, or a cool burn to remove dead plant material; these actions should be timed to coincide with seed fall and the greatest likelihood of rains for germination.

A group of young trees growing on the banks of Namoi and protecting against erosion. Photo Guy Roth.

3. Replant the northern bank first in east–west flowing streams, as this provides a maximum amount of shade for in-stream life. In consultation with local experts, select a mix of plant species focusing on the early stage or pioneer species that are favoured for their fast growth rate and ability to cope with full sun and frosts. Once established, birds, other animals, windblown seed and occasional floods are likely to bring in a diversity of additional species over time.

4. Implement a weed control strategy to protect the area being rehabilitated. Weed control prior to and following planting is often the key to successful revegetation. However, many areas have been invaded by exotic weed species following extreme disturbance of the natural vegetation, and significant time is required to remove and control these pest species, to prepare the site, to replant and to continue follow-up maintenance.

5. Avoid the tendency to 'tidy up' and burn fallen timber in riparian areas as it important habitat for plants and animals. It can make control of weeds and feral animals more difficult, but it should be left wherever possible.

Useful references

Rural Industries Research and Development Corporation, 1999, *Growing Trees on Cotton Farms, A Guide to Assist Cotton Farmers to Decide How, When, Where and Why to Plant Trees*, Canberra.

Carr, D. & Curtis, D. 2000, *Plants in Your Pants 2: A Pocket Guide to the Trees and Shrubs of the North-West Plains of NSW* (available through Greening Australia, NSW).

Andrews, S. 2000, *Optimising the Growth of Trees Planted on Farms: A survey of farm tree and shrub plantings of the north-west slopes and plains and northern tablelands of NSW*, Greening Australia, NSW.

Greening Australia NSW has available a range of booklets and species lists for particular locations in the north-west of New South Wales, for example "The Trees and Shrubs of the Wee Waa/Merah North Area" and "Native Plants of the Boggabilla Area". A wide range of Fact Sheets are also available, and cover how to collect and grow seeds of native trees and shrubs, selecting species for farm forestry, bush food plants and plants for attracting particular animals, as well as brochures on native plant species suitable for riparian zone revegetation. These are available through the Greening Australia North-West NSW Regional Office in Armidale, tel: 02 6772 3248.

Weed management

Riparian environments are subject to natural disturbances, such as flooding, fire or severe frost, as well as the impacts of stock grazing, drift of pesticides and access by machinery. These disturbances provide opportunities for weed species to invade riparian vegetation. Lippia is an example of a recent invader of both disturbed and healthy riparian lands in cotton districts. Most weed species, however, are much more likely to invade riparian vegetation that has been disturbed and is unhealthy. The recommended management approaches that follow, aim to reduce weed invasion into riparian vegetation.

1. Maintain a mix of different vegetation types and levels in riparian areas, so that there are trees, shrub understorey and ground layers of grasses. This will prevent many weeds from finding places to invade.
2. Maintain natural riparian vegetation so that it is wide enough to resist drying winds, nutrient movement, and the transport of weed seeds in bird droppings, as these factors assist weeds to invade waterways. The ideal width is at least 30 to 50 metres of riparian vegetation. The smaller width will assist animal species to move and disperse across the landscape, but greater widths are required for species to remain resident in the area.
3. Avoid human disturbance in riparian vegetation, for example, from fires, vehicle and equipment access, timber gathering or other clearing.
4. Exclude stock from riparian lands or use fencing to control the timing and season of grazing activity — this includes exclusion of feral or native animals where possible if they exist in large numbers.
5. In situations where weeds have already invaded riparian vegetation, control them by regular spot-spraying, stem injection treatment, or by hand removal where this is feasible. In many districts, there are community organisations able and willing to assist in such work. There are some noxious weeds that have a legislative requirement for control. Periodic monitoring and weed control will need to be continued each year (e.g. during the non-cropping seasons) until the problem can be overcome. When controlling weeds using herbicides near riparian land, ensure label directions are read and followed. Care must be taken not to disturb the surrounding natural vegetation unnecessarily, as this will only encourage further weed invasion.
6. Work with neighbours to prevent reinfestation of the areas being rehabilitated. Most weed invasions of relatively intact riparian vegetation have come from adjacent and upstream lands, where there may be agricultural or urban weeds. This will often require work in upstream regions first and then gradually moving downhill. If this approach is not followed, unattended lands upstream may continue to provide a source of infestation.

This riparian zone has been fenced out to restrict stock access. Once the area has been rehabilitated, stock may be permitted access for drought refuge or shelter in times of severe weather events. Photo Siwan Lovett.

Above: This riparian zone has been cleared and Lippia has invaded the whole area right down to the water's edge. Right: Lippia. Photos Guy Roth.

Lippia

Lippia is a serious weed of inland river systems of New South Wales and Queensland. It is estimated that at least 800,000 hectares of floodplain grazing, riverbanks and watercourse country is infested by Lippia.

Lippia is a perennial, broadleaf, flat growing plant, with numerous branched stems of up to 1 metre long. It has the ability to root at nodes along the stems, providing a solid mat-like ground cover. The stout central taproot (80 centimetres long) has fibrous secondary roots. Leaves arise in pairs from stem nodes; they are 2–5 centimetres long and covered in minute hairs. The flowers are white and look similar to lantana weed flowers. It spreads both vegetatively and by seed. Plants break up during flooding and can quickly reestablish as the water subsides. The plant tolerates frost and drought and can survive inundation for at least three months.

Lippia invasion can result in increased soil erosion, especially along riverbanks. The plant's dense mat of stems and leaves prevent the growth of other species. Under the dense mat the soil is bare and at high risk of erosion should the Lippia die back in drought, or when flooding causes water levels to rise. There are many examples in cotton districts of Lippia invasion along riverbanks being followed by bank slumping and accelerated erosion. Lippia also prevents regeneration of native vegetation leading to a further loss of biodiversity. Lippia is well adapted to floodplain situations and is extremely difficult to control. It is rapidly spreading, not only within the floodplain regions, but also on adjacent higher ground.

Cultivation and herbicides can be used to provide short-term Lippia suppression in the process of establishing a pasture. Farmer experience has shown that cultivation of dry soil in hot weather prevents transplants and gives the best Lippia kill. There are cultivation restrictions in riparian areas and growers should check with State agencies about native vegetation legislation and riparian zone regulations. With good soil moisture and actively growing Lippia, apply a herbicide prior to cultivation to give better results. Several herbicides are registered for suppression of Lippia (Refer to New South Wales Agriculture Agnote DPI-384, *Herbicides for Lippia control*). Glyphosate, 2-4-D amine and Lantana DP 600 are options. Restrictions exist concerning the use of products near waterways and 24D should not be used during the cotton season. Results vary from region to region, as does the best time of year to spray. Spot spraying can be used for keeping a check on Lippia in a relatively uninfested area. Lippia can invade very quickly and vigilant spot spraying is needed.

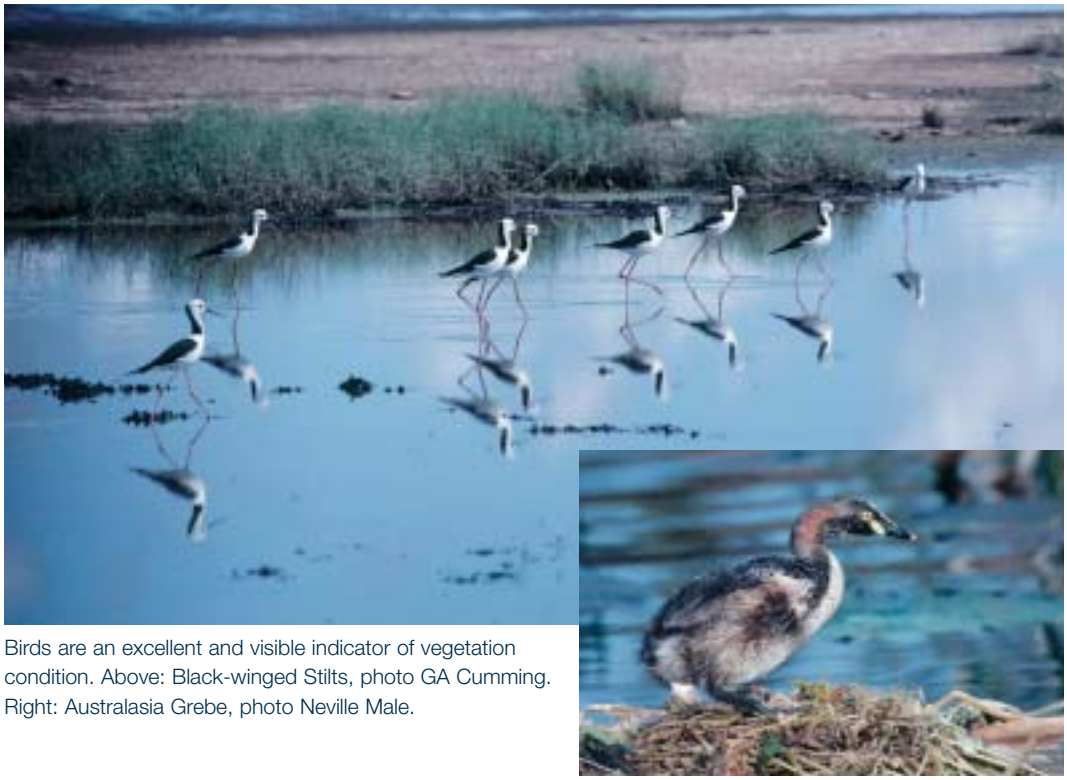
Fire

Fire is an important natural component of many Australian landscapes and is often used as a tool in vegetation management. In the past, fires escaping from cropping operations have been an important force in degrading riparian vegetation in cotton districts. This has become less of an issue with the adoption of stubble retention and direct drilling of cereal crops (where other crops are grown on cotton farms), but care should still be exercised whenever fire is used. Carefully managed fire, generally a low intensity burn, can be used to help reduce weed infestation along waterways, or to provide conditions for reestablishment of native species. However, the season and exact timing of the burn needs to be planned carefully to ensure that it is beneficial and not damaging. It may also be necessary to get local council consent and notify neighbours.

Self-assessment

Cotton growers will be able to check the progress of their riparian rehabilitation projects by assessing some of the following indicators:

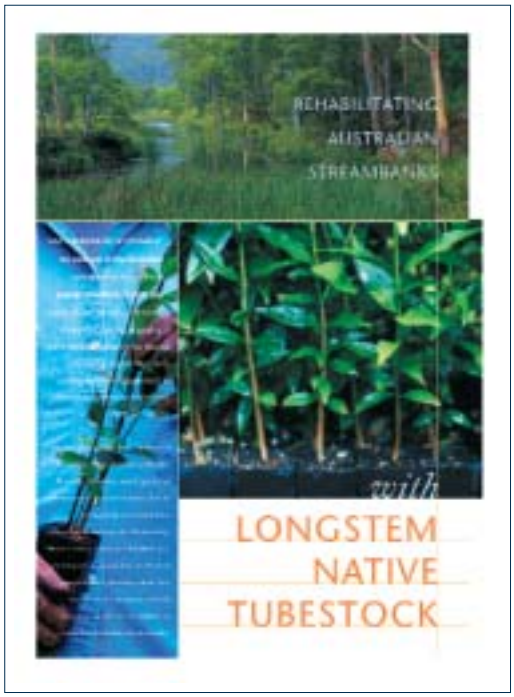
- riparian vegetation along on-farm waterways is intact and healthy with a diverse mix of local native plant species;
- there is a low level of weed infestation;
- there is no evidence of damage to riparian vegetation through drift of pesticides, fire, uncontrolled grazing by stock, or through vehicle/equipment access; and,
- bird lists that grow with the number of species present as the rehabilitated area develops (compare with local list for natural areas — see Bird Atlas of Australia to assess progress).



Birds are an excellent and visible indicator of vegetation condition. Above: Black-winged Stilts, photo GA Cumming. Right: Australasia Grebe, photo Neville Male.

Using longstem native tubestock to restore riparian lands

Modified from Department of Land & Water Conservation fact sheet



The problem with willows

Since the 1950s, willows have been used extensively to help stabilise many streambanks. Willows establish easily, grow rapidly, produce fine matted roots ideal for stabilising soils, and require little attention after planting. However, over time the consistent use of willows (and the planting of male and female plants of most species) which successfully spread by seed, has caused changes to the ecology and flows of rivers and streams. Some southern rivers are now completely choked by invasive willows. Willows have displaced native riparian species and colonised sand and gravel bars in streams, diverting floods and causing erosion on vulnerable banks. The soft textured leaves that are all dropped at the same time do not provide a year-round food source for native in-stream animals. This, together with the extreme shade provided by willows, has reduced biodiversity wherever willows dominate riparian areas. Since 1998, willows have been declared a noxious weed in New South Wales.

Using longstem tubestock as an alternative to willows

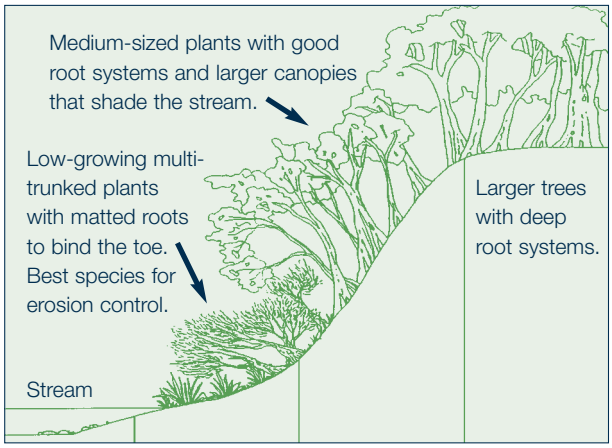
Bill Hicks, a Hunter Valley Landcarer, has developed an alternative for planting and growing native trees — longstem native tubestock, or 'longstems'. Longstems differ from regular native tubestock in the way they are grown and planted. Longstems are grown for up to 18 months using a specific nutrient and storage regime. The result is a climate-hardened plant with thick, woody, elongated stems (up to 2 metres long) with closely spaced growth nodes from which roots sprout once the longstem is planted. The longstem is planted in the streambank with its root ball buried 0.5–1.5 metres deep in the soil, leaving only the top 5–10 centimetres of the plant above the surface. Special water jets have been developed to plant longstems.

The results of trials show that longstems have the following advantages over regular native tubestock:

- increased growth rates and better survival rates — planting at depth enables longstems to access sub-surface soil moisture and potentially lessens competition with weeds;
- root establishment at depth — longstems can be planted in environments where previously only willows could be expected to have survived;
- longstems achieve rapid erosion control; and,
- longstems require minimal follow-up care, with the need for watering and weeding largely eliminated.

Where to use longstems

Most species that occur naturally along streams are considered to be suitable for longstem development due to their tolerance to sediment build-up around the stem, although it is always a good idea to trial any untested species before mass plantings take place. Longstems can potentially be planted in the riparian areas of most Australian streams. Use well-vegetated riparian areas as a guide for planting layouts. The form of the grown plants should guide selection of a planting position in the streambanks as illustrated in the diagram below.



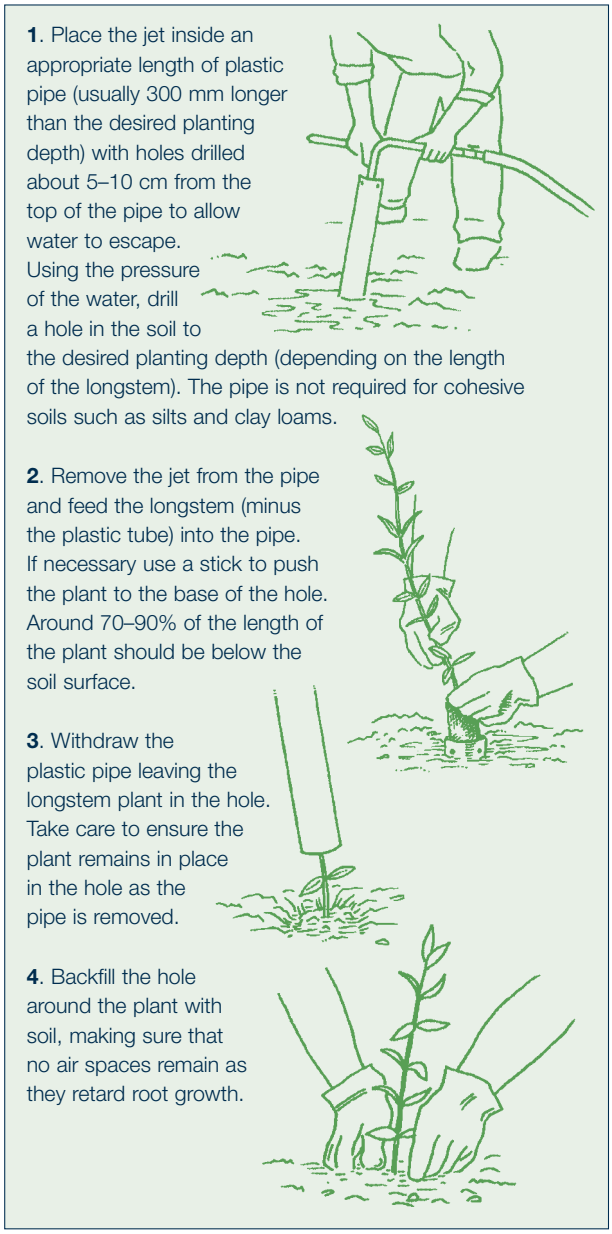
Source: Raine and Gardner 1995.

More information

Supplies of longstems are currently limited, however, commercial production is being encouraged through regional workshops and education. A detailed brochure outlining how to grow and plant longstems is available, and the Rivercare Officer at your local office of the New South Wales Department of Infrastructure, Planning and Natural Resources will be able to send you a copy. They will also be able to provide you with details of local longstem suppliers and the best species for your area.

Source: Department of Land & Water Conservation, *Rehabilitating Australian Streambanks with Longstem Native Tubestock*.

Source: Department of Land & Water Conservation, *Rehabilitating Australian Streambanks with Longstem Native Tubestock*.



Riparian areas as living 'haystacks'

Bruce Kirkby — 'Koiwon', Bellata

By Nicky Schick

Bruce Kirkby manages a mixed dryland cotton, wheat and grazing enterprise west of Bellata in northern NSW. He has been fencing riparian areas to reduce soil erosion and to provide stock fodder as a form of 'living haystack'. He says "it has proven very handy this year given the recent drought, we have managed to maintain our stock by rotating them on the creeks. Normally, if managed properly, the creeks provide a very good feed source. However, the grazing must be managed to avoid damage to pasture establishment and ground cover".

"We had been farming right up to the creek bank. However, we found that if runoff from the cropped area coincided with a sizeable flow in the creek, this resulted in erosion of the creek bank with potential to wash back into the paddock." To avoid this, Bruce moved "...right back off the creeks and planted oats and lucerne to gain some establishment on the past farming country, in time we hope natural pasture will regenerate. Another thing we did was to use rocks where there were fresh areas of erosion to prevent further cut back while we are trying to get the pasture to establish. There is always the risk of small washes becoming big washes on these friable soils, particularly when it has been so dry and windy. This recent drought just emphasises the need for good vegetation in your riparian areas".

Bruce says he has a few more areas where they will be looking at shifting the fence lines back off the creek in the future. The highest flood line determines the location of the fence. He hopes to get quick establishment of ground cover to prevent weed problems from developing. Large floods can result in a weed seed bank becoming established right alongside the cropped area, which is another reason for getting native vegetation established quickly. Reducing weed growth is another reason for spot grazing when circumstances permit.

A final word...

"Walking through the creek the last time I moved the weaners out, I was happy to see the number of little River Gums rather than Black Wattle coming up through the grass." Bruce is pleased that he has found an economic management strategy for his creeks that has a definite environmental benefit and leaves natural habitat for the next generation.

The photo at right shows the trees in one of the creeks and the fence line moved back to the high flood line. The area planted to oats and lucerne on either side of the creek should eventually reestablish to natural pasture. Photos Nicky Schick.

Using riparian areas as wildlife corridors

Bobbie and Lyn Brazil — 'Anchorfield' and 'Bemarng', Brookstead

By Ingrid Christiansen

Bobbie and Lyn Brazil's properties at Brookstead lie along the Condamine River. Along most of the river frontage they have retained, replanted and regenerated riparian corridors that are up to 250 metres wide. With natural billabongs and open Eucalypt forest, riparian lands provide habitat for a range of animal life. Bobbie and Lyn believe that native vegetation areas need to be at least 30–50 metres wide to be of enough value to wildlife, and they exclude cattle, as stock prevent plants from regenerating naturally.

CASE STUDY chapter three F

Working by the philosophy 'only do what you can manage' the Brazils have revegetated small areas each year when there has been sufficient moisture. Along one stretch of their part of the Condamine River, the Brazils established over 1500 trees in a planting coordinated with five other farms in the district. Each of these farms planted similar trees along the river to supplement native trees along a 12 kilometre reach of the river. On 'Anchorfield' and 'Bemarng', River Red Gums and Chinchilla White Gums have been the main species planted. They have also taken out a few rows of cropping county to provide a wildlife corridor between water sources.

In planning revegetation projects, Lyn comments that you need to be practical and provides the following advice:

- look for where you can most practically restore vegetation within your farming system;
- use areas of the farm that are not highly productive;
- use little corners and shapes of field that are not easy to farm;
- use areas around ring tanks to plant trees and gain aesthetic benefits;
- look to where a revegetation program will enhance what is already there;
- excluding stock from some areas may be enough to encourage natural regeneration;
- do your tree planting at the right time — make use of soil moisture when it is there and fits in with your work planning;
- make sure you prepare your areas carefully — just like you would for other crops; and,
- read books, talk to people and look at what is being done around you.

A final word...

"There are outstanding people out there who are putting in a tremendous effort, planting large areas of trees. Don't be put off just because you can't do something of this scale. Do what you can — every little bit counts." Bobbie and Lyn Brazil

Photos Ingrid Christiansen.

Improving biodiversity on cotton farms

Summarised from material prepared by Leah MacKinnon and Martin Dillon, Ingrid Rencken, and Peter Jarman and Janelle Montgomery

Areas of land used for intensive agriculture, such as crop production, generally have low levels of biodiversity compared with adjacent natural areas. The frequent disturbance and other activities associated with crop production, such as soil tillage, bed preparation, planting a monoculture crop, application of fertilisers and pesticides, and eventual harvest, results in a simplified system with a low diversity of plants and animals. These systems can be highly productive and profitable, but they also tend to have low resilience in the face of climate changes, pest or disease, or other unusual events such as flood or fire. Below are three stories that outline some of the benefits that may be achieved by managing cotton farms deliberately to increase the level of biodiversity adjacent to cropped paddocks. These are drawn from work supported by the Australian Cotton CRC, by the CRDC, and from other sources.

1. Bats — natural pest controllers

Retaining or replanting native vegetation around cotton fields provides habitat for plants and animals that can assist in the control of pest species. Recent research has shown that many small, insectivorous bats that have been found in and around cotton crops, feed on the pest moth *Helicoverpa spp*, amongst other species. As well as directly catching and eating the pest species, the presence of bats can disturb flight patterns and egg-laying, another means of helping to control pest populations. Bats use different frequencies of ultrasound to search for and locate their insect prey. Many insect species can detect the bat sonar and immediately adopt avoidance behaviour of fast or erratic flight away from the approaching bat. For the important pest of cotton crops, *Helicoverpa spp*, this means interruptions to normal nightly activities of mating and egg-laying in cotton fields.

Bats, even though they are voracious feeders and may consume something approaching their own bodyweight in insects each night, need to be present in large numbers to have a significant impact on pest populations. However, it is possible that even a small population of bats at the beginning of the cropping season may have a significant impact on how quickly pest populations increase. This can potentially limit the damage caused and the level of crop protection measures required later in the season.

Studies in Texas, USA, of large maternity Mexican Freetail bat populations have shown that each female needs to eat around 70% of her body weight each night, estimated to be about 9 grams of insects. It has been estimated that the large recorded populations of this bat may consume 1000 tons of insects in a single night!

Trees are needed to provide hollows for birds and bats. Photo Guy Roth.

A study is currently underway in northern New South Wales to provide estimates of the potential impact of insectivorous bats on cotton pests. So far, 10 bat species have been identified around cotton crops in the Narrabri area, with more species found in cotton fields that are near native vegetation than in those without. The table below lists the different bat species so far identified, and shows the type of habitat they prefer for hunting.

Table of insectivorous bat species identified around cotton fields in the Narrabri area

Species of bats detected with an Anabat ultrasound recorder*, Narrabri, Lower Namoi Valley, 1999/2000 and 2000/2001 cotton seasons	Woodland next to water storage (Richards)	Cotton next to remnant vegetation (Richards)	Cotton isolated from vegetation (MacKinnon)
Inland Freetail (*Mormopterus planiceps* Sp.3)*	✓	✓	✓
Inland Broadnosed (*Scotorepens balstoni*)*	✓	✓	✓
Little Broadnosed (*Scotorepens greyii*)*	✓		✓
White-striped Freetail (*Tadarida australis*)*	✓	✓	
Southern Freetail (*Mormopterus planiceps* Sp.4)*	✓	✓	
Chocolate Wattled (*Chalinolobus morio*)*	✓	✓	
Gould's Wattled (*Chalinolobus gouldii*)*	✓		
Little Forest (*Vespadelus vulturnus*)*	✓		
Yellow-bellied Sheathtail (*Saccolaimus flaviventris*)*		✓	
Lesser Longeared (*Nyctophilus geoffroyi*) (dead in *Helicoverpa armigera* feramone trap — trapped while chasing prey)		✓	
Total species	**8**	**7**	**3**

This data is from work done by Richards and MacKinnon 2002, as yet unpublished.

All these bat species require tree hollows for roosting sites, with the type of hollow most preferred varying between species. For example, Gould's Wattled bats use the dead limbs of River Red Gums, whilst Lesser Longeared bats roost only in cracks of dead trees. Trees are very important habitat for bats, with studies of riparian trees (mainly River Red Gum) on the cotton property 'Little Mollee', Mike Carberry's 'Cardale', and Phil Norrie's 'Mollee', revealing that single trees can contain from 2–29 roosting hollows. The trees surveyed were a mix of dead and living, with the dead trees averaging 22 hollows and 8 cracks, and the living trees 11 hollows. Not all hollows are suitable for bats, and unfortunately most of the trees in the survey are extremely old and in decline, which means that habitat for bats is becoming increasingly scarce. At the same time, Eucalypts do not develop hollows suitable for bats until they are around 120–180 years old. In many riparian areas within cotton districts there is little natural recruitment of trees occurring due to continuous access by stock to riverbanks and adjacent areas.

A final word...

The many species of bats now known to be present in cotton districts that may be able to provide a useful service to growers in helping to reduce pest insect populations at certain times of year. It is important that they be conserved as an important part of the natural ecosystem.

Strips of vegetation provide habitat for bats, insects and other predators that can assist cotton farmers to control pest populations. Photo Guy Roth.

2. Providing habitat for insect predators and pollinators

Windbreaks around cotton properties offer a unique opportunity to reintroduce biodiversity into the agricultural landscape. Greening Australia and other organisations can provide information on the effectiveness of different types of windbreaks and their height and orientation, as well as on suitable species and planting techniques. In addition to the direct benefits of reduced wind speed, these windbreaks can provide habitat for a range of pollinators and predators of insect pests that are then able to forage in adjacent paddocks.

Two windbreaks on a cotton property west of Narrabri were sampled to investigate whether insect predators were using them. The trees were a mix of Eucalypts, Casuarinas, Acacias and Melaleuca. The results showed that a wide range of insect predators were in the windbreaks, including lacewings, ladybirds, damsel bugs and assassin bugs. The presence of larvae indicated that the lacewings also use the windbreaks for egg-laying. Within the windbreaks, different predators seemed to favour different trees. An interesting observation from this study was that all predator species seemed to prefer windbreaks offering north–south aspects rather than those oriented east–west; the former possibly provides a better microclimate for insects. These are initial results and it is yet to be seen whether windbreaks and the predators they contain can have a significant effect on insect pest populations or through assisting pollination of crops.

A final word...

The research being undertaken is encouraging as it clearly show that windbreaks can be a valuable way of reintroducing or retaining biodiversity on cotton farms.

3. Water birds and irrigation storages

On-farm storages in the Lower Gwydir Valley in northern New South Wales now cover around 120 square kilometres in total, equivalent to more than 1% of the landscape and representing around 45% of the total area of natural and artificial wetlands in the region. During the period 1999–2001, several surveys were undertaken of on-farm storages and wetlands on nine cotton farms. Over 45 species of water birds were recorded, including several rare species and four that are listed under the NSW *Threatened Species Conservation Act 1995*.

The water bird communities recorded on the on-farm storages were dominated by ducks, geese and swans, followed by pelicans, darters and cormorants. The four most abundant individual species were all ducks. Variations in the number and species recorded during repeat surveys suggested that the water birds were highly mobile, using on-farm storages as part of the dispersed system of wetlands in the Lower Gwydir.

The study found consistent and significant differences in the number, density and composition of water bird communities on different types of on-farm storage. The five most bird-rich storages carried 10–30 times as many birds as the five most bird-poor. There was also a significant difference between bird species in the frequency at which they were recorded on the on-farm storages. Some species, such as Whistle-Ducks, were very numerous but occurred only irregularly, whereas Black Duck were present on most storages. The water birds were, in general, more numerous and more frequently present on storages:

- that included trees in the water, beds of aquatic vegetation, and shallow areas that formed mud islands as water level fell; and,
- that had soil species-rich seedbanks with high total seed numbers.

Very few water birds were observed to breed on the on-farm water storages. The study also concluded that although the on-farm storages in the Lower Gwydir constitute nearly half of its mapped wetland areas, they probably support, on average, only 1–5% of the Valley's water bird community and less than 0.5% of water bird nesting numbers. The study has also suggested ways in which the characteristics of on-farm storages could be modified without unacceptably reducing their usefulness in water management on irrigated cotton farms. Modifications might be made to existing storages when they are drawn down, or incorporated in new designs, to include areas of shallow slopes, aquatic vegetation and trees and standing dead timber. This would significantly increase the value of these storages for use by water birds, and enable growers and the industry in general to maintain and enhance its existing contribution to water bird biodiversity in cotton regions.

Pelicans are commonly found living in and around cotton farm storages. Photo Guy Roth.