

## Rehabilitation of the The Lower Genoa River, Far East Gippsland, Victoria With Assisted Regeneration

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**SUMMARY:** Assisted Regeneration is a means of restoring the integrity of disturbed or degraded riparian environments using range of management actions including weed control, fencing and planting organised to provide favorable conditions for the *in situ* germination and growth of indigenous plant species. As an integrated management approach, Assisted Regeneration has the potential to facilitate the establishment of large numbers of indigenous plant species for a relatively modest cost. Implementation of an effective Assisted Regeneration program requires organization of management resources to provide an on-going and comprehensive program based on an evaluation of the physical conditions of the site, the river and its catchment; detailed knowledge of the river flora and ecology; contemporary riparian vegetation management techniques and communication and recording skills. The lower Genoa River case study in far East Gippsland, Victoria, demonstrates a process that could be generally applied in Assisted Regeneration programs in a range of riparian environments.

### THE MAIN POINTS OF THIS PAPER

- • Assisted Regeneration of indigenous plant species is a viable riparian vegetation management option in selected locations.
- • Assisted Regeneration requires management on and off site to reduce competition and disturbance.
- • Assisted Regeneration requires implementation of integrated, on going management.

### 1. INTRODUCTION

Since 1990 the primary, long-term aim of river management in far East Gippsland, Victoria has been to create and maintain 'Healthy Rivers'. Healthy Rivers are bordered by vigorous and visually appealing riparian vegetation that provide habitat, food, shade, bank stability and protection from sediment and nutrient runoff from surrounding land, and contain viable populations and communities of fauna and flora with a minimum of exotic species, both from non-Australian locations and from other Australian catchments. (CSIRO, 1992).

This case study centres on the river management from 1990 to 1998 along a highly disturbed, ten kilometre agricultural reach of the lower Genoa River, in far East Gippsland. The river has a wide (to 100 metres), shallow sand filled bed (up to four metres deep) with steep alluvial banks (to four metres high). A major aim of river management was to vegetate the sand of the bed to immobilise the movement downstream.

Management actions included erosion, stock and weed control and planting. The actions were often separated geographically along the ten kilometres and carried out at different times over the eight years. In hindsight all contributed to the creation of conditions necessary for the regeneration of indigenous species which have substantially colonised the broad sand bed of the river.

The term Assisted Regeneration has been adopted to describe the sequence of management actions that resulted in regeneration being the primary means of establishing indigenous plants. The entire operation on the lower Genoa River can be termed a management program of Assisted Regeneration.

Regeneration is defined as the recovery of natural integrity following disturbance or degradation and Assisted Regeneration is defined as assistance by human intervention to accelerate the process of recovery, Cairnes (1996).

Regeneration of plants results from seed germination or establishment of vegetative material (suckering, layering or rooting of twigs or branches). Assistance extends from the management arrangements to the onground actions. Ongoing actions include addressing threatening processes and promoting values that accelerate recovery.

From the experience on the lower Genoa River, Assisted Regeneration may be considered as a management option, adapted and applied to select river reaches requiring rehabilitation. The following appear to have been essential to the success (to date) of the works:

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**Planning:** Assessment to determine the suitability of the site, including an examination of the values, threats and resources and a subsequent clarification of objectives, priorities and strategies for the site. Establishment of management capability to ensure suitable ongoing management inputs.

**Communication:** Effective communication to all stakeholders - implementing staff, authority structures and community members. To introduce the plans and strategies often requires practical demonstration of a suitable scale, size and complexity is. It must go beyond the mechanics of individual action and link them in the less obvious aim of assisting regeneration of the larger reach. It is essential, initially to engage local knowledge and in the longer term catalyze local involvement and the mobilization of local resources to sustain an ongoing management commitment.

**Observation:** As a highly site-specific approach, Assisted Regeneration requires attention to detail including the responses to management actions. If the implementation is not adequately observed and recorded, experience gained may be lost to the detriment of subsequent efforts. Observation and recording allow the strengths of every endeavor to be incorporated into the next effort and, alternatively, weaknesses may be similarly eliminated.

**Adaptive Management:** The Assisted Regeneration approach is a dynamic process of establishment and growth that requires a sustained commitment to management. Much is dependant on the yearly and seasonal climatic variations and the subsequent effect on the river flows and vegetation response. When applied to a new river reach management requires adaptation to the developing circumstances some unexpected and others unforeseen.

## 2. STUDY AREA

The Genoa River is located in southeastern Australia. Originating in the Southern Tablelands of New South Wales, the Genoa River flows south through far East Gippsland, into the coastal Mallacoota Lakes system and the Croajingalong National Park that is part of an internationally recognized UNESCO Biosphere Reserve. Most of the Genoa River Catchment in NSW and Victoria is public land designated as national park and state forest.

Rainfall in the Genoa River catchment occurs evenly throughout the year (1000mm per annum), however drought and heavy, intense rainfall events are not uncommon. The frequency of 24 hour periods in which more than 76 millimetres of rainfall is experienced is greater in East Gippsland than for any other region of Victoria (Linthorpe, 1969). The intense rainfall events

often cause flooding. The years 1996 to 1998 were exceptionally dry with the driest year in 15 years experienced at Genoa in 1997. A moderate flood occurred in June 1998.

The Genoa River catchment in Victoria lies within the East Gippsland Basin. The Basin is mostly covered by native vegetation (approximately 97 percent) and 98 percent of the total length of streams are in good to excellent condition. The lower Genoa River at Genoa was assessed to be in very poor to poor condition (Mitchell, 1990).

The study reach is immediately upstream of the Mallacoota Lakes, it is a relatively straight, wide and shallow and flows through a wide floodplain. The Genoa township is located on the reach and beef cattle grazing is the major agricultural enterprise.

Sand, up to four metres deep has been deposited in the riverbed of the study area since 1971. The sand was mainly from channel erosion generated by the catastrophic flood of 1971. The sand and poor environmental condition were of longstanding concern. (Erskine, 1992).

## 3. METHOD

The river management works are reported as they relate to the planning, communication, observation and adaptive management. Reporting on communication, observation and adaptive management are largely confined to vegetation management for the period 1994 to 1998. Stabilisation and fencing works which are integral components of the Assisted Regeneration approach are summarised.

Beginning in 1990, extensive rock beaching and retardation fences were installed to prevent a major meander cut off, bed deepening and the subsequent release of sediment.

To remove stock from the river corridor ten kilometres of electrified fencing was installed to compliment ten kilometres of fencing previously installed by landholders.

To assist bank stability and provide a rapid cover 30,000 indigenous trees and shrubs were planted into Kikuyu (*Pennisetum clandestinum*) pasture from 1991 to 1993. There was limited weed control.

**Planning:** The study area now falls under the management responsibility of the East Gippsland Catchment Management Authority (EGCMA) formed in 1997 under the Catchment and Land Protection Act (1994). Prior to this, the Genoa, Cann and Bemm River catchments were managed from 1990 by the East Gippsland River Management Board (EGRMB).

Before 1990, river management works in the study area were landholder initiated. The establishment of the voluntary, community based, EGRMB in 1990 to manage State river management funds gave a planning, ongoing works capacity, and a community focus for river management. It had one employee and a floating pool of casual labor.

The EGRMB commissioned an investigation of the sediment (sand) sources of the Genoa River catchment (Erskine 1992). Management recommendations for the study area included extraction to remove the sand and vegetating of stream verges to immobilize the sand in order to reduce its movement to the Murrumbidgee Lakes.

The EGRMB developed a Strategic Plan in 1994 to guide its works (*Community Works, 1994*). The primary, long-term aim of the plan was to manage rivers and streams in ways that led to the creation and maintenance of 'Healthy Rivers' across the Board's district. The primary objective was to reduce sediment movement to the East Gippsland coastal lakes. The Board's definition of Healthy Rivers was adapted from the CSIRO Report Towards Healthy Rivers (1992).

Riparian Australia was engaged by the EGRMB in 1994 to develop the Streamside Vegetation Management Strategy to guide Board policy and decision-making on frontage management, (*Riparian Australia, 1995*). The Vegetation Strategy was developed within the framework of the Strategic Plan and (for the study area) the Genoa River catchment sediment assessment.

The Vegetation Management Strategy was based on an assessment of river and vegetation conditions. It recognized the regions outstanding biological values, the potential of regeneration and the threat of environmental weeds. It also addressed management including work practices and resources, staff training and the landholder/EGRMB relationship. It promoted the development of planning, programming and budgeting as the basis for successful integrated vegetation management.

Observation of the existing regeneration of the study area encouraged the pursuit of regeneration as a means of establishing large numbers of indigenous plants of a variety of species on the sand bed. Catchment and management features assessed as supportive of regeneration included: the uncleared, relatively weed free upstream catchment with its abundant multi-species seed source; the sand bed which is a natural propagation medium; the fencing and the quality of the adjoining grazing properties which were largely vermin and weed free.

**Communication:** In 1995, Riparian Australia introduced the Vegetation Management Strategy to the EGRMB Board, staff and community through the

establishment of demonstration sites on the Genoa, Cann and Combienbar Rivers (Riparian Australia, 1996). The small-scale demonstration sites were adopted as the central means of communicating the practical implications of the Vegetation Management Strategy to the rural population. The sites introduced new integrated systems at a scale that allowed ease of monitoring and analysis.

All the of the short lengths of riverbank selected as demonstration sites were previously fenced (for as long as 20 years) and had different vegetation management issues. Two sites, each 600 metres long, were established on the north bank of the study area at Genoa. Each site, although contiguous, had contrasting uses, growing conditions and vegetation, thereby requiring different methods of recording, monitoring and vegetation management. One site was dominated by multiple weed species. The second site was established to monitor the success of regeneration on the sand bed (to illustrate regeneration survival over time).

Work concentrated on the sites for six months (Jan. 1996 to June 1996) and continued thereafter as required. After June 1996, works expanded to the remaining reaches of the lower Genoa River.

The demonstration sites facilitated communication with the EGRMB, staff, landholders and public. Communication with field staff was practical, on-site and interactive. New techniques in assessment, weed and willow control, planting and site rehabilitation were introduced.

The Genoa River sites were chosen for their site characteristics and their location relative to Genoa. They had high, local public and tourist profiles, (particularly from the old Highway Bridge which bisected one of the sites), recreation and aesthetic importance, and conservation and stabilisation significance. Landholder and local public communication therefore happened largely as a result of first hand observation.

Regular reports were made to the EGRMB on planning and works. Vegetation management budgets were incorporated into the EGRMB planning cycle to allow for the management of indigenous riparian vegetation and to provide for weed and preventative fence maintenance. Evaluation and preplanning, equipment upgrades and recording systems were implemented, (Riparian Australia, 1997a).

**Observation:** The primary role of the demonstration sites was to allow staff to observe the exotic and indigenous vegetation in detail, to witness first hand the responses to management actions and to test techniques new to the local area. The secondary role was to use the

record of works on the demonstration sites combined with the local knowledge of staff to provide the basis of work programs and budgets for a larger ongoing management program to be applied across the reach. The intention of the process was for staff to apply the works catchment wide after the initial training period.

**Adaptive Management:** The study area has had the geomorphologist, river management engineers and the riparian vegetation manager (among others) study the conditions, each has contributed to building a picture of the river and vegetation processes from which management responses have been determined and applied. It is inherently a multi-disciplinary approach.

Over the eight years, management has moved from engineering to weed and seed management. Onground management has largely devolved from the specialists to the staff with backup as needed. The flexibility has seen the development of a relatively sophisticated vegetation management capacity in recent years.

#### 4. RESULTS

On the sand bed of the lower Genoa, flood frequency and intensity dominates the success of regeneration. Management assistance is confined to the control of competition from stock, vermin and weeds and to planting where regeneration will be restricted or slow.

The years 1996, 1997 and 1998 were dry with relatively low flows and only one moderate flood. These conditions affected establishment, although no comparative data exists, observations suggest that the lack of flow had a positive affect on the area of regeneration.

##### Regeneration

In the dry period regeneration on the sand bed of varied according to subtle changes in micro-relief, moisture and presumably seed deposition. The dry sand ridges were bare while dense regeneration (>100 m<sup>2</sup>) occurred in places along the lower, usually moist river margins.

Wetland species dominated regeneration at the lower end of the reach. By April 1998, all the sand had an open scattering of plants. Plants multiplied by seedlings (*Juncus spp* and *Cyperus spp* and others) and by expansion of the established stands of stoloniferous species (Common Reed *Phragmites australis* and others).

A survey of the regeneration demonstration site, undertaken initially in November 1995 and repeated in November 1997, assessed the regeneration of the 600 x 65 metre, (39,000 m<sup>2</sup>) representative sample of the sand bed (Riparian Australia, 1997b). It was concluded that over the two-year time frame the total area of

regeneration had increased by 6400m<sup>2</sup>. Extrapolation from the sample suggests that the area of regeneration may have increased by as much as 100,000m<sup>2</sup> on the estimated 650,000m<sup>2</sup> of sand bed over the same period.

Regeneration on the sand was dominated by Wattles (*Acacia sp.*), with Black Wattle (*A. mearnsii*) the most numerous with at least four other species. Seedlings of *Eucalyptus*, *Leptospermum*, *Melaleuca* and *Lomandra* were also common. Regeneration included all plant forms - grasses, creepers, shrubs and trees. Weeds were limited to Hybrid Crack Willow (*S. x rubens*) seedlings and twigs the occasional Blackberry (*Rubus. fruticosus* L. aggregate). Kikuyu (*P.clandestinum*), Couch (*Cynodon dactylon*) and Sorrel (*Acetosella vulgaris*) expanded vegetatively from established populations along the riverbank.

On June 24 1998 a flood 4.8 metres deep, measured at the gauge on the Princes Hwy Bridge at Genoa, filled the channel and flooded the adjacent paddocks. The rise and fall of floodwaters was abrupt. In terms of Genoa River floods, it was described as moderate (R. Allan pers. comm.).

During the flood about one metre of sand was eroded or deposited at different locations on the sand bed and a large proportion of the regenerated plants were therefore lost from the regeneration demonstration site (E. Thexton inspection 16-7-98). Further down the river, the wetland plants which had colonised the sand bed were removed, while those out of the main flow survived. From observations, another cycle of regeneration has already begun (R. Allan pers. comm.).

##### Fencing

From January 1996 to June 1998, ten days (8hrs days) were spent on preventative fence maintenance on the 20 kilometres fenced frontage, (as opposed to breakage repairs).

##### Weed Management 1996/97

Weed control is herbicide based and confined to the warmer months. From January to June, weed control was undertaken at both the weed management and the regeneration demonstration sites. The relative weediness of each site is indicated by the control times, more than 60 hours on the former and two hours on the latter.

The dominant weeds of the reach in order of coverage are Blackberry (*R. fruticosus* L. agg.), Hybrid Crack Willow (*S. x. rubens*), Cape Ivy (*Delairea odorata*), and one infestation of Bridal Creeper (*Myrsiphyllum asparagoidies*). Several other minor infestations of environmental weed were also controlled. Pasture species which dominate groundflora among the bank plantings are not controlled.

During December to August, all environmental weeds were controlled on 16km of the 20km of bank and on all of the sand bed. A total of 56 person days (8hr day) were spent on these control measures at an average cost of \$1,750/km (developed using a daily costing rate of \$500 per two man equipped 4WD).

### **Weed Management 1997/98**

From December to June, control of all environmental weeds was repeated for the second year on the 16 km length of bank treated the previous year and on the 65 hectares of sand bed. In addition, the 4km length of bank untreated in 1996/97 received its first year of chemical control application. The total application time was 55 days (8hr one person).

Treatment of the previously untreated 4 km of bank took 22 days (and included huge infestations on a meander cut off). Treatment of the previously treated 16 km of bank was undertaken in the second year mainly using hand sprayers and took only 13 days. Weed control along the study reach took nearly 5.5 days per km in the first year and only 1.2 days per km in the second year.

The sand bed required annual treatment as new propagules are transported predominantly by wind, and water. Control on the 65 hectare sand bed area took 20 days. The main weeds were seedling of Hybrid Crack Willow (*S. x rubens*), (germinations were recorded as huge). The mass germination occurred despite the control of all seed producing willows along the river reach in the previous year. Seeds were subsequently found to be blowing in from a tree within a riverside garden in Genoa and germinating 2-3 kilometres downstream.

Weed management practised along the 10 kilometre length of the lower Genoa River in 2.5 years required 119 days work at a total cost of \$30,000 or \$3000 per km or \$1,200 per km/annum. If the declining trend in treatment time follows the 1997/98 direction control may be accomplished in 38 days at a total cost of less than \$10,000 or \$1,000 per kilometre.

### **Planting**

Twenty thousand plants of selected indigenous species were propagated, (courtesy of a \$10,000 sponsorship). Over 5,000 Sword Tussock Grass (*Poa ensiformis*) were planted as cells into denuded weed control areas at the weed management demonstration site. River Tea Tree (*Leptospermum obovatum*) and Giant Honey Myrtle (*Melaleuca armillaris*) were planted into pasture dominated fenced banks.

Planting were also used to accelerate the reinstatement of selected important species already regenerating in small numbers such as Kanooka (*Tristaniopsis laurina*). Kanooka is an indigenous riparian tree

recognized for its flood hardiness and longevity. It was planted in summer, as cells at the waterline into the root mat of previously controlled willows. Plantings of larger 500-ml pots (1800) were undertaken at the toe of the bank into pockets judged to be more protected with the capacity to withstand flood flows.

During the 1996/97 period, 1kg of seed of 10 terrestrial and wetland species was collected for propagation. However, in 1997/98 seed production was limited and very little was collected.

## **5. DISCUSSION**

The Assisted Regeneration approach is inherently heterogeneous, with management varying according to the site details, the physical condition of the river, the plant species and the growing conditions. Management also varies over time from establishment to maintenance. The annual maintenance cycle operates at a very modest level of input (the major expense on the study reach being \$1,000/km for weed control).

The success of Assisted Regeneration relies on the establishment of the capacity and commitment to provide ongoing management inputs. The base requirements are the regular containment of the weed population and fence maintenance the enhancements such as plantings are more flexible.

Persistence in weed control is critical because the rivers of temperate Australia are now among the most weed rich of any environment. (Carr, 1995). Typically, a multispecies weed flora coexists with the often depleted remnant indigenous community. In creating conditions suitable for the regeneration of indigenous species, conditions are also created for the regeneration of weed species. The weeds often have a competitive advantage over the indigenous species. Careful assessment is therefore required to determine whether Assisted Regeneration is appropriate. In many highly disturbed and depleted riparian environments, there is an overwhelming dominance of weed seed and a vastly reduced range of seed producing indigenous species.

Weed management is required at three levels - control of the standing crop, reduction in propagation material and management of incoming seed from the catchment. In the riparian environment, control of existing weeds must consider the implications for the maintenance of bank stability and/or hydraulic conveyance. Rehabilitation requires shifting the plant community from weed to indigenous domination without denuding the bank. Management over years and replanting assist in this process. Reduction in the source of propagation material is particularly critical when fencing removes stock grazing as a means of weed control. Small seemingly benign infestations have the potential to spread rapidly particularly in floods. Weeds are now ubiquitous in every catchment and propagation material is constantly transported to the waterway.

Although Assisted Regeneration relies on expert assessment and management inputs initially, the bulk of management demands over time are for the consistent application of generally basic and repetitive actions. Although consistent with agricultural work, the distinction of Assisted Regeneration is that management aims for indigenous vegetation diversity as opposed to uniformity in most agricultural enterprises.

## 6. CONCLUSION

The aim of this paper has been to introduce a river management approach which acknowledges the potential of regeneration in the rehabilitation of selected river reaches.

It has been developed from river management experience attempting the unusual (vegetation of a river bed) on a reach in very poor condition in a catchment unlike most in temperate Australia. It has examined the sequence of actions required and attempted to draw out the criteria that have underpinned the success of the process.

The lower Genoa River is botanically rich, has a dramatic climate and offers an uncomplicated view of river rehabilitation processes (uncomplicated by population, salinity, etc.) These conditions generate rapid responses and require correspondingly relatively large management inputs. The opportunity to observe the river management works over a long time period has allowed the accumulated field practise to be developed into the river rehabilitation approach described as Assisted Regeneration.

The study period of eight years concluded with a flood which illustrated the unpredictability, and frailty of vegetation rehabilitation in the altered river environment. It reinforced the reality that while the forces and consequences may not be diminished they can be anticipated by ensuring that the most cost effective means of vegetation establishment are employed in vulnerable localities. It is estimated that rehabilitation of this reach will take decades.

The principles of Assisted Regeneration are applicable to other riverine environments with different conditions. Applied to dryer climates and harsher environments, responses may lengthen and inputs reduce.

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