



## Riparian Planting for Aquatic and Terrestrial Biodiversity

### The Past

In pre-human times the water of most of New Zealand's streams, rivers, lakes and wetlands passed through forest for a substantial part of its journey to the sea. In lowland areas the riparian zones alongside streams were typically covered by luxuriant and diverse forest that extended from the water's edge and merged with lowland forest at the edge of the floodplains.

Most of our streams had low sediment, nutrient and pathogen base loads and were heavily (over 90%) shaded. They generally had stony bottoms and wide meandering channels. The indigenous plant and animal life within the streams was specifically adapted to high shade, low water temperatures, and a diversity of organic matter delivered to it by the surrounding vegetation.

The zones alongside the streams were fertile and sheltered, and water was readily available. Consequently a diversity of tree and shrub life grew in these zones and growth rates were comparatively fast because of the favourable conditions. Riparian zones were favoured habitat and provided dispersal corridors for native birds, reptiles, amphibians and invertebrates because of the diversity of plant and animal life and abundance of food and water.

### The Present

Today, the picture is very different. Our lowland forest now consists of fragments scattered across the landscape and separated by large tracts of land hostile to many native plant and animal species. Dispersal from patch to patch is difficult for most species and impossible for many. While some of our streams may rise in native bush many pass unshaded through pastureland to the sea, with the water temperature reaching well above 20 degrees Celsius in mid summer. This makes them unsuitable as habitat for most of our native fish species and many native stream invertebrates. Stream bottoms are typically muddy and the channel narrow, steep-banked and weed filled.

Despite their modified state, waterways and their riparian margins can be restored to greater native form and function. They can once again, become important habitat and dispersal corridors for aquatic and terrestrial animals and plants allowing movement between remnant bush patches, and for migratory fish to complete their life cycles. A review of the effectiveness of riparian buffer zones is given in Parkyn (2004) and Parkyn et al. (2003).

# RESTORING AQUATIC BIODIVERSITY

## Shade

The re-establishment of effective shade is one of the most important steps to restoring healthy habitat for indigenous aquatic invertebrates and fish. Shade levels of 70% or better, when created by trees and shrubs, will:

- restrict the growth of aquatic plants and algae even if the water contains moderately high nutrient levels;
- lower peak summer water temperature to levels that can be tolerated by sensitive stream invertebrates and native fish if the shaded portion of the stream is long enough; and
- provide an important source of food and energy (organic carbon) to aquatic animal life.

A good measure of how much shade is needed is the amount required to keep mid-summer water temperatures to 20° C or lower. This is likely to be sufficient to protect sensitive invertebrate species such as stoneflies and mayflies (Collier et al. 1995) and provide more tolerable conditions for native fish. In narrow headland streams shade provided by stream banks and overhanging bank sedges may be sufficient to keep water temperatures low, but taller shade vegetation is necessary to lower water temperature in larger streams. Greater reward for effort and cost will be achieved by cooling upstream reaches of streams rather than attempting to cool a warm downstream reach.

## Sediment

Low sediment concentrations in stream water is important if habitat suitable for many of our native fish and invertebrates is to be created. In catchments prone to soil erosion very effective grass/sedge filters will need to be established (refer to Technical Article 9.2 in this Handbook) and the retention of streambank grasses and sedges may be necessary.

With time, species composition along riparian areas will change especially where increasing shade from overtopping trees and shrubs occurs. Ground covers of light-demanding grasses, sedges and rushes are likely to be replaced by shade-tolerant species such as ferns.

Shading of 70 % or more is likely to eliminate the sedges and grasses growing on the streambanks which in turn may lead to an increase in sediment generation as the banks erode. Ultimately the banks will revert to a more stable shape but if keeping sediment levels low is a primary objective for stream restoration then the amount of shade created may need to be reduced to around 50% to sustain sedges and grasses on the stream banks.

## Plant species selection

Riparian vegetation is an important source of food and energy for aquatic fish and invertebrates. A variety of plants of different species, sizes, and forms and with different leaf shapes should be planted alongside streams to support a diversity of in-stream fauna.

Included in the variety should be (Ministry for the Environment (2000):

- a mixture of species with soft leaves, e.g., wineberry (*Aristotelia serrata*), tree fuchsia (*Fuchsia excorticata*), koromiko (*Hebe stricta*), mahoe (*Melicytus ramiflorus*) and pate (*Schefflera digitata*), that break down rapidly, and hard leaves, e.g., titoki (*Alectryon excelsus*), karamu (*Coprosma robusta*), lemonwood (*Pittosporum eugenioides*), kohuhu (*Pittosporum tenuifolium*), five finger (*Pseudopanax arboreus*) and kamahi (*Weinmannia racemosa*), that break down over longer periods;
- a mixture of species with larger leaves, e.g., wineberry, karamu, tree ferns, five finger and pate, that will stay resident in a section of stream for longer, and small leaves e.g. koromiko, red matipo (*Myrsine australis*), and kohuhu, that are more inclined to be carried downstream in the current;
- a selection of shorter-lived species, e.g., wineberry, karamu, koromiko and kohuhu, that are more likely to supply important and rapid sources of woody debris to the streams; and
- trees and shrubs with a weeping habit over stream edges, e.g., toetoe (*Cortaderia* species), *Carex* species, flax (*Phormium tenax*), kowhai (*Sophora* spp.), native brooms (*Carmichaelia* spp.) and tree ferns, to supply a variety of terrestrial insects and other invertebrates for fish to feed on.



The banded kokopu (*Galaxias fasciatus*) is one of several native fish.

Photo: Brenda Baille, Scion





## RESTORING TERRESTRIAL RIPARIAN HABITAT

The ecological value of a restored patch of indigenous riparian habitat is likely to be enhanced where:

- the riparian bush area is continuous and as wide and long as possible;
- the impact of edge effect is reduced;
- the restored patch is close to other established areas of bush;
- the planting is diverse in terms of species composition and plant form; and
- weeds and animal pests can be controlled.



### Width and length of riparian planting zone

Natural riparian zones typically extend from the stream edge, across the floodplain to the base of the hills, and in steeper catchments part way up the slopes. The productive value of stream margins and flood plains from a farming perspective makes the restoration of the full riparian zone to native trees and shrubs impractical and unaffordable. However, the wider the zone restored to natives the greater its value is likely to be for native terrestrial flora and fauna.

Longer, continuous patches of bush provide safer habitat and passage for more native invertebrates (and possibly reptiles too) than do patches separated by non-native vegetation.

### Impact of edge effects

Research has shown that there are significant differences in microclimate extending at least 20 metres into an area of bush from the bush edge compared to forest interior (Norton 2002). This is termed “edge effect”. Wind speed, temperature and humidity fluctuate more widely close to the bush edge with the result that the conditions in this edge environment are unsuitable for the natural establishment and growth of some forest interior species. Consequently, unless the restored riparian margin can be made 40 metres wide or more (which in most cases will be impractical) then the impact of edge will have an effect on the suitability of the site for plant species more suited to a forest interior and on the likelihood of natural regeneration of these species occurring.

The edge effect can be reduced to some extent by establishing a dense buffer of hardy shrub and small tree species along the most exposed edges (usually the pasture edge) of the riparian zone. A mixture of hardy, densely leaved species such as kohuhu, kanuka (*Kunzea ericoides*), manuka (*Leptospermum scoparium*) and karamu can be planted to form a thick barrier that will reduce the fluctuations in wind, temperature and humidity. With a protective buffer established forest interior species such as rimu (*Dacrydium cupressinum*), matai (*Prumnopitys taxifolia*), pukatea (*Laurelia novae-zelandiae*) etc. can be planted with a greater likelihood of success.

### Management options

While the creation of 40 to 100 metre wide riparian zones

is likely to be completely impractical on most productive farmland, opportunities do occur where sections along riparian margins can be made considerably wider than normal without greatly increasing the cost of fencing. Deltas created by meandering stream channels are often prone to flooding and require regular re-fencing because of this. By fencing these deltas into the retired riparian area larger bush patches can be created and the cost of fencing and fence maintenance may be reduced (refer to Technical Article No. 7.2 in this Handbook).

In hill country areas streams often pass around steep erosion prone faces. These faces are usually less productive for farming and can often be fenced into the riparian area without having any great impact on farm productivity.

## Plant species selection

When planting a riparian area to enhance indigenous biodiversity the species composition and planting layout should be carefully planned.

Firstly, select those species that are required to perform specific functions, such as creating a filter strip to extract sediment, or a thick buffer to minimise edge effect.

Secondly, select a variety of species to increase the diversity of habitat and food for other native plants, invertebrates, amphibians, reptiles and birds. The species selection should include:

- a percentage of fast growing species that will fill space quickly and help exclude exotic weed species, e.g., wineberry, karamu and ribbonwood (*Plagianthus regius*);
- species with a variety of leaf shapes and growth forms, e.g., large and small leaved, upright and spreading;
- several species that produce flowers, scent and nectar to attract insects and birds to the area eg. flax, wineberry, cabbage tree (*Cordyline australis*), and tree fuchsia;
- a selection of species that produce fruits that attract birds eg. titoki, pigeonwood (*Hedycarya arborea*), and kahikatea (*Dacrydium dacrydioides*), and including those that produce fruit only a few years after planting, e.g., karamu. Birds encouraged to the site to feed will deposit seed consumed in other patches of bush thus promoting natural regeneration; and
- taller growing forest canopy trees that will eventually produce good bird nesting habitat and are tolerant of the more variable microclimate of narrow riparian margins, e.g., totara (*Podocarpus totara*) and kahikatea.

## References:

- Collier, K.J.; Cooper, A.B.; Davies-Colley, R.S.; Rutherford, J.C.; Smith, C.M.; Williamson, R.B. 1995: *Managing Riparian Zones: a contribution to protecting New Zealand's rivers and streams*. Vol. 1: Concepts; Vol. 2: Guidelines. Department of Conservation, Wellington.
- Ministry for the Environment, 2000: *Managing Waterways on Farms: a guide to sustainable water and riparian management in rural New Zealand*. Ministry for the Environment.
- Norton, D.A. 2002: Edge effects in a lowland temperate New Zealand rainforest. *DOC Science Internal Series 27*. Department of Conservation, New Zealand.

## Weed and pest control

Because of the favourable growing conditions and diversity of plant and animal life that occur along riparian margins exotic weeds and animal pests can be a significant problem in newly planted riparian areas if not well managed.

Time and resources should be allocated to manage fast growing weeds such as blackberry (*Rubus fruticosus* agg.) and gorse (*Ulex europaeus*) for several years following planting. In some parts of New Zealand weed control (using herbicides or hand cutting) will need to be carried out two or three times per year for two or three years after planting to stay on top of the problem. The exclusion of problem weeds can occur more quickly if the riparian native plants are planted at reasonably close spacings (i.e., 1.5 to 2 metres between plants) so that a shrub canopy is formed quickly, eliminating open spots for weeds to establish. The planting mix with a good proportion of fast growing, leafy native plants with a spreading form (e.g., karamu, wineberry, koromiko) will produce a shrub canopy faster than the use of more upright species (such as kanuka and manuka) alone.

Restored riparian areas can become highways for animal pests such as possums, stoats and rats. The planted native trees provide protection and food for the pests and safe passage to other feeding grounds. Ongoing pest control must be undertaken if invertebrate and native bird populations are to establish and grow in the restored riparian zones (refer to Technical Article No. 7.2 in this Handbook).

Parkyn, S. 2004: Review of riparian buffer zone effectiveness. *MAF Technical Paper No: 2004/05*. Prepared for MAF Policy by NIWA.

Parkyn, S.M.; Davies-Colley, R.J.; Halliday, N.J.; Costley, K.J.; Croker, G.F. 2003: Planted riparian buffer zones in New Zealand: do they live up to expectations? *Restoration Ecology 11* (4) 436-447.

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Tāne's Tree Trust promotes the successful planting and sustainable management of New Zealand native trees and shrubs for multiple uses.