DEVELOPMENT and application of a method for the

by Amy Jansen, Alistar Robertson, Leigh Thompson & Andrea Wilson

Riparian habitats are where terrestrial and aquatic ecosystems meet. They are vital sites in a catchment, supporting high levels of biodiversity and being critical in controlling flows of energy and nutrients between terrestrial and aquatic ecosystems. Being at the boundary of terrestrial and aquatic ecosystems means that riparian areas are powerful indicators of catchment quality. Human settlement has always been focused on rivers and is often a major determinant of riparian structure and function. One of the biggest impacts on riparian areas has been the introduction of domestic stock, with grazing being the major land use over 60% of Australia's land surface. Stock concentrate around water sources, which means riparian and wetland habitats, as well as those around artificial watering points in pastoral regions, suffer greater impacts from domestic and feral grazing herds than dryland areas. These impacts have led to extensive loss of ecological condition in riparian areas in Australia.

Given the critical role of riparian areas within catchments, and their extensive degradation in Australia, there is a need for improved management of these areas. A baseline for improved management must be an understanding of current condition, and the factors which determine this. Within this context a need was identified for a rapid method of measuring riparian condition, both to enable assessment of a large number of sites in a catchment and to investigate relationships with current management practices. This project focused on developing a rapid method which could be used at a large number of sites and was responsive to changes in grazing management.

CONDITION
refers to the degree to which human-altered ecosystems diverge from local semi-natural ecosystems in their ability to support a community of organisms and perform ecological functions.

Rapid Appraisal of Riparian Condition (RARC)

Assessment methods incorporating indicators of geophysical and biological properties and processes are likely to provide reliable estimates of ecological condition in riverine ecosystems. Ladson et al. (1999) described an index of stream condition based on 18 indicators that measure alterations to the hydrology, physical form, streamside vegetation, water quality and biota of streams. This project used a similar approach, and chose indicators to reflect functional aspects of the physical, community and landscape features of the riparian zone, as defined by Naiman & Decamps (1997) (see Table 1 opposite). Some of the indicators chosen reflect a variety of functions, e.g. different aspects of vegetation cover can play a role in reducing bank erosion, providing organic matter and habitat for fauna, and providing connections in the landscape. The Rapid Appraisal of Riparian Condition (RARC) index is made up of five sub-indices, each with a number of indicator variables (see Table 2 overleaf). Each sub-index is scored out of 10, with a total possible score of 50 representing best condition. Photos 1 and 2 show contrasting sites in excellent and very poor condition.

Applications of the RARC index

The RARC was initially developed as a tool to determine the impacts of grazing management practices on riparian condition, and to identify those practices which resulted in minimal impacts. We have now tested this approach in three areas of south-eastern Australia: on the Murrumbidgee River between Gundagai and Hay in NSW; in West and South Gippsland, Victoria; and in the Goulburn-Broken catchment also in Victoria. In all three regions, we examined the relationship between stocking rates and riparian condition, with Figure 1 (overleaf) showing our results. Clearly, riparian condition declined with increased stocking rates, across all regions and a large range of stocking rates. Given

Rapid Appraisal of Riparian Condition

***Table 1**: Functions of the riparian zone at different levels of organisation, the components of the riparian ecosystem which perform those functions, and the indicators of the function used in this study.*

Functions	Components	Indicators
Physical		
Reduction of erosion of banks	Roots, ground cover	Vegetation cover*
Sediment trapping	Roots, fallen logs, ground cover	Canopy cover, fallen logs, ground cover vegetation, leaf litter cover
Controlling stream microclimate/ discharge/water temperatures	Riparian forest	Canopy cover
Filtering of nutrients from upslope	Vegetation, leaf litter	Ground cover vegetation, leaf litter cover
Community		
Provision of organic matter to aquatic food chains	Vegetation	Vegetation cover*, leaf litter cover
Retention of plant propagules	Fallen logs, leaf litter	Fallen logs, leaf litter cover
Maintenance of plant diversity	Regeneration of dominant species, presence of important species, dominance of natives *vs* exotics	Native canopy and shrub regeneration, grazing damage to regeneration, reeds, native vegetation cover*
Provision of habitat for aquatic and terrestrial fauna	Fallen logs, leaf litter, standing dead trees/ hollows, riparian forest, habitat complexity	Fallen logs, leaf litter cover, standing dead trees, vegetation cover*, number of vegetation layers
Landscape		
Provision of biological connections in the landscape	Riparian forest (cover, width, connectedness)	Vegetation cover*, width of riparian vegetation, longitudinal continuity of riparian vegetation,
Provision of refuge in droughts	Riparian forest	Vegetation cover*
* Vegetation cover = canopy, understorey and ground cover		

For further information

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***Photo 1**: A site in excellent condition on the Edward River (RARC score = 50; note continuous canopy of native trees, standing dead trees and fallen logs, native shrub understorey, reeds and regeneration of canopy trees).*

***Photo 2**: A site in very poor condition on the Murrumbidgee River (RARC score = 13.2; note discontinuous canopy, lack of shrubs, small amounts of leaf litter, lack of native ground cover and reeds, little regeneration of canopy trees).*

***Table 2**: Sub-indices and indicators used in the Rapid Appraisal of Riparian Condition.*

Sub-index	Indicators
HABITAT (Habitat continuity and extent)	~ Width of riparian vegetation ~ Longitudinal continuity of riparian vegetation
COVER (Vegetation cover, structural complexity)	~ Canopy (greater than 5 metres tall) ~ Understorey (1–5 metres tall) ~ Ground (less than 1 metre tall) ~ Number of layers
DEBRIS (Standing dead trees, fallen logs, leaf litter)	~ Leaf litter ~ Standing dead trees (greater than 20 centimetres diameter at breast height) ~ Fallen logs (greater than 10 centimetres diameter)
NATIVES (Dominance of natives *vs* exotics)	~ Canopy (greater than 5 metres tall) ~ Understorey (1–5 metres tall) ~ Ground (less than 1 metre tall) ~ Leaf litter
FEATURES (Indicative features)	~ Native canopy species regeneration ~ Damage to regeneration ~ Native shrub/sub-canopy regeneration ~ Reeds

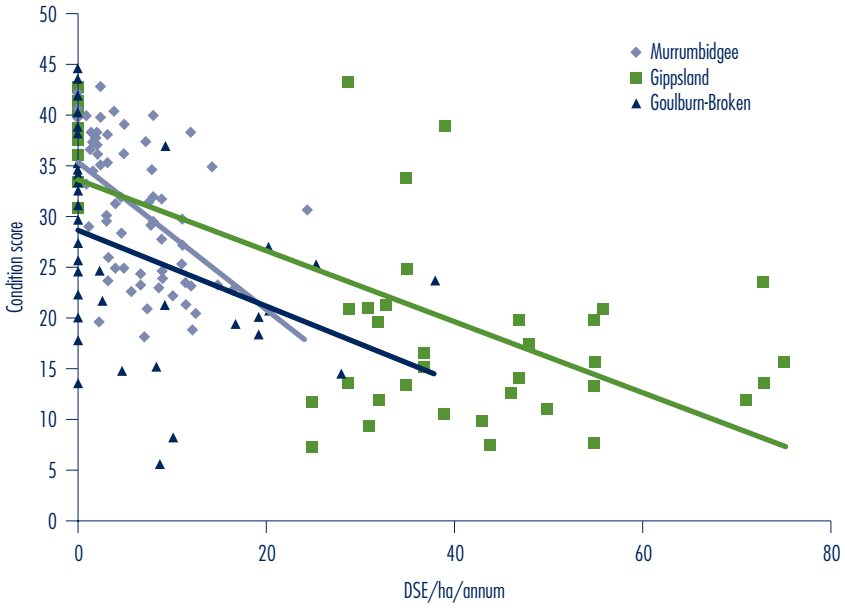

***Figure 1**: Condition scores in relation to stocking rates (DSE/ha/annum) for three regions: Murrumbidgee River, West and South Gippsland, and upper and mid-Goulburn-Broken catchment.*

the large number of sites in poor condition in all catchments, this suggests that stocking rates commonly used on private properties are too high to maintain riparian zones in good condition.

Why is the RARC a useful tool?

What does riparian condition tell us about the biodiversity and functioning of riparian zones?

The RARC has been tested against more detailed measures of the biodiversity and functioning of riparian zones in the Murrumbidgee and Gippsland regions. There was a significant positive relationship between litter decomposition rates in the soil and the COVER sub-index of the RARC score in both Summer (r = 0.50, p <0.05) and Autumn (r = 0.78, p <0.01), indicating that decomposition rates were higher where there was more vegetation cover in the riparian zone of the Murrumbidgee River.

There were highly significant relationships between bird communities and all sub-indices, as well as the total RARC score (r = 0.68, p <0.0001), indicating that riparian bird communities varied according to the condition of the riparian zone of the Murrumbidgee River. Of particular significance (r = 0.74, p <0.0001) was the DEBRIS sub-index (scoring for leaf litter, fallen logs and standing dead trees), indicating that retention of leaf litter and woody debris in riparian habitats is crucial to the survival of riparian bird communities. Many of the species most dependent on these features (e.g. Brown Treecreepers) are threatened or declining throughout the agricultural regions of southern Australia. In Gippsland, there was also a significant relationship (r = 0.59, p <0.0001) between bird communities and the total RARC score, indicating again that riparian bird communities varied according to the condition of riparian zones in Gippsland.

r = correlation coefficient (indicates the strength of a relationship

p = significance (where p < 0.05 indicates a significant relationship)

Given the importance of riparian zones in supporting high levels of regional biodiversity, and the links between riparian condition and biodiversity demonstrated here, the RARC is a useful tool for assessing riparian condition and hence biodiversity and functioning of riparian zones.

Inter-observer reliability testing of the RARC

Ten people participated in a RARC training workshop in November 2003, including three already trained in the method. As part of the training, 11 sites were each visited by three to four observers. Each observer independently scored riparian condition at each site, so that pairs of scores for each site could be compared as shown in Figure 2. It can be seen that most scores fell within two points of each other, and the maximum difference between the scores of different observers at the same site was five points, or 10% of the total possible score. This suggests very good inter-observer reliability, with even minimal training (half a day).

Concluding comment

The RARC is a general tool for assessing riparian zone function and biodiversity. It shows clear relationships with more detailed measures of biodiversity and function in catchments where this has been tested. It is also simple to use, easily taught to new users, and shows good inter-observer reliability. It is now freely available as the fourth in our *River and Riparian Management Technical Guideline* series, contact CanPrint Communications on 1800 776 616 or download it from the website www.rivers.gov.au.

If you would like further information about the method, are are interested in attending a training workshop, please contact:

References

Jansen, A. & Robertson, A.I. 2001a, Relationships between livestock management and the ecological condition of riparian habitats along an Australian floodplain river, *Journal of Applied Ecology*, vol. 38, pp. 63–75.

Jansen, A. & Robertson, A.I. 2001b, Riparian bird communities in relation to land management practices in floodplain woodlands of south-eastern Australia, *Biological Conservation*, vol. 100, pp. 173–185.

Ladson, A.R., White, L.J., Doolan, J.A., Finlayson, B.L., Hart, B.T., Lake, S. & Tilleard, J.W. 1999, Development and testing of an Index of Stream Condition for waterway management in Australia, *Freshwater Biology*, vol. 41, pp. 453–468.

Naiman, R.J. & Decamps, H. 1997, The ecology of interfaces: Riparian zones, *Annual Review of Ecology and Systematics*, vol. 28, pp. 621–658.

Thompson, L., Robertson, A., Jansen, A. & Davies, P. 2003, *Identifying Best Management Practices for Riparian Habitats in Gippsland Dairy Regions: Riparian condition and relationships with farm management*, Johnstone Centre Report no. 178, Wagga Wagga, NSW, Johnstone Centre, Charles Sturt University.

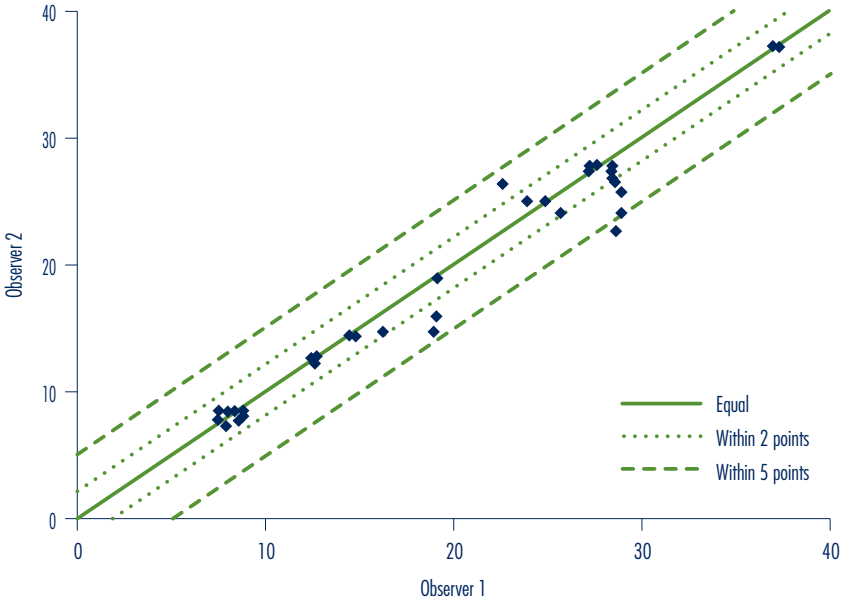

***Figure 2**: Scores obtained for the RARC by pairs of observers at the same sites.*