CHAPTER 8

Riparian wildlife and habitats

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Summary

~ Riparian lands are among the most productive ecosystems on earth. They occupy only a small proportion of the landscape but frequently support a greater variety and abundance of animal life than adjacent habitats.

~ Important habitat components include vegetation (often taller, denser, more diverse, and more complex in riparian lands), food, standing water, shelter from predators, sites for nesting and roosting, and a local microclimate with less extreme temperatures and more humid conditions than adjacent areas.

~ Wildlife species differ in their dependence on the riparian zone: some are confined to it throughout their lives; others may use it only occasionally, although their long-term persistence depends on access to intact riparian habitats.

~ Riparian areas are often corridors for wildlife movement. This occurs naturally in dry regions, where stream-side vegetation forms distinctive networks across the landscape. In regions where most native vegetation has been cleared for human use, vegetated riparian zones also provide habitat for many species.

~ Degradation of riparian lands by clearing and grazing has negative impacts on a range of wildlife species which depend on these riparian areas.

~ Restoration of riparian lands, including fencing to exclude livestock and re-instatement of native vegetation, can lead to improved riparian habitat for a variety of wildlife species. There may also be benefits to other aspects of farm productivity, such as reduced impacts of pest species.

8.1 Wildlife ecology in riparian lands

Riparian lands occupy only a small proportion of the landscape, but they frequently have a much higher species richness and abundance of animal life than adjacent habitats. Research in Australia has documented the importance of riparian lands to a variety of wildlife across many habitat types.

The majority of this work has been on birds, and mostly in eastern and northern Australia, but the results are likely to be applicable to wildlife in general across the country, since work in other countries has provided similar conclusions (e.g. Knopf et al. 1988). In savanna landscapes in northern Australia, it has been found that the number of species of birds, mammals, reptiles, frogs and spiders (Williams 1993, Woinarski et al. 2000, Woinarski et al. 2002, Woinarski & Ash 2002), and the total abundances of birds (Woinarski et al. 2000, Woinarski & Ash 2002) were significantly higher in riparian areas than away from creeks and rivers. The adult forms of aquatic insects were much more abundant close to creeks and rivers than further away, and even terrestrial insects were more abundant in riparian areas (Lynch, Bunn & Catterall 2002). Likewise, in the forests and woodlands of eastern Australia, birds were significantly more abundant and diverse in riparian areas than upslope (Bentley & Catterall 1997, Mac Nally, Soderquist & Tzaros 2000, Catterall et al. 2001, Palmer & Bennett 2005, Martin & McIntyre, submitted) while leaf litter-dwelling invertebrates (Catterall et al. 2001) and ground-dwelling and arboreal mammals (Soderquist & Mac Nally 2000) were more abundant in riparian areas than upslope. In the mulga lands of south-western Queensland, the abundance and number of species of birds was higher in riparian than non-riparian areas (Kingston, Catterall & Kordas 2002).

As well as supporting disproportionately high species richness and abundance of many faunal groups, riparian areas are also critical habitat for many individual wildlife species. For example, Woinarski et al. (2000) listed 17 species of birds which were only found in riparian areas in an extensive survey of birds across the savanna of northern Australia, while Kingston et al. (2002) listed 16 species of birds in the mulga lands of south-western Queensland which were only found

Arboreal: living in trees.

in riparian sites. Williams (1993) found 31 species of birds, the water rat, five species of reptiles and 11 species of frogs which were only recorded in riparian areas in savanna woodlands west of Townsville in North Queensland. In the wetter eucalypt forests of eastern Australia, there are generally few species of birds and mammals which are found only in riparian areas, but for many species, abundances are much higher there (e.g. Bentley & Catterall 1997, Mac Nally, Soderquist & Tzaros 2000, Soderquist & Mac Nally 2000, Catterall et al. 2001, Palmer & Bennett 2005).

These differences occur because riparian land provides the habitat features needed by many terrestrial wildlife species. For some species this habitat is critical. Habitat components include food, water, shelter from predators and from harsh physical conditions, and safe sites for nesting and roosting. Some animals rely on such resources from the riparian zone for their entire lifetime, whereas others may only need them at particular times of the day, in certain seasons, or during specific life stages.

The extent to which these resources are available to the full range of riparian-dependent wildlife species within a region depends on the structure and composition of vegetation within the riparian zones. When a waterway bordered by native vegetation runs within cleared or more open land, this vegetated riparian zone provides the only suitable habitat for many species, and is also a potential corridor for their movements. Riparian areas which have been cleared or degraded by grazing or other human impacts have significantly lower habitat value than those supporting native vegetation. Throughout Australia, riparian lands are one of the most highly impacted, reduced and fragmented habitat types.

Range of riparian environments providing habitat for wildlife.

Photo Ian Dixon.

Photo Jenny O'Sullivan.

Photo Land & Water Australia.

Photo John Dowe.

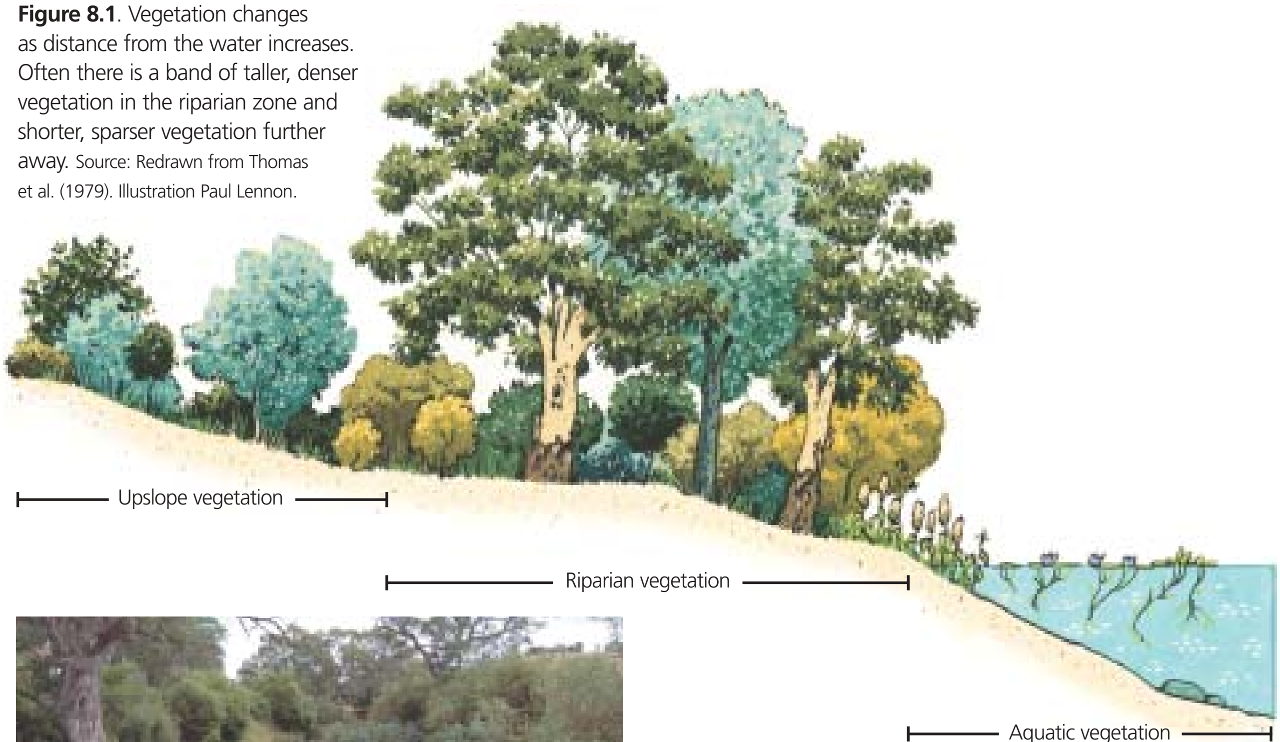
8.2 Habitat features of riparian lands

Vegetation structure and diversity

Riparian vegetation dynamics were discussed in detail in Chapter 2. A number of features of riparian vegetation are important for wildlife. Firstly, riparian vegetation is often taller, more dense, and structurally more complex in riparian lands than in upslope areas. Secondly, riparian lands are a zone of transition in plant communities from aquatic or semi-aquatic species adjacent to the waterway, through communities which are often specifically riparian in composition, to fully terrestrial species on higher ground (see Figure 8.1). Riparian vegetation communities are also spatially and temporally variable, due to the interacting effects of environmental gradients both along and across the riparian zone, as well as temporal changes due to the effects of flooding. For example, a survey of riparian vegetation of the Murray River identified three vegetation zones (an inner floodplain, an outer floodplain, and rises within the floodplain) with a total of 37 floristic communities (Margules et al. 1990). On the floodplain of Cooper Creek in inland Australia, Capon (2005) found that plant communities were structured according to flooding regimes, with less frequently flooded sites being very variable and quite different to frequently flooded sites. Flooding clearly created a diversity of vegetation communities across the floodplain. Heterogeneity in vegetation structure and plant communities provides a diversity of wildlife habitats.

Trees such as this one are 'living ecosystems' and vital for wildlife. Photo Jim Puckridge.

Figure 8.1. Vegetation changes as distance from the water increases. Often there is a band of taller, denser vegetation in the riparian zone and shorter, sparser vegetation further away. Source: Redrawn from Thomas et al. (1979). Illustration Paul Lennon.



Left: An example of vegetation zonation adjacent to a stream. Photo Roger Charlton.

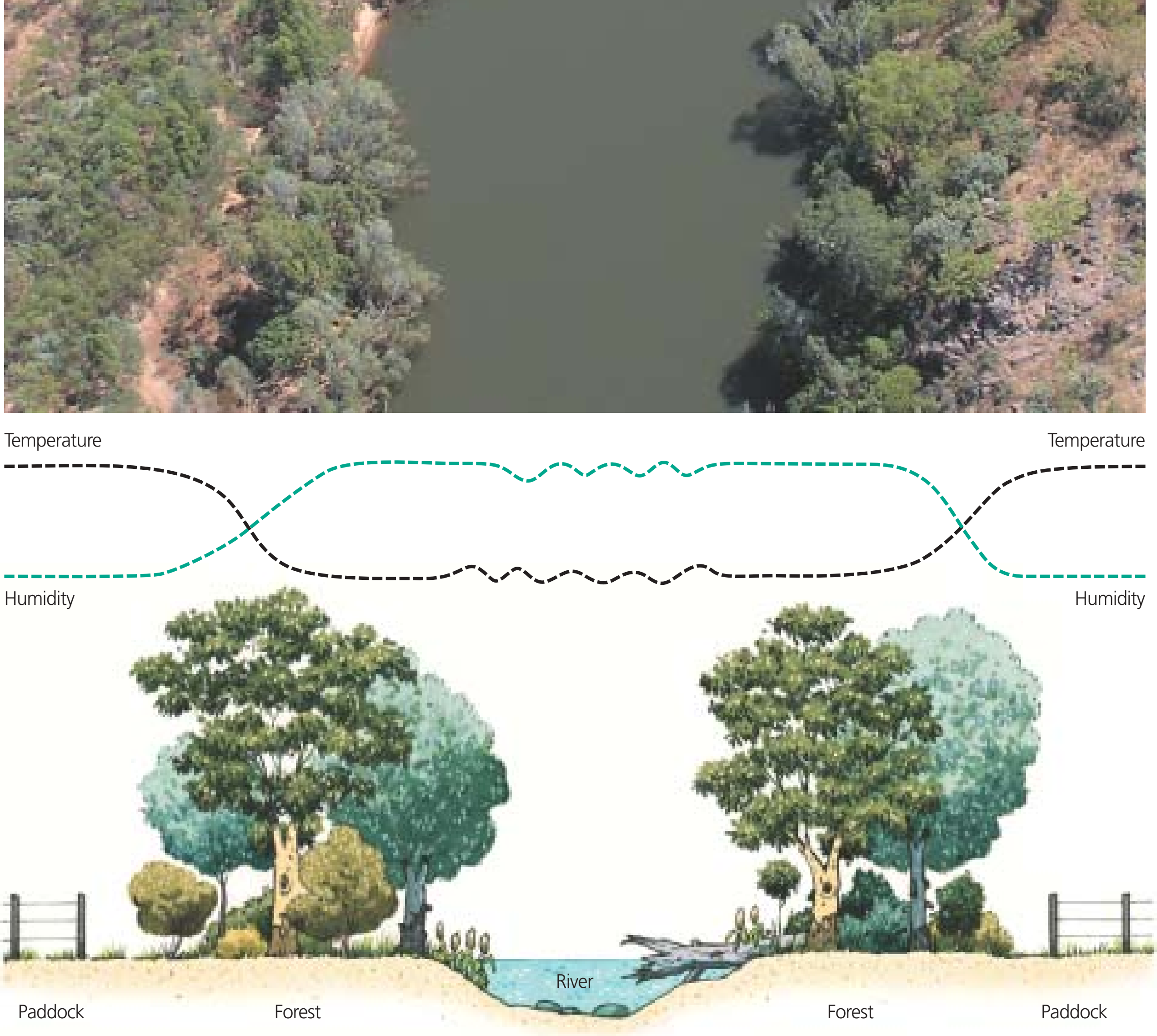


Figure 8.2. Riparian vegetation has a moderating effect on local microclimatic parameters such as air temperature and humidity. Source: Redrawn from Malanson (1993). Illustration Paul Lennon. Photo at top Ian Dixon.

Water and microclimate

Moisture is an important habitat feature of riparian lands, and occurs in a variety of forms: surface water in the channel and in wetlands; groundwater, including sub-surface flow when the channel appears dry; and soil moisture (Malanson 1993). Water is directly important to a large proportion of riparian wildlife both as drinking water (particularly important in arid and seasonally dry environments), and as habitat for larval stages of semi-aquatic organisms such as frogs and dragonflies. When wetlands in riparian lands in the arid zone of Australia fill with floodwaters from the Cooper Basin, they provide habitat for large numbers of waterbirds which move in from other regions (Roshier, Robertson & Kingsford 2002). Wetlands can also be a focus for the activity of terrestrial birds, with sites containing wetlands supporting more species and higher abundances of birds than non-wetland sites within a floodplain woodland (Parkinson, Mac Nally & Quinn 2002).

The water available in riparian areas is also indirectly important to riparian fauna, because it supports the special vegetation communities which provide them with food, refuge and breeding sites. Riparian vegetation reduces the impact of wind and lowers solar radiation reaching understorey vegetation and the forest floor. Together with evaporation from surface water and evapotranspiration by plants, this creates a local microhabitat with less extreme temperatures and more humid conditions than adjacent areas (Malanson 1993, see also Figure 8.2). As a result, riparian habitats are the only part of the landscape that can support some species which are sensitive to desiccation, and may be used as retreats by other species when conditions elsewhere are unfavourable (too hot, too cold or too dry).

The width of a band of riparian vegetation is a major determinant of the extent to which it will moderate the local microclimate. The effect of forest on microclimatic parameters increases with distance from the edge (Saunders, Hobbs & Margules 1995). In North American forests, soil moisture reaches a maximum at a distance from the edge of about half the height of the tallest trees; incoming radiation and soil temperature levels stabilise where the riparian forest width is about equal to the height of the tallest trees; and air

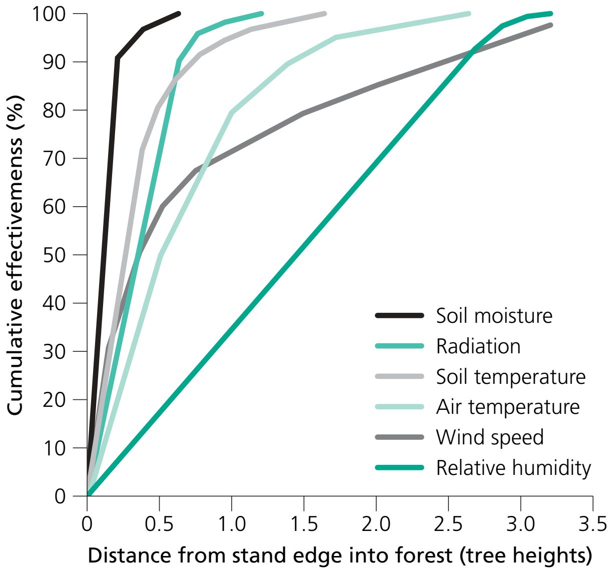


Figure 8.3. These generalised curves indicate the distance from the edge of a forest at which the effect on microclimate attributes is maximised. Source: Redrawn from Collier et al. (1993).

Right: Comb-crested jacana. Photo Ian Dixon.

temperature, wind speed and relative humidity stabilise where the forest width is two to three times the tallest tree heights (Collier et al. 1995, see also Figure 8.3). A study of the effects of riparian buffers in the north-western USA recommended a 45 metre buffer adjacent to small streams to maintain a natural riparian microclimate (Brosofske et al. 1997).

Food and productivity

Riparian lands are among the most productive ecosystems on earth (Croonquist & Brooks 1991). The high primary productivity of riparian lands is the result of a greater availability of water and the presence of soils which are richer in nutrients than those further upslope. Riparian soils receive nutrients from both the land and water: by surface runoff from upslope areas after rain and by deposition along stream banks during floods (Cummins 1993).

High primary production leads to a larger and more reliable supply of plant products such as leaf litter (Malanson 1993). Riparian vegetation may also contain a greater number or greater diversity of flowering and fruit-bearing plants, or these plants may flower or fruit more consistently as a result of the availability of water and nutrients. This productivity creates conditions that promote higher abundances of terrestrial invertebrates which, in turn, are food for riparian insectivores. This means there are food resources present for a wide range of animal feeding groups.

The stream environment also contributes to the diversity and abundance of food resources available in the riparian zone. The nutrient and energy dynamics of riparian ecosystems are linked with cycles in both adjoining aquatic ecosystems and the wider landscape. Transfer of nutrients and energy from in-stream to terrestrial habitats can occur in a number of ways, although little specific research has been done in this area. Aquatic organisms may be eaten by semi-aquatic predators such as kingfishers and water rats, resulting in a transfer of nutrients to terrestrial soils in these animals' dung and urine. Water birds that prey on aquatic invertebrates and fish may, similarly, be vectors for substantial nutrient movements from lowland floodplain rivers to their fringing riparian habitats.

Many 'aquatic' insects have adult stages that emerge from the stream and move into adjacent riparian or terrestrial habitats. The abundance and biomass of these adult aquatic insects is highest close to the water in riparian habitats, and declines with distance from the edge of the water (Lynch, Bunn & Catterall 2002). These aquatic insects may die and enter the riparian detritivore food web or fall prey to riparian insectivores, thus moving aquatic nutrients and energy into riparian food webs. Terrestrial species that forage in riparian habitats may in turn move nutrients and energy into adjacent non-riparian habitats. In this way, the productivity of the riparian zone may be important in supporting a wider area.

Nest and retreat sites

Riparian vegetation may provide a greater variety of perches, roosts, rest sites and nest sites, or these may be of a better quality than those available in adjacent habitats (that is, they may offer greater protection from predation or climatic extremes). For example, flying foxes in the Northern Territory preferentially roost in riparian forests in the dry season, when these areas are likely to provide the coolest, dampest microhabitats (Palmer & Woinarski 1999). Large riparian trees are a source of nest hollows for birds, bats and arboreal mammals. The density and structural complexity of riparian forest also provides numerous protected perch, nest and roost sites for mobile species which feed in surrounding habitats. For example, riparian habitats are very important for nesting of the threatened Regent Honeyeater in New South Wales, even though these birds range over large areas to find flowering trees for foraging (Geering & French 1998, Oliver, Ley & Williams 1998).

Leaf litter, fallen timber and flood debris accumulated in the riparian zone provide foraging sites and retreats for invertebrates, small mammals, reptiles and amphibians. On the floodplain of the Murray River, experimental accumulations of dead wood provided new foraging habitat for birds such as brown treecreepers (Mac Nally, Horrocks & Pettifera 2002) and yellow-footed antechinus (Mac Nally & Horrocks 2002). Riparian soils are often more loose and friable than those of adjacent upland habitats and, therefore, provide ideal conditions for burrowing and nesting by ground-dwelling fauna, ranging from insects to mammals.

Above: Crimson rosella. Photo Andrew Tatnell.
Photo (below) CSIRO Sustainable Ecosystems.

8.3 Modes of use of riparian lands by wildlife

Riparian lands support both fully terrestrial wildlife and some aquatic organisms during particular stages in their life cycles. Three broad groups of riparian fauna can be recognised: riparian-dependent aquatic species; riparian specialists; and riparian-dependent terrestrial species. A given species' riparian-dependence may vary among bioregions. For example, a study in the mulga lands of south-western Queensland found that the pied currawong was entirely restricted to riparian areas (Kingston, Catterall & Kordas 2002), whereas in coastal regions this bird commonly occurs in upslope areas.

Many different types of wildlife are found in riparian lands. Ecological groupings include soil fauna, litter fauna, ground-surface dwellers, bark and foliage dwellers, and aerial species. The most prominent and best known groups are the insects and vertebrates.

Detritivore: animal that feeds on dead plant or animal matter, e.g. leaf litter, woody debris, dead grass, dead insects.

Within each of these groups there are many species, which differ in their lifestyle, life-history, and ecological roles. Some will be tolerant of changes and degradation in riparian vegetation, but many will not. The latter will depend in various ways on the continued existence of adequate native vegetation cover on riparian land.

Riparian-dependent aquatic fauna

Many fully aquatic organisms are dependent in various ways on stream banks and riparian habitat. Fish and turtles within the stream often depend on riparian inputs (such as fruit and insects) for food, and riparian plant material (such as fallen submerged logs and branches) for shelter. Animals such as crocodiles, turtles and platypus feed in the water but use stream banks and riparian lands for resting, moving and nesting. Many insects and frogs are aquatic for part of their life cycle, and may be riparian-dependent for the remainder.

Water in the stream and riparian wetlands provide habitat for the larvae of many 'aquatic' insects. The adult stages of these insects are often particularly dependent on riparian vegetation, which influences the quality of their aquatic larval habitat and provides resources and shelter for adults. Natural stream-side vegetation may be important to such taxa during pupation, emergence, reproduction and egg-laying (Erman 1981). For example, alderflies and dobsonflies, *Megaloptera*, lay their eggs close to the water, often on overhanging vegetation. When the eggs hatch, the larvae fall or crawl into the water. The larvae of many aquatic insects leave the water to pupate in soil, moss and leaf litter or around stumps and logs on riparian land. Some aquatic insects, such as mayflies, shelter on stream-side vegetation immediately after emerging from an aquatic pupal stage. Adults of some aquatic insects, such as caddisflies and male mosquitoes, cannot feed on solid food, and nectar from riparian plants may be an important source of energy for these species.

Examples of animals dependent on visiting riparian land. Photos: (top) Ian Dixon, (middle) Peter Davies, (bottom) Michael Douglas.

The larval (tadpole) stages of most frog species are aquatic and, though the adults may not always live in riparian habitats, some species congregate in these areas to mate and lay their eggs. On the floodplain of the Murrumbidgee River in New South Wales, several frog species are strongly associated with wetlands, and more species and individuals are found at wetlands with better quality fringing and aquatic vegetation (Jansen & Healey 2003).

Top: Platypus. Photo Andrew Tatnell. Above: Water monitor. Photo Ian Dixon.

Riparian specialists

Riparian specialists require specific riparian conditions throughout their life-cycles (Collier 1994). These species may be either terrestrial or semi-aquatic. Some regularly use both aquatic and riparian habitats. For example, the water rat (a semi-aquatic riparian specialist) forages in the water for large aquatic insects, crustaceans, freshwater mussels, fish and frogs and also along stream banks for terrestrial insects (Woollard et al. 1978). Other mammals which are riparian specialists include *Rattus lutreolus* and *R. colletti*. *Eulamprus quoyii*, a small riparian skink found in eastern Australia, is primarily terrestrial and usually forages along the banks of streams but may also capture surface-swimming aquatic prey such as damselfly nymphs, water beetles and tadpoles (Cogger 1992). Several semi-aquatic reptiles are also riparian specialists, exploiting both terrestrial and aquatic food resources. These include two water monitors, *Varanus mertensi* and *V. mitchelli*, the water dragon and the water python (e.g. Shine 1986). Some frogs are also riparian specialists; for example, three terrestrial frogs of the genus *Geocrinia* are restricted to small strips of riparian habitat in south-western Australia (Wardell-Johnson & Roberts 1991).

Little is known about the dependence of terrestrial insect species upon riparian lands. However, many taxa are associated with terrestrial habitats bordering waterways. For example, about one-quarter of all Australian carabid beetle species occur on the edges of waterways or waterbodies (CSIRO 1991). Some groups of insects are associated with mud and moist or decaying vegetation at the margins of waterbodies. For example, limnichid beetle larvae and heterocerid beetles burrow in mud or sand on the margins of ponds and streams where they feed on organic matter (CSIRO 1991). Toad-bugs (*Hemiptera: Gelastocoridae*) are found at the edges of creeks and waterholes where they prey on small invertebrates that venture near the water's edge (Williams 1980). Many groups of flies have some species which require damp sand, mud or rotting vegetation as larval habitat (CSIRO 1991) and in drier regions these conditions exist mainly in riparian and floodplain areas. Adults are frequently found in vegetation bordering waterways.

Australia has many examples of birds that are riparian specialists. For example, bitterns hide in dense riparian vegetation by day and forage at night for aquatic prey. The azure and little kingfishers are riparian specialists that favour well-vegetated creeks and streams. A survey across savanna landscapes in the Northern Territory identified 17 species of birds only found in riparian habitats; these included seven aquatic and fish-eating species, a raptor and an owl, two species of honeyeaters, and six insectivorous species (Woinarski et al. 2000). In box-ironbark forests in southern Australia, a survey identified seven species of birds which were only found in riparian habitat (Mac Nally, Soderquist & Tzaros 2000).

Riparian-dependent terrestrial fauna

Many mobile animals inhabit riparian land during a part of their lifetime, while spending the rest of their lives elsewhere in the landscape (Catterall 1993). Some of these species depend on access to riparian areas, whereas others may benefit from the riparian habitat but still persist without it. Terrestrial animals may travel to riparian lands on a daily basis (for activities such as drinking, feeding and roosting), on a seasonal basis (for activities such as foraging or breeding), or during a particular stage of the life cycle (such as when they are juveniles). For example, in the arid zone, ground-feeding granivores such as pigeons, finches and parrots, fly to waterholes on a daily basis to drink, especially during hot weather. Kangaroos and wallabies often retreat to the denser shady cover of riparian vegetation in the heat of the day. Rufous and powerful owls (genus *Ninox*) roost during the day in riparian forest, although they forage widely for small mammals at night in eucalypt forest and woodland. In eastern Australia, the regent parrot nests only in large hollows found in mature, senescent or dead river red gums within 60 metres of a waterway or waterbody (Burbidge 1985), while in the Riverina, superb parrots also only nest in river red gums adjacent to water (Blakers, Davies & Reilly 1984). Insectivorous bats visit riparian areas to drink and feed, but spend much of their time elsewhere in the landscape (Strahan 1983).

Many terrestrial herbivorous insects are likely to be associated with plant species that occur primarily in riparian habitats, though few Australian examples have been documented. The role of riparian forests in the conservation of butterflies has been recognised overseas (Galliano et al. 1985). In Australia the Richmond birdwing butterfly, once widespread in subtropical lowland rainforest, now occurs mainly in riparian remnants as a consequence of clearing other habitats.

In many drier environments, riparian areas may also provide 'refuge habitat' during dry seasons, drought, or after fire. Narrow bands of river red gum along watercourses are significant habitat for koalas in drier parts of their range, especially during drought (Gordon et al. 1988). In the wet–dry tropics, riparian rainforest vegetation may be an important source of dry-season food and shelter for amphibian species which are found mainly in eucalypt forest and woodland during the wet season (Martin & Freeland 1988). Also during the dry season in the wet-dry tropics, brown honeyeaters move from eucalypt woodlands into riparian forests as paperbarks begin to flower (Morton & Brennan 1991), and fruit bats tend to shift their roosting sites into riparian forests, while during other seasons they roost more frequently in non-riparian rainforest (Palmer & Woinarski, 1999).

Granivore: animal that feeds on seeds.
Senescent: old trees with some dead limbs.

Yellow-bellied sheathtail bat. Photo Angus Emmott.

Many species that occur in riparian habitats may also be found in a range of other habitats. These species are not dependent on riparian lands, but may occur in higher abundances there because of the concentration of resources. For example, the crucifix toad *Notaden bennetti*, a burrowing frog of inland eastern Australia, is found in savanna woodland and mallee areas, but is especially abundant on the black soil flood plains of the large river systems throughout its range (Cogger 1992). Reptiles that are commonly found in riparian zones, but also occur in other habitats, include six species of *Eulamprus* skinks and the semi-arboreal *Lophognathus* dragon lizards (Cogger 1992). Bird species that are common in riparian areas but that also occur (although often at lower density) in a wide range of habitats include many honeyeaters, fairy wrens, flycatchers and others (see Bentley & Catterall 1997, Loyn 1985, Recher et al. 1991). Many other studies have shown higher abundances of wildlife species in riparian than non-riparian areas: frogs, reptiles and mammals (Williams 1993); leaf litter invertebrates (Catterall et al. 2001); and birds (Williams 1993, Bentley & Catterall 1997, Mac Nally, Soderquist & Tzaros 2000, Woinarski et al. 2000, Catterall et al. 2001, Kingston, Catterall & Kordas 2002, Palmer & Bennett 2005).

8.4 Riparian lands as habitat corridors

Animals move for a variety of reasons and over a range of time scales and distances, in order to use resources that are patchily distributed, exploit different seasonal environments, accommodate different life stages, and colonise new areas (Harris & Scheck 1991, Merriam & Catterall 1991). Small isolated populations are at risk of local extinction as a result of unpredictable events such as fires or drought. Movement and recolonisation can be aided by a network of riparian corridors across the landscape. There are two main situations in which riparian lands may function as movement corridors: first, as a distinctive habitat network in uncleared landscapes; second, as connections among the remnant forest patches in cleared landscapes.

Riparian corridors in uncleared landscapes

In drier areas of the continent, where riparian vegetation forms both a discrete habitat which differs greatly from that of surrounding habitats and an extensive natural network across the landscape, fauna may use riparian lands as movement corridors. For instance, in the semi-arid Riverina in south-eastern Australia, riparian forests along the Murray and Murrumbidgee Rivers provide corridors for colonisation by many species characteristic of higher rainfall areas to the east, such as the feathertail glider, the frog *Crinia signifera* (Robertson et al. 1989), the white-browed scrubwren and white-throated treecreeper (Jansen & Robertson 2001b). In tropical savanna landscapes in the Northern Territory, birds typical of wetter forests extend their distributions into drier areas only along riparian corridors (Woinarski et al. 2000).

Riparian corridors in cleared landscapes

Most terrestrial wildlife species show preferences for particular types of habitat, and many show a strong aversion to areas cleared of native vegetation, such as agricultural and urban landscapes. In many parts of Australia the formerly continuous forest cover has been cleared and converted to pasture, cropland or urban development, leaving only remnants of native forest. The conservation of many species of forest-dependent wildlife may rely on linking remnants into networks by means of habitat corridors (Merriam & Saunders 1993, Saunders et al. 1995, Saunders & de Rebeira 1991).

In cleared landscapes, the retention of continuous bands of riparian vegetation provides primary habitat for riparian specialists and other species, as well as corridors for wildlife to move between patches of remnant vegetation (Figure 8.4). Studies in fragmented landscapes of southern and northern Queensland, and central NSW, have shown that forest-dependent birds and mammals use riparian corridor remnants as habitat even if these are isolated from other forest patches (Crome, Isaacs & Moore 1994, Bentley & Catterall 1997, Fisher & Goldney 1997).

Riparian areas are ideally suited to form the basis of linked wildlife habitat networks because they: form a hierarchy of natural corridors throughout the landscape; are used by most forest-dependent species; and also act as buffers to protect water quality and aquatic ecosystems (Naiman & Decamps 1997). Riparian corridor connections should help to sustain wildlife populations in remnant forest patches by allowing movement between patches, while also increasing wildlife diversity within the riparian areas since, without connections to larger remnants, the riparian corridors themselves are small, narrow habitat fragments.

In the drier areas of Australia riparian corridors are vital for wildlife. Photo Michael Douglas.

The remaining riparian corridor is clearly visible in this agricultural landscape. Photo CSIRO Sustainable Ecosystems.

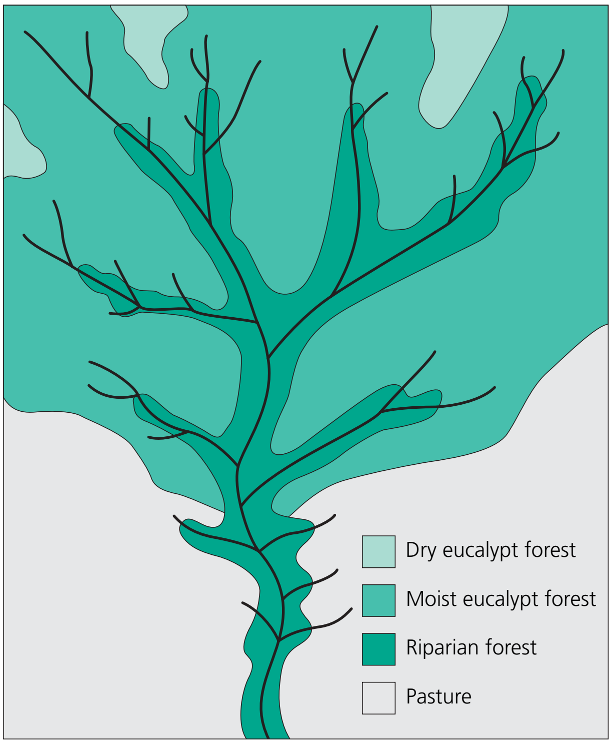


Figure 8.4. Riparian vegetation can provide a distinct habitat network in undisturbed landscapes and potential movement corridors within human-modified landscapes. Source: Adapted from Thomas et al. (1979).

This landholder has set the fence back from the river to restore a riparian area that will not only stabilise the streambed but provide valuable habitat for a range of different organisms. Photo Michael Askey-Doran.

Corridor width

Within both cleared and uncleared landscapes, the width of natural riparian vegetation needed for either primary habitat or movement depends on the wildlife species concerned and the habitat type and landscape. Some smaller animals may require only a narrow band of natural habitat, perhaps no more than 10 metres wide. Larger species generally forage over larger areas and will often require wider corridors. Unfortunately, little hard data exist regarding exactly how wide a corridor needs to be in any given situation (Saunders & de Rebeira 1991). A study in the eastern United States found that minimum corridor widths varied with the stream and with the species of bird or mammal in question, making definition of a single minimum width for riparian corridors meaningless (Spackman & Hughes 1995). The values to wildlife of narrow corridors of riparian forest within cleared lands are likely to be degraded by edge effects, including altered microclimate, invasion by weeds, and altered interactions among species (Saunders & de Rebeira 1991, Saunders, Hobbs & Margules 1995, Wilson & Lindenmayer 1995).

In many landscapes, natural riparian corridors may not be very wide; in forested catchments small low order streams have a narrower zone of influence than larger watercourses. In landscapes where much of the former vegetation cover has been cleared, the width of riparian vegetation is likely to be an important determinant of the corridor's effectiveness for different taxa, and riparian corridors would often need to be wider than the riparian zone itself. Edge effects may reduce the habitat value of narrow corridors, but even narrow strips of riparian vegetation will be useful to some species.

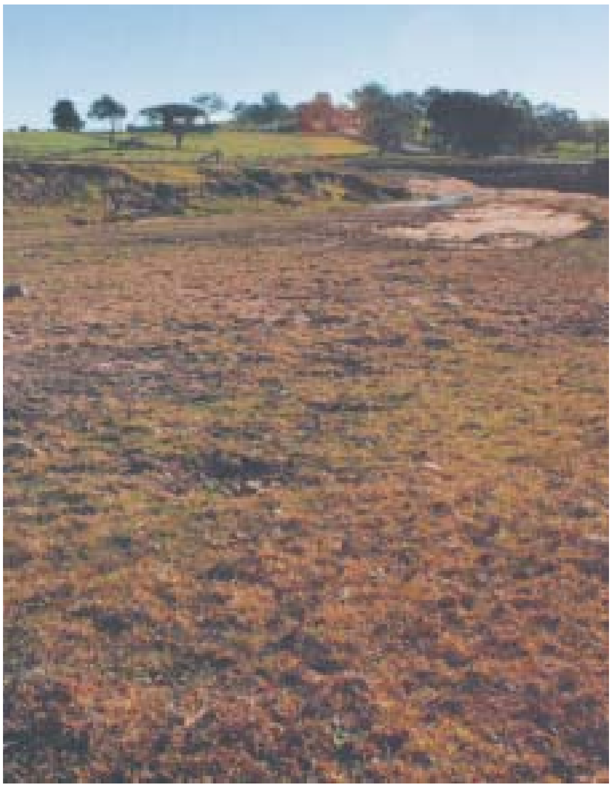
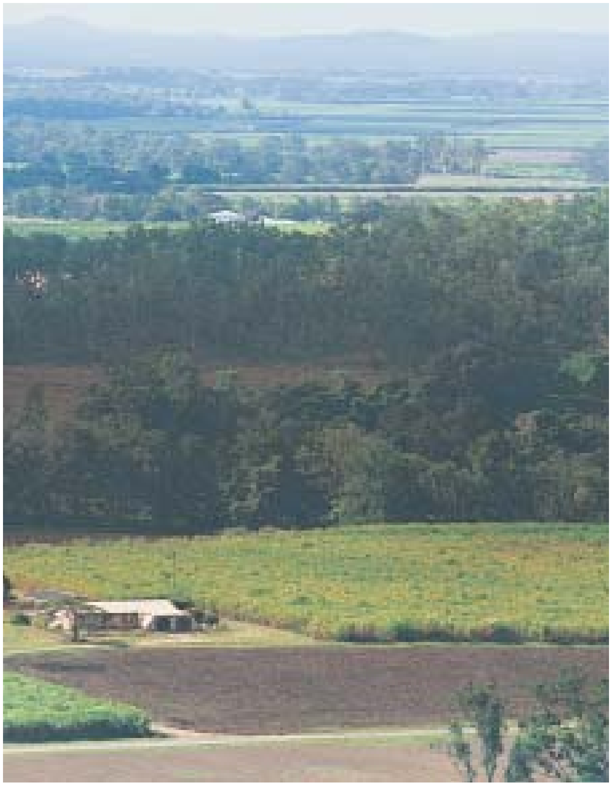
8.5 Influences of habitat degradation on riparian wildlife

Degradation of riparian lands can occur through removal and fragmentation of native vegetation, or through the removal of particular components of the vegetation cover (usually the understorey, involving removal of shrubs, woody debris and native ground cover). Riparian land degradation is widespread in Australia, and has mostly been caused by either clearing for agriculture or impacts on the understorey resulting from domestic livestock grazing (Wilson 1990, Walker 1993). Changes to the frequency of fire, and invasion by exotic weeds and feral animals, are frequently a part of the degradation syndrome. These factors interact with grazing, clearing, and understorey changes in ways that may be complex, and poorly understood.

Riparian specialist species will be particularly sensitive to such degradation of riparian areas, and protection of riparian habitats is a priority for their conservation (see Geier & Best 1980, Pearce et al. 1994, Wardell-Johnson & Roberts 1991). Degradation of riparian habitats is also likely to have a major impact on many riparian-dependent aquatic species, which rely directly or indirectly on the vegetation as a food supply or as habitat, and on mobile terrestrial fauna which depend on access to riparian lands on a daily, seasonal or life-history basis. Additionally, population reductions are likely to occur in species which, although able to survive without access to riparian lands, are typically most common there.

Clearing of native woody riparian vegetation will result in the replacement of a diverse wildlife community composed of species that are typically found in riparian forest or woodland by a different, often less diverse, set of widespread "open-country species", which are typically common in pasture or cropland. Furthermore, small patches and narrow strips of remnant riparian vegetation are likely to experience similar trends; some woodland or riparian species will persist in these remnants, but others will be lost, and replaced by open-country species. For birds, this phenomenon has been described from a variety of bio-regions (Crome, Isaacs & Moore 1994, Bentley & Catterall 1997, Fisher & Goldney 1997, Jansen & Robertson 2001b).

Studies in uncleared savanna and grassy eucalypt woodlands in eastern Australia have linked livestock grazing to declines or disappearances in riparian wildlife, including species of ants and spiders (Woinarski et al. 2002), frogs (Jansen & Healey 2003), reptiles and mammals (Woinarski & Ash 2002) and birds (Jansen & Robertson 2001b, Woinarski & Ash 2002, Martin & Possingham 2005). In most of these studies, the changes in wildlife were related to changes in vegetation structure caused by grazing. At least in the case of birds, loss of woodland and riparian specialist species such as the brown treecreeper, eastern yellow robin, and speckled warbler are typically accompanied by their replacement with common pasture birds such as the Australian magpie and crested pigeon (e.g. Jansen & Robertson 2001b, Martin & Possingham 2005). The loss of large woody debris from the floodplain of the Murray River has been associated with declines in numbers and diversity of ground-dwelling mammals and birds (Mac Nally et al. 2001). On the floodplain of the Murrumbidgee River, studies of ants found that seed predators became more common in heavily grazed sites (Meeson, Robertson & Jansen 2002). This in turn may cause further degradation in future years, because the seed predators consume river red gum seeds, which cannot then germinate and grow to replace aging trees.

Contrasting riparian areas where one has been degraded and cleared and the other has been retained as a buffer and habitat for wildlife.
Photos: (left) Siwan Lovett, (right) Canegrowers.

8.6 Restoration of riparian vegetation and wildlife

Works aimed at restoring riparian vegetation in areas grazed by livestock generally involve fencing to remove or control stock access. In areas which have been cleared for pasture or agriculture, it is also necessary to replace the lost riparian vegetation. This has been most commonly attempted by planting seeds or seedlings of locally-occurring trees, shrubs and grasses, and frequently also involves the removal and on-going control of weeds. Fenced-off areas of cleared land may also be allowed to regenerate naturally, although weeds may dominate the initial regrowth. Because mature vegetation develops slowly, other habitat elements, such as large woody materials, have sometimes been added.

There have been few studies of the effects of riparian restoration on wildlife, and most have been conducted over relatively short time frames, when compared with the time necessary to re-establish the large trees and associated habitats typical of riparian lands. However, replanting of cleared riparian lands can produce rapid improvements in wildlife communities. In the wet tropics of north Queensland, where plants grow rapidly, rainforest and riparian birds began to use a replanted and fenced riparian corridor within three years (Jansen, 2005). A survey of a large number of differently restored rainforest sites (both riparian and upslope) in the Australian tropics and sub-tropics concluded that reforestation can lead to moderate colonisation by rainforest wildlife within 5–10 years (Catterall et al. 2004), although many factors will affect its extent, including the density and diversity of plantings and the presence of other forest nearby (Kanowski, Catterall & Wardell-Johnson 2005). Restoration of rainforest along waterways in north Queensland cane fields has been shown to benefit not only riparian wildlife but also the cane farmers, since replacement of tall weedy riparian grasses with forest vegetation leads to a significant decline in numbers of rats which damage sugar cane (Anonymous, undated).

In the upper Murrumbidgee catchment, fencing of remnant riparian vegetation influenced bird community composition and the abundances of indicator species such as superb fairy-wrens and brown treecreepers, with shifts towards more grazing-sensitive species and fewer grazing-tolerant species as time since fencing increased from 1–5 years to greater than 10 years (Thompson, Jansen & Robertson 2002). The area fenced was also important to some species, for example brown treecreepers only used fenced patches larger than 4 hectares.

Top: Natural regeneration once stock are removed. Above: Assisted planting following willow removal. Below: Brown treecreeper. Photos: (top to bottom) CSIRO Sustainable Ecosystems, Lizzie Pope, Andrew Tatnell.

Photo Peter Walton Photography.

Although many wildlife species show rapid responses to restoration, some will be much slower, because they depend on particular microhabitats that may take centuries to develop fully, such as tree hollows and dead wood, or require certain plant species or certain forms of local vegetation structure. For example, in the wet tropics, corridors of secondary-growth riparian rainforest, several decades after regeneration began, had around half the number of regionally-endemic bird species (of high conservation value) as similarly-sized corridors of intact riparian rainforest (Hausmann 2004). Adding the missing habitat elements can help some species establish more rapidly. For example, studies on the floodplain of the Murray River have found that replacing large woody debris resulted in increased abundances of *Antechinus* and brown treecreepers (Mac Nally & Horrocks 2002, Mac Nally, Horrocks & Pettifera 2002).

Weeds and feral or pest animals are an on-going issue in the restoration of riparian lands in a number of respects. Fencing to exclude livestock can often result in the growth of many weeds (e.g. Jansen & Robertson 2001a). This creates a management dilemma: weeds are typically considered undesirable, and the control of some, such as lantana and blackberries, may be required by law in particular regions. But this weedy regrowth can provide good habitat for riparian wildlife, especially in the absence of native shrubs (e.g. Crome, Isaacs & Moore 1994, Jansen & Robertson 2001b). Therefore, weed removal in some circumstances may lead to declines in riparian wildlife. Solving such dilemmas, and finding the best methods for cost-effective restoration of wildlife habitat, requires more real-world experimentation with different forms of restoration and management, coupled with scientifically-designed monitoring programs which can evaluate and compare their outcomes.

Current research

Although riparian lands are clearly very important to wildlife, and some research has been carried out in the last few years in Australia, there is little current research. A PhD on birds has recently been completed and is being written up for publication which examines responses of birds to grazing in riparian (and non-riparian) lands in south-eastern Queensland. This study has looked at both the effects of habitat degradation within riparian sites, and also the landscape context of sites: increasing intensity of land use surrounding riparian lands can also influence the birds found there. A PhD project in western Queensland has investigated the importance of riparian vegetation and water availability to the regional avifaunas of the mulga lands. Work in the Murray-Darling Basin is examining responses of ants to changed grazing regimes in river red gum forests, using an experimental approach with grazing exclusion plots and different seasonal grazing regimes. The aim of this work is to determine grazing management practices suitable for use in state forests to maintain biodiversity values. Experimental work on the effects of replacement of large woody debris on the Murray floodplain is also on-going, examining effects on invertebrates, birds and mammals.

White-breasted woodswallows. Photo Angus Emmott.

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