Chapter One - Introduction

PURPOSE AND SCOPE

The *Practical Stream Bioengineering Guide* is a user's guide to natural stream stabilization techniques for the arid and semi-arid Great Basin and Intermountain West. Bioengineering can simply be defined as increasing the strength and structure of the soil with a combination of biological and mechanical elements.

This guide was produced primarily for the professional conservationist who provides technical resource assistance to individual landowners. The user should understand that riparian areas are complex ecosystems and that restoration efforts require interdisciplinary teams. The goal of this publication is to provide an easy to understand guide for coordinators of riparian restoration projects. A coordinator needs to have a basic awareness of the overall process and the disciplinary skills required for restoration. Other resources address specific issues in greater detail and should be consulted such as *The Stream Corridor Restoration Handbook* (a multi-agency publication to be published in 1998 - See Resource section).

The first part of this guide covers the basic principles of restoration and bioengineering. The second part consists of detailed, illustrated technique sheets for different bioengineering methods, including how to install, materials, type of use, and other special considerations (Appendix A). This guide was formatted to fit in a three-ring binder so that additional Technique Sheets can be added later. Appendix B includes data sheets and illustrations on plant species suitable for bioengineering techniques. Comments from users of this guide are extremely valuable and will be incorporated in future revisions and Technique Sheets. We have enclosed a comment sheet at the end of this guide for your use.

The condition of streams and riparian areas reflect the health of the surrounding landscape. Consequently, restoration of these areas needs to address land use management. Bioengineering should not be viewed as a substitute when management changes may be necessary. This guide briefly discusses general management issues for common land uses in the region. The Resource section of this guide as well as other professionals should be consulted for additional information on specific land use management.

WHAT IS A RIPARIAN AREA?

A riparian area is an ecosystem situated between aquatic and upland environments that is at least periodically influenced by flooding. (Fig. 1.1) (Mitsch and Gosselink 1993). Riparian zones often have a rich diversity of plant species and several vegetative layers. Riparian vegetation composition and structure is regulated by: (1) frequency, magnitude, duration, and seasonal

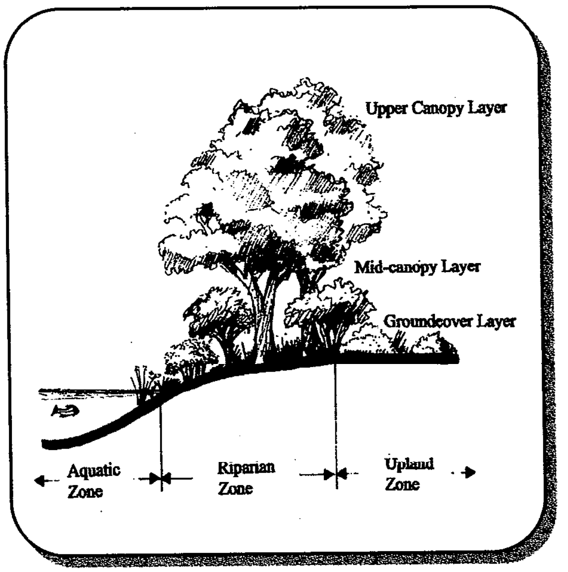

Fig. 1.1 *Riparian Area*

timing of stream flooding and (2) subsurface moisture conditions. These factors are the result of fluvial processes necessary for the formation and maintenance of riparian ecosystems (Brinson et al. 1981). In the West, riparian areas often appear as green ribbons winding through the gray-brown landscape of grasses and sagebrush.

WHY ARE RIPARIAN AREAS VALUABLE?

Riparian areas provide many important benefits which are well documented (Fig. 1.2) (Hellmund and Smith 1993; Mitsch and Gosselink 1993). The following are just a few of the many benefits that riparian areas provide:

<u>Water Quality Protection</u>
Nonpoint source water pollution occurs as a result of runoff and shallow groundwater flow from urban and rural areas. Nonpoint source pollution is estimated to be responsible for 99% of sediments, 88% of nitrates, 84% of phosphates, and 73% of the biological oxygen demand in our lakes and streams (Clark et al. 1985). Riparian areas can reduce the impacts of nonpoint source pollution in a variety of ways.

Riparian vegetation traps sediments and nutrients from surface runoff and prevents them from entering the aquatic system (Binford and Buchenau 1993). In addition, the dense matrix of roots in a riparian zone can serve as an effective filter of shallow groundwater (Shultz 1994). Nitrogen dissolved in groundwater is a major input to streams in some areas (Peterjohn and Correll 1984). In one study, woody riparian vegetation removed six times as much nitrogen from groundwater as was exported to the stream (Lowrance et al. 1985). This matrix of roots also reduces sediment delivery to the stream by minimizing streambank erosion (Binford and Buchenau 1993).

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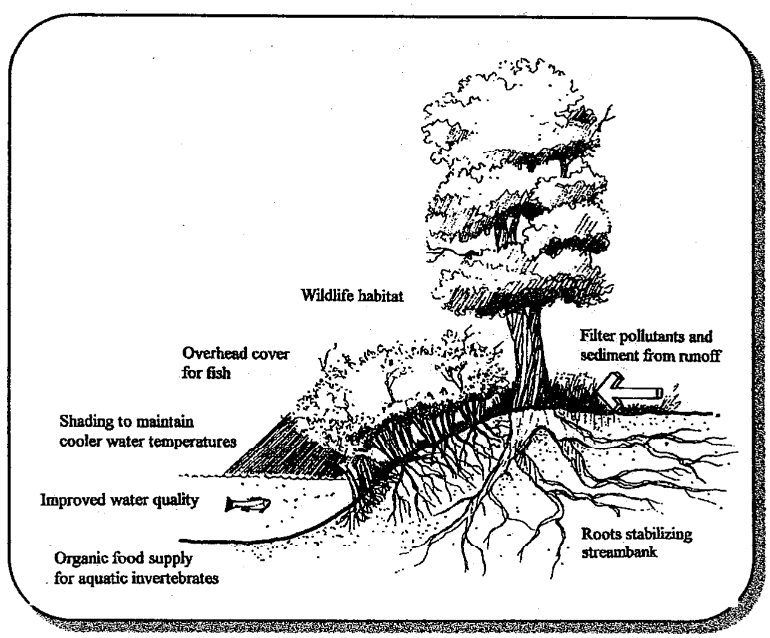

Fig. 1.2 *Riparian Functions*

Flood Control

Riparian areas also act as a sponge by absorbing floodwaters. The water is then slowly released over a period of time which minimizes flood damage and sustains higher base flows during late summer (Binford and Buchenau 1993). When the flood storage capacity is compromised by human activity, the impacts from flooding can be aggravated. Examples include the mid-western floods of 1993, 1994, and 1997 and the floods in the Pacific Northwest in 1996 and 1997.

Streamflow Maintenance

In our semi-arid to arid environment, some riparian landowners are concerned that riparian vegetation reduces the stream water available for other uses. However, studies have shown that elimination of woody riparian vegetation and debris may result in the eventual loss of summer stream flow because the water storage capacity of the soils is greatly reduced (Stabler 1985). Studies in Utah have shown that mature woody riparian vegetation uses water from below the active stream-flow zone (Dawson and Ehleringer 1991).

Water Temperature

Water temperature in streams plays a critical role in the health of the riparian ecosystem. Riparian vegetation maintains cooler water temperatures by shading the water surface and is particularly important in headwater streams that have a small volume of water (Binford and Buchenau 1993). Temperature influences factors such as the rate of nutrient cycling and dissolved oxygen. For example, a slight increase in temperatures above 59° F will produce a substantial increase in the release of phosphorus (Karr and Schlosser 1978). Because phosphorus is often a limiting nutrient in freshwater systems, a substantial release of this nutrient can result in eutrophication which can reduce water quality and diversity of aquatic life. In addition, salmonid fish species and cold water macroinvertebrates require cool water temperatures in order to survive.

Wildlife Habitat

Riparian corridors are among the most productive wildlife habitats in many regions of the country (Noss 1993). They are particularly important habitats in arid and semi-arid landscapes (Szaro 1991; Thomas et al. 1979). Both wildlife species diversity and density are high in healthy riparian habitats (Noss 1993). Thomas et al. (1979) found that 75% of the terrestrial vertebrates in the Blue Mountain study area in eastern Oregon were dependent upon or preferred riparian habitat. Best and Stauffer (1980) found an average of 506 breeding pairs of birds per 100 acres in riparian corridors compared to 339 pairs in upland forests.

The vegetative community in most riparian areas is structurally more varied than adjacent landscapes and thereby provides a rich diversity of habitat niches. This diversity translates to the fulfillment of the primary life requisites (e.g.; food, cover, reproductive habitat) for a great variety of wildlife. Water, aquatic invertebrates, and fish provide resources that support species that inhabit and utilize an aquatic/upland ecotone.

Riparian vegetation adjacent to a stream is an important source of food for benthic macroinvertebrates which are a necessary food source for other forms of aquatic life. Detritus from leaves and herbaceous vegetation is

Tiger Salamander
Ambystoma tigrinum

consumed by these organisms as soon as it is deposited in streams while large woody debris provide long-term food reserves for aquatic life (Binford and Buchenau 1993).

In addition, the linear form of riparian areas may serve as critical wildlife corridors allowing for movement between different habitat areas (Forman 1995). Riparian corridors may be important for dispersal of juveniles (Noss 1993).

Recreation Benefits

Riparian areas are especially attractive locations for recreation, particularly for trails. The presence of water, diverse vegetation, moderated climate, and abundant wildlife enhance the recreation experience. Boating, rafting, kayaking, tubing, fishing, and hunting are popular activities in many corridors with perennial flowing water. Some riparian corridors have become so popular that demand frequently exceeds social and ecological carrying capacity. Conflicts between different types of users and degradation of the riparian resource often result (Cole 1993).

Economic Benefits

The economic value of these benefits is not always apparent and difficult to estimate. Thibodeau and Ostro (1981) used cost/benefit analysis techniques to calculate the value of riparian wetlands along the Charles River near Boston. They estimated the value of property value increase, water supply, flood prevention, pollution reduction, and recreation at between $153,000 and $190,000 per acre. However, in the arid West, one quickly realizes that these resources are actually priceless.

STATUS OF RIPARIAN AREAS AND STREAMS

Despite the multitude of benefits that riparian areas provide, many of these areas have not been managed with care. For example, only about 2% of the Southwest landscape consisted of riparian ecosystems before Anglo settlement. Today, Arizona and New Mexico are estimated to have lost 90% of their riparian areas (Johnson 1989).

A nationwide study of fisheries in 666,000 miles of perennial streams revealed some very disturbing trends (Judy et al. 1984). For example, 40% of the stream miles were adversely affected by turbidity, 32% by elevated temperature, 22% by bank erosion, and 21% by excess nutrients. Approximately 75% of the stream miles would only support a low-quality sport fishery, and only 5 to 6% would support high-quality sport fishery.

While preservation and conservation of healthy streams and riparian areas should receive high priority, it is clear that restoration of degraded areas is a necessity as well. "If the damage to these ecosystems is not reversed, they will most likely undergo further significant, and in some cases irreversible, ecological deterioration" (NRC 1992). This guide provides some tools to help reverse this trend.

Coyote Willow
Salix exigua