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Rapid Appraisal of Riparian Condition

Version Two

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Summary

- Riparian habitats are where terrestrial and aquatic ecosystems meet. They are vital sites in a catchment supporting high levels of biodiversity.
- Given the extensive degradation of riparian zones in Australia, there is a need for a rapid method of measuring riparian condition to underpin strategies for improved management.
- Riparian *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.
- The Rapid Appraisal of Riparian Condition assesses the ecological condition of riparian habitats using indicators that reflect functional aspects of the physical, community and landscape features of the riparian zone.
- The Rapid Appraisal of Riparian Condition index is made up of five sub-indices, each with a number of indicators: Habitat continuity and extent (HABITAT), Vegetation cover and structural complexity (COVER), Dominance of natives *versus* exotics (NATIVES), Standing dead trees, hollows, fallen logs and leaf litter (DEBRIS), and Indicative features (FEATURES).
- The Rapid Appraisal of Riparian Condition has been tested in three areas in south-eastern Australia: on the Murrumbidgee River, in Gippsland, and in the Goulburn-Broken catchment. In all three areas, there was a strong negative relationship between grazing intensity and riparian condition.
- Testing of the Rapid Appraisal of Riparian Condition index confirms that it is a good indicator of the biodiversity and functioning of riparian zones.
- This Technical Guideline Update is the second version of the Rapid Appraisal of Riparian Condition, and incorporates a simplified scoring system, additional indicators, and some adjustments to scoring of individual indicators.

Background

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 (Naiman & Decamps, 1997). Being at the boundary of terrestrial and aquatic ecosystems, riparian areas are powerful indicators of catchment quality (e.g. Rapport et al., 1998). Human settlement has always been focused on rivers and is often a major determinant of riparian structure and function (e.g. Dynesius & Nilsson, 1994). 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 (Wilson, 1990). 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 (Robertson, 1997; James et al., 1999). 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. Thus, there is a need for a rapid method of measuring riparian condition, to enable assessment of a large number of sites in a catchment. There is an expanding field of research focused on rapid appraisal techniques to measure ecosystem condition or integrity (Fairweather, 1999; Boulton, 1999). We have developed a rapid appraisal method for use at a large number of sites which is responsive to changes in grazing management. Subsequent testing of the method and trialling with many willing workshop participants led to modifications to the original method. These modifications have greatly simplified the scoring system, but comparison of the versions showed that it makes little difference to the overall score given to a site. This Technical Guideline Update 4A is the second version of the Rapid Appraisal of Riparian Condition, and incorporates a simplified scoring system, additional indicators, and some adjustments to scoring of individual indicators.

Throughout this Guideline, *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 (c.f. Karr, 1999).

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 (Fairweather, 1999; Boulton, 1999). 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). 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). In summary they cover:

1. Habitat continuity and extent (HABITAT).
2. Vegetation cover and structural complexity (COVER).
3. Dominance of natives *versus* exotics (NATIVES).
4. Standing dead trees and fallen logs and leaf litter (DEBRIS).
5. Indicative features (FEATURES).

Table 1. Summary table of functions, components and indicators assessed in the Rapid Appraisal of Riparian Condition index.

Functions of the riparian zone at different levels of organisation	Components of the riparian ecosystem that perform those functions	Indicators of the functions used in the RARC
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 *versus* 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, hollows, 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, proximity to other habitat
Provision of refuge in droughts	Riparian forest	Vegetation cover*

* Vegetation cover = canopy, understorey and ground cover

Table 2. Sub-indices and indicators of the Rapid Appraisal of Riparian Condition, the range within which each is scored, the method of scoring for each indicator, and the maximum possible total for each sub-index (note that in Table 2 the indicators are not grouped by function as they are in Table 1).

Sub-index	Indicator	Range	Method of scoring	Total
HABITAT				11
	Longitudinal continuity of riparian vegetation (≥ 5 m wide)	0–4	0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = ≥ 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (≥ 50 m long)	
	Width of riparian vegetation (scored differently for channels < or ≥ 10 m wide)	0–4	*Channel ≤ 10 m wide:* 0 = VW < 5 m, 1 = VW 5–9 m , 2 = VW 10–29 m, 3 = VW 30–39 m, 4 = VW ≥ 40 m *Channel > 10 m wide:* 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW ≥ 4, where CW = channel width and VW = vegetation width	
	Proximity to nearest patch of intact native vegetation > 10 ha	0–3	0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha	
COVER				12
	Canopy (> 5 m tall)	0–3	0 = absent, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Understorey (1–5 m tall)	0–3	0 = absent, 1 = 1–5%, 2 = 6–30%, 3 = > 30% cover	
	Ground (< 1 m tall)	0–3	0 = absent, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Number of layers	0–3	0 = no vegetation layers to 3 = ground cover, understorey and canopy layers	
NATIVES				9
	Canopy (> 5 m tall)	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Understorey (1–5 m tall)	0–3	0 = absent, 1 = 1–5%, 2 = 6–30%, 3 = > 30% cover	
	Ground (< 1 m tall)	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
DEBRIS				10
	Leaf litter	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Native leaf litter	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Standing dead trees (> 20 cm dbh)	0–1	0 = absent, 1 = present	
	Hollow-bearing trees	0–1	0 = absent, 1 = present	
	Fallen logs (> 10 cm diameter)	0–2	0 = none, 1 = small quantities, 2 = abundant	

dbh = diameter at breast height, < less than, ≤ less than or equal to, > greater than, ≥ greater than or equal to.

Table 2. continued

Sub-index	Indicator	Range	Method of scoring	Total
FEATURES				8
	Native canopy species regeneration (< 1 m tall)	0–2	0 = none, 1 = scattered, 2 = abundant; with 1/2 point subtracted for grazing damage	
	Native understorey regeneration	0–2	0 = none, 1 = scattered, 2 = abundant; with 1/2 point subtracted for grazing damage	
	Large native tussock grasses	0–2	0 = none, 1 = scattered, 2 = abundant	
	Reeds	0–2	0 = none, 1 = scattered, 2 = abundant	

Photo 1. A site in excellent condition on the Edward River (RARC score = 50; note continuous canopy of native trees, standing dead trees, hollow-bearing 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 = 14; note discontinuous canopy, lack of shrubs, small amounts of leaf litter, lack of native ground cover and reeds, little regeneration of canopy trees).

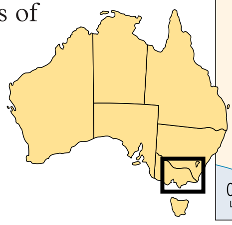
Photos 1 and 2 show contrasting sites in excellent and very poor condition. Details of the scoring for these sites can be found in the box below.

Example of scoring indicators for the sites shown in Photos 1 and 2 (see Table 2 for indicators and details)

Sub-index	Excellent condition site (Photo 1)		Very poor condition site (Photo 2)	
Habitat	4 + 4 + 3 =	11	0 + 0 + 0 =	0
Cover	3 + 3 + 3 + 3 =	12	1 + 0 + 3 + 2 =	6
Natives	3 + 3 + 3 =	9	1 + 0 + 1 =	2
Debris	3 + 3 + 1 + 1 + 2 =	10	1 + 1 + 1 + 1 + 1 =	5
Features	2 + 2 + 2 + 2 =	8	1 + 0 + 0 + 0 =	1
Total		50		14

Applications of the Rapid Appraisal of Riparian Condition 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 (see Figure 1); some results are presented below. Note that these results were obtained using the original version of the RARC, but the two versions give very similar scores.



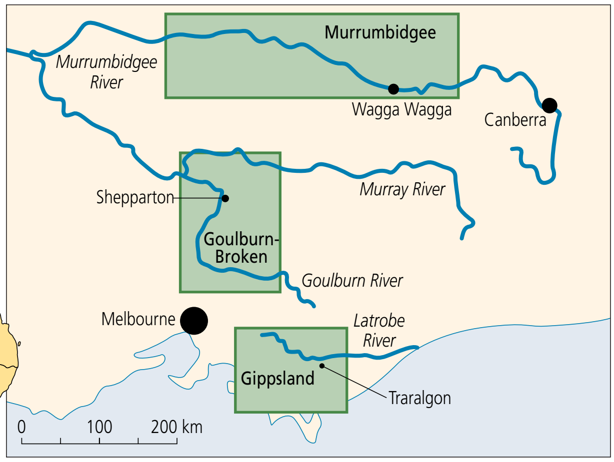


Figure 1. Location of sites where the Rapid Appraisal of Riparian Condition has been applied.

Murrumbidgee River

A total of 138 sites (each 1 kilometre in length) were surveyed between Gundagai and Hay, on private properties, crown land and State Forests (Jansen & Robertson, 2001a). The majority of sites on private property were in very poor condition, while sites on Crown Land (mainly Travelling Stock Reserves) were very variable. Most State Forest sites were in good to excellent condition (Figure 2a).

Gippsland

A total of 108 sites (each 150 metres in length) were surveyed in West and South Gippsland, at three types of sites — grazed paddocks on private properties, planted and fenced riparian areas on private properties, and remnant patches of uncleared native vegetation both on private properties and in reserves (Thompson et al., 2003). All private property sites were on dairy farms. The majority of sites were in very poor condition, with only remnant sites scoring above average (Figure 2b). It should be noted that most planted sites were relatively recently fenced, and their condition can be expected to improve as the plantings mature.

Goulburn-Broken

A total of 46 sites (each 200 metres in length) were surveyed in the upper and mid-Goulburn-Broken catchment, at grazed and ungrazed sites on private properties, and at ungrazed sites in reserves (Wilson et al., 2003). Again, the majority of sites were in very poor condition (Figure 2c). Like the Gippsland planted sites, many of the Goulburn-Broken ungrazed sites on private properties were relatively recently fenced, and their condition can be expected to improve as plantings mature.

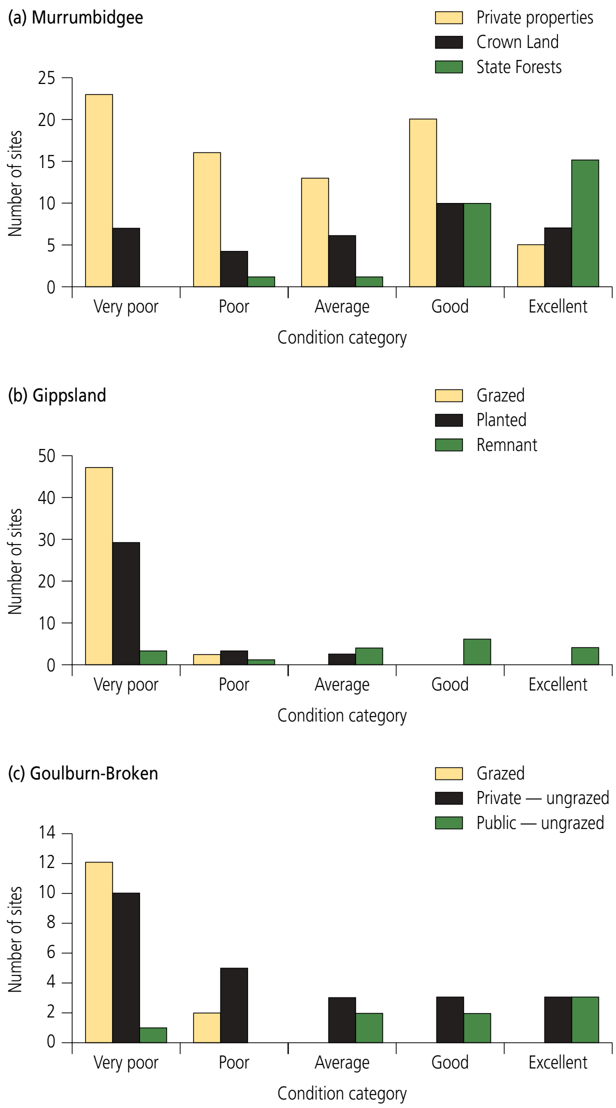


Figure 2. The number of sites scoring in each category (< 25 very poor, 25–30 poor, 30–35 average, 35–40 good and > 40 excellent) of the RARC index for three regions: (a) Murrumbidgee River, (b) West and South Gippsland, and (c) upper and mid-Goulburn-Broken catchment.

Riparian condition in relation to stocking rates

In all three regions, we examined the relationship between stocking rates and riparian condition, with Figure 3 below showing our results. Clearly, riparian condition declined with increased stocking rates, across all regions and a large range of stocking rates. Given 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.

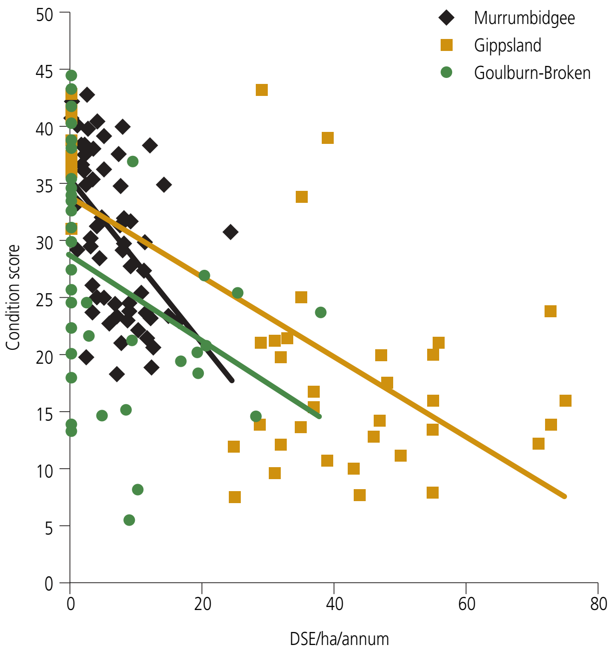


Figure 3. RARC condition scores in relation to stocking rates (DSE/ha/annum) for three regions: Murrumbidgee River, West and South Gippsland, and upper and mid-Goulburn-Broken catchment.

Sub-indices of the riparian condition index

There was variation across regions in relation to which sub-indices accounted for most of the variation in the total riparian condition score (Table 3). In the Murrumbidgee region, 85% of the variance in the total condition score was explained by the DEBRIS sub-index (scoring for leaf litter, fallen logs and standing dead trees). In Gippsland, 90% of the variance in the total condition score was explained by the NATIVES sub-index (scoring for native species in the vegetation cover and debris). In the Goulburn-Broken, 79% of the variance in the total condition score was explained by the COVER sub-index (scoring for % cover in each vegetation layer, and the number of vegetation layers).

Sub-index	Murrum-bidgee	Gippsland	Goulburn-Broken
COVER	0.42	0.83	0.79
DEBRIS	0.85	0.75	0.70
HABITAT	0.81	0.80	0.62
NATIVES	0.23	0.90	0.77
FEATURES	0.60	0.32	0.56

Table 3. Proportion of variance in the total riparian condition index score explained (R^2 value) by each sub-index for three regions: Murrumbidgee River, West and South Gippsland, and upper and mid-Goulburn-Broken catchment. The R^2 value was obtained by regressing the values for each sub-index against the total index scores for each site.

Clearing and overgrazing of riparian vegetation in the Mount Lofty Ranges, South Australia. Photo Amy Jansen.

The DEBRIS sub-index consistently explained at least 70% of the variance in the total condition score, suggesting that management practices aimed at retaining standing dead trees and fallen logs would improve riparian condition scores in all regions. The HABITAT sub-index was also relatively consistent across regions, explaining at least 62% of the variance in total condition scores. This suggests that maintaining or restoring a continuous canopy in the riparian zone is also important in all regions. In contrast, the NATIVES sub-index explained little of the variance in the Murrumbidgee but most of it in Gippsland. This sub-index indicates that in the Murrumbidgee, the canopy trees are predominantly native, there is little shrub cover, and the ground cover is predominantly exotic. In this region, there is little chance of altering this on a large scale. In Gippsland, however, the index indicates a lot of variability in the dominance of natives over exotics in all vegetation layers, and that management aimed at maintaining or restoring native species could significantly improve riparian condition.

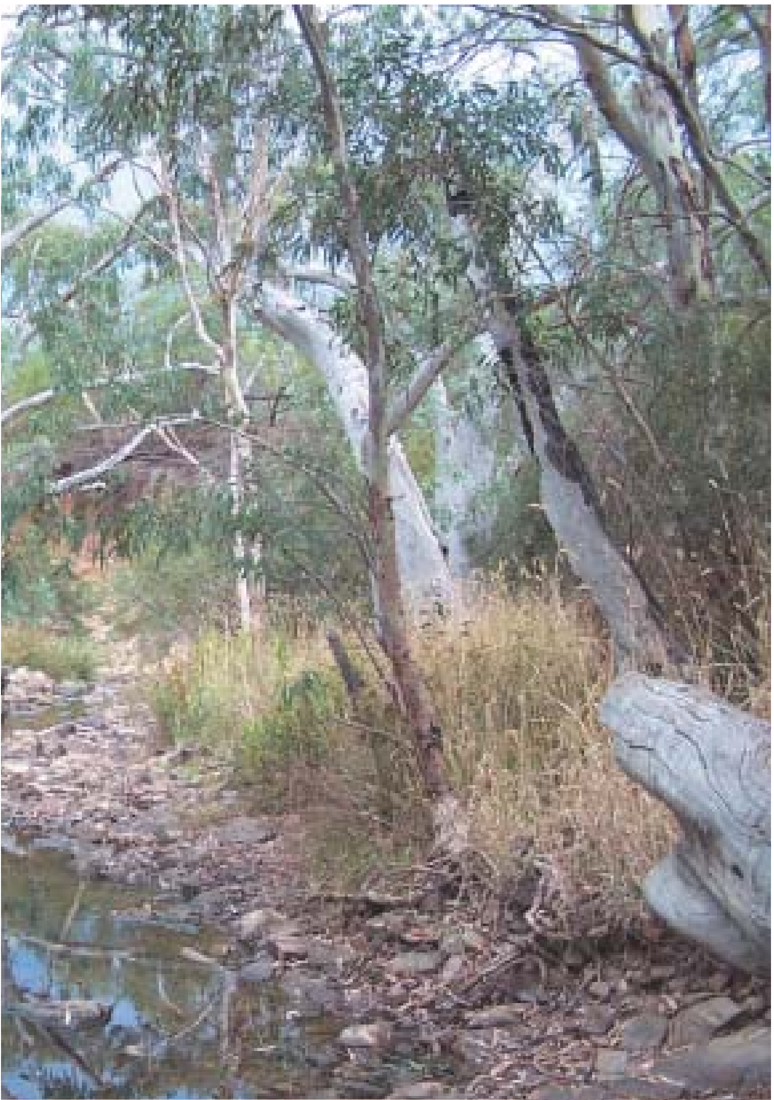
Why is the RARC a useful tool? What does riparian condition tell us about the biodiversity and functioning of riparian zones?

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 (Robertson, Wassens & Jansen, in prep.). 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 (Jansen & Robertson, 2001b). 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 (Ford et al., 2001).

Above: Healthy riparian area with a diversity of vegetation providing habitat for both aquatic and terrestrial animals, Mount Lofty Ranges, South Australia. Photo Amy Jansen.

Right: A brown treecreeper. These birds live in riparian areas and their presence can be used as an indicator of riparian health. Photo Andrew Tatnell.

r = correlation coefficient (indicates the strength of a relationship
p = significance (where $p < 0.05$ indicates a significant relationship)



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 (Thompson et al., 2003).

Given the importance of riparian zones in supporting high levels of regional biodiversity (Naiman & Decamps, 1997), 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.

Applying the RARC:
Steps in assessing riparian condition

The Rapid Appraisal of Riparian Condition index can be used for a variety of applications. Examples include determining relationships between riparian condition and management practices, as in the studies mentioned in the Guideline, or surveying overall condition within a catchment to determine priorities for future rehabilitation works in the catchment. Whatever the application, care should be taken to clearly define the question to be answered, determine the sampling design and select sites appropriately to answer the question. This may require help from a consultant with experience in experimental design and data analysis. In general, sampling of sites should be *random**, rather than only sampling sites which are easily accessible by road.

A single observer should conduct all assessments, and they should undertake some training beforehand, to ensure consistency of data collection. The observer will need to have some experience in discriminating native and exotic plant species, and may benefit from previous experience in habitat surveys.

All sites should be surveyed at a similar time of year. Use a separate scoring sheet for each site. Allow 20–60 minutes per site, depending on size and accessibility.

*** If you were interested in surveying overall catchment condition, you could choose sites randomly by laying a grid over a map of the catchment, locating and numbering all squares which contain a riparian zone, then putting these numbers in a hat and pulling out as many sites as you wish to sample.**

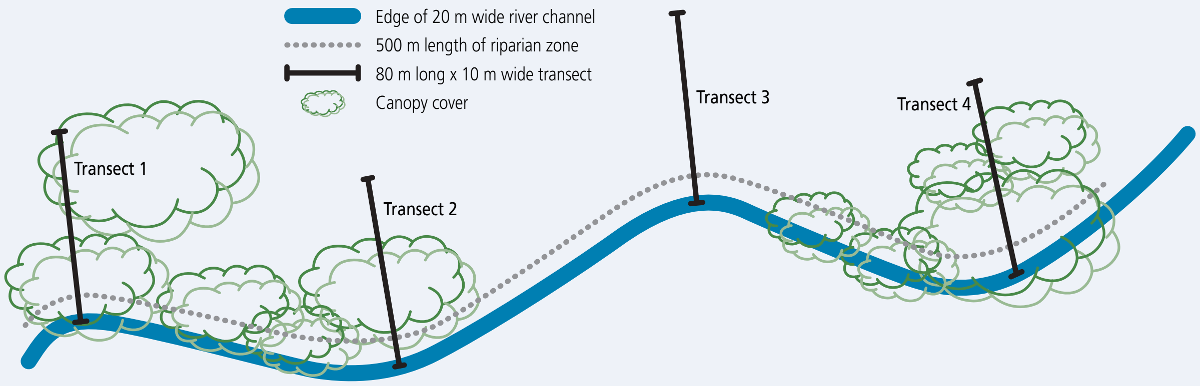
1 Determine site size

Site size must be determined according to the size of the management unit of interest. For example, our studies have examined impacts of grazing management on riparian condition, so management units have been individual paddocks. On the Murrumbidgee River, where paddocks are relatively large, a 1 kilometre length of the riparian zone was defined as a 'site', while in Gippsland, where paddocks are much smaller, a 150 metre length was used. Ideally, sites should be at least 200 metres long, with 500 metres being the preferred length where practicable. On larger rivers, only one side of the river is surveyed, while at smaller sites where it is practicable to do so, both sides may be surveyed (provided they are subject to the same management regime).

The transects at each site should ideally traverse the width of the riparian zone. However, this is not always easy to determine in the field. To simplify this, we use a transect length determined by the width of the river channel — 40 metres long for channels < 10 metres wide, and four times the channel width for larger rivers. A minimum width of 40 metres should be assessed, unless there is a very clear distinction between riparian and non-riparian areas. Where the riparian zone is clearly narrower than 40 metres or four times the channel width (for example, in a gorge), the transect length should be adjusted accordingly. Where the riparian zone is much wider than this (for example, on a lowland floodplain river), four times the channel width should be adequate to represent the riparian zone. Figure 4 illustrates a hypothetical river with the layout of the survey area and the transects indicated.

2 Score indicators

A sample scoring sheet can be found on page 14 of this Guideline. The complete scoring system is summarised in Table 2. Longitudinal continuity and proximity are given single values for the whole site. All other indicators are scored along four transects (10 metres wide; perpendicular to the direction of river flow) evenly spaced along the bank.



Calculation of condition scores for this hypothetical riparian sample site

Longitudinal continuity of riparian canopy vegetation (> 5 m wide)

Map			Score
200 m vegetated	150 m bare	150 m vegetated	1.5 (70% vegetated with 1 discontinuity)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	20	> 80	4
2	20	60	3
3	20	0	0
4	20	70	3

Vegetation cover

Transect	Canopy
1	3
2	2
3	0
4	3

Figure 4. Hypothetical river with length and transects marked. The scoring for the indicators in this diagram is shown (see page 14 for full score sheet).

HABITAT

At each site, canopy vegetation along the bank is mapped to show the length and number of any discontinuities (gaps of more than 50 metres) in canopy cover (the bank is considered to be vegetated if the riparian canopy vegetation is at least 5 metres wide). Longitudinal continuity is then scored as follows:

> 0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = ≥ 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (> 50 m long)

An assessment is made of the shortest distance to the nearest patch of at least 10 hectares of relatively intact native vegetation (with an extra point if the area being assessed is within a patch of at least 50 hectares of relatively intact native vegetation). This can be assessed on-site or later using aerial photographs. Proximity is then scored as follows:

> 0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha

> A patch of relatively intact native vegetation should have at least the dominant overstorey vegetation remaining. This may not be trees, if the area is a natural grassland or shrubland.

The channel width is defined by the area normally lacking any terrestrial or bankside vegetation. The width of the riparian canopy vegetation is the distance from the bank to the first gap of > 50 metres in the canopy vegetation. Channel width (CW) and width of the riparian vegetation (VW) are estimated to the nearest 5 metres in the field. For channels less than 10 metres wide, the vegetation width is converted directly to a score, while for channels more than 10 metres wide, the vegetation width is divided by the channel width to obtain the score as follows:

> Channel ≤ 10 m wide: 0 = VW < 5 m, 1 = VW 5–9 m, 2 = VW 10–19 m, 3 = VW 20–39 m, 4 = VW ≥ 40 m

> Channel > 10 m wide: 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW ≥ 4

> For example, for a channel 12 metres wide and a vegetation width of 30 metres, VW/CW = 2.5, giving a score of 3.

COVER (see Photo 3 below)

Vegetation cover within each layer is scored as follows:

> Canopy cover (trees > 5 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

> Understorey cover (herbs, reeds, shrubs and saplings 1–5 m tall): 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%
> (Note that understorey cover is scored on a different scale to the others, since it is normally less dense)

> Ground cover (lichens, mosses, grasses, herbs, reeds and sedges to 1 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

The number of layers of vegetation is scored as follows:

> 0 = no vegetation layers to 3 = ground cover, understorey and canopy layers

NATIVES (see Photo 4 overleaf)

Native vegetation cover within each layer is scored as for cover, but excluding the contribution of exotic species (to estimate cover of native species, imagine removing all exotic species and re-estimating vegetation cover with only the native species):

> Canopy cover (trees > 5 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

> Understorey cover (herbs, reeds, shrubs and saplings 1–5 m tall): 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%

> Ground cover (lichens, mosses, grasses, herbs, reeds and sedges to 1 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

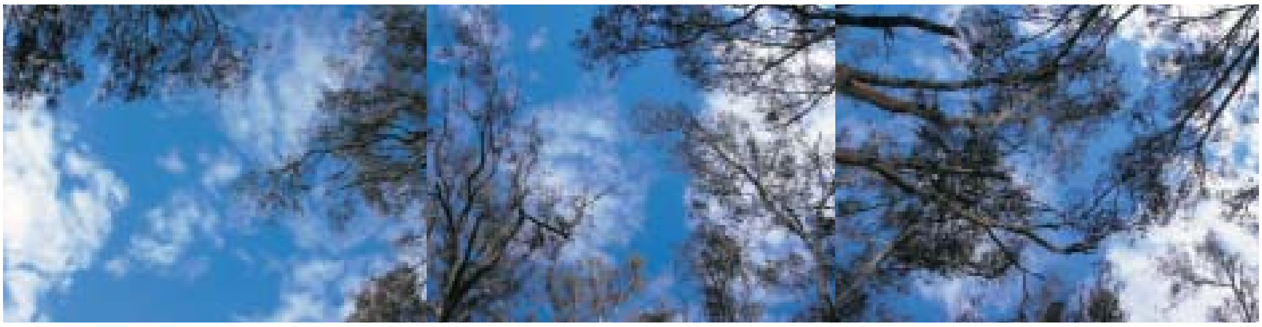


Photo 3. Canopy cover increasing from 1 to 3 (left to right). Photos Amy Jansen.

Tussocky perennial (long-lived) grasses tend to be native species while annual (short-lived) grasses tend to be exotic species (with a few obvious exceptions such as *Phalaris* which is a perennial exotic species).

Photo 4. Exotic annual ground cover (left) *versus* native perennial tussock ground cover (right). Photos Amy Jansen.

Photo 5. Leaf litter cover increasing from 1 to 3 (left to right). Photos Amy Jansen.

DEBRIS (see Photo 5 above)

Cover of leaf litter on the ground, and cover of native leaf litter are scored as follows:

0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover

Standing dead trees > 20 centimetres diameter at breast height, and hollow-bearing trees (look for dead branches and broken-off branch stubs in large trees which may have developed hollows) are scored as follows:

0 = absent, 1 = present

Fallen logs (> 10 cm diameter) are scored as follows:

0 = none, 1 = small quantities, 2 = abundant (where small quantities = one or two logs, and abundant = three or more logs)

FEATURES

The abundance of native canopy species regeneration (< 1 metre tall) and native understorey regeneration is scored as follows:

0 = none, 1 = scattered, and 2 = abundant, with 1/2 point subtracted for grazing damage (where scattered = one or two seedlings, and abundant = three or more seedlings; grazing damage is evidence that any of the seedlings have been browsed by grazing animals such as domestic livestock or kangaroos)

Photo 6 (right). *Poa labilliardieri*, an example of a large native tussock grass found in riparian zones. Photo Amy Jansen.

The abundance of large native tussock grasses (species such as *Poa labilliardieri*) and reeds (species such as Phragmites, *Typha* (Cumbungi) and *Carex* which are normally only found on riverbanks or in swampy areas) is scored as follows:

0 = none, 1 = scattered, and 2 = abundant (where scattered = one or two plants, and abundant = three or more plants)

3 Analyse data

The indicators are averaged across transects, then summed into sub-indices. The final index score is then the sum of the sub-indices, with a possible maximum of 50 indicating best condition. To examine the results, it is helpful to categorise the index scores, e.g. less than 25 very poor, 25–30 poor, 30–35 average, 35–40 good and more than 40 excellent. It is also helpful to examine sub-index scores, and to determine which sub-indices contribute most to the final condition score. This can be done by regression of sub-index scores on the total index score.

4 Benchmarking

The scoring system given here has been developed for a generalised riparian area in south-eastern Australia, and may need to be adjusted for particular situations. Ideally, a number of relatively pristine sites in the region should be surveyed to provide a benchmark for the scoring system. The scores for each indicator can then be checked to ensure that all indicators are present, and that the maximum score can be achieved for each indicator. For example, in wet forests with a dense canopy, there may be no large tussock grasses but ferns could be used as an indicator instead. Also, ground cover may never reach > 60% due to shading, so this indicator may need to be adjusted accordingly (for example, the scores given for different levels of ground cover could be rescaled similarly to those given for understorey cover). Benchmarking against relatively pristine sites is not always possible in highly modified catchments. In these situations, we can only make a 'best guess', based on local knowledge and historical information, about the appropriate scoring for each indicator in these catchments.

Limitations of the RARC

While the condition index outlined in this Guideline has been tested in a number of catchments and situations, it has some limitations:

~ The RARC has been designed and tested on creeks and rivers in south-eastern Australia. Its usefulness in other regions is yet to be explored.
~ The RARC is designed for riparian zones that are naturally dominated by trees, with at least 60% canopy cover.
~ The RARC is designed for riparian zones of rivers and creeks which have relatively permanent water. In some situations it may work for temporary streams, but not if water availability is too low to support trees.
~ The RARC is intended as an indicator of *current* condition. Thus for restored areas, it will not indicate the potential for recovery of ecosystem function.

Further information

We will be continuing to refine and update the RARC so to get the latest version visit www.rivers.gov.au. There you will find an Excel spread sheet which includes a printable field data sheet, and a data entry sheet. If you enter data for a site, it will automatically calculate the averages for each transect and the final sub-index and total scores for you. If you have a number of sites, you will need to save a separate worksheet for each site. There is also a field calculation sheet which you can print on the reverse of the field data sheet if you wish to calculate scores in the field (you may need a calculator to take the averages across the transects). There are also details about how the RARC can be tailored to a particular region and some examples of how this has been done. If you have a technical query about using the RARC, contact details for Dr Amy Jansen (the developer of the tool) are also listed. Hard copies of the RARC 4A are available from CanPrint Communications 1800 776 616.

Rapid Appraisal of Riparian Condition

Site: ____________________ Site number: ____________________ GPS start: ____________________

Date: ____________________ Observer: ____________________ GPS end: ____________________

Longitudinal continuity of riparian canopy vegetation (> 5 m wide)

Map	Score

0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = ≥ 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (> 50 m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1			
2			
3			
4			
Average			

Channel ≤ 10 m wide: 0 = VW < 5 m, 1 = VW 5–9 m, 2 = VW 10–19 m, 3 = VW 20–39 m, 4 = VW ≥ 40 m vegetated
Channel > 10 m wide: 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW ≥ 4

Proximity

Score

Nearest patch of native vegetation > 10 ha: 0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha

Vegetation cover: Canopy > 5 m, Understorey 1–5 m, Ground cover < 1 m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	Number of layers
1							
2							
3							
4							
Average							

Cover and ground cover: 0 = none, 1 = 1–30%, 2 = 31–60% , 3 = > 60%
Understorey cover: 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1					
2					
3					
4					
Average					

Leaf litter and native leaf litter cover: 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%
Standing dead trees (> 20 cm dbh) and hollow-bearing trees: 0 = absent, 1 = present
Fallen logs (> 10 cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1				
2				
3				
4				
Average				

Regeneration < 1 m tall: 0 = none, 1 = scattered, and 2 = abundant, with 1/2 point subtracted for grazing damage
Reeds and large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site number:____

Longitudinal continuity of riparian canopy vegetation

Score	A

Width of riparian canopy vegetation

Average	B

Proximity

Score	C

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	Number of layers
Average	D	H	E	I	F	J	G

Debris

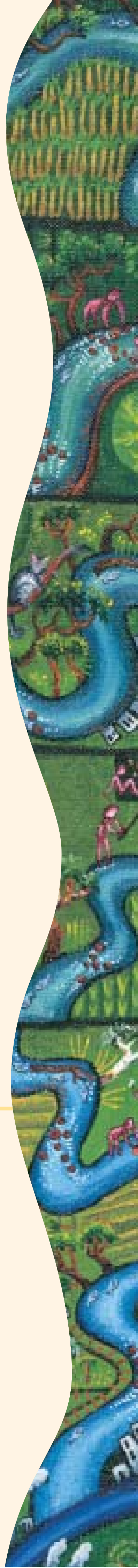
	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	K	L	M	N	O

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	P	Q	R	S

Totals

Site number	Habitat	Cover	Natives	Debris	Features	**Total**
(out of)	11	12	9	10	8	**50**
	A+B+C	D+E+F+G	H+I+J	K+L+M+N+O	P+Q+R+S	



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