Cultural Perspectives

Propagating Riparian Plants

As I'm sure you've noticed, riparian restoration projects have become increasingly more common in natural resource management. Here in the Western US, the vegetation along streams and rivers has been severely depleted by years of overgrazing, and concerns about water quality have become an environmental issue all over the world. Filter strips are being recommended to treat agricultural runoff, urban storm water, and mining wastewater before it enters our rivers and streams. All these issues will increase the demand for riparian plant materials, so nurseries must become proactive to meet this new market.

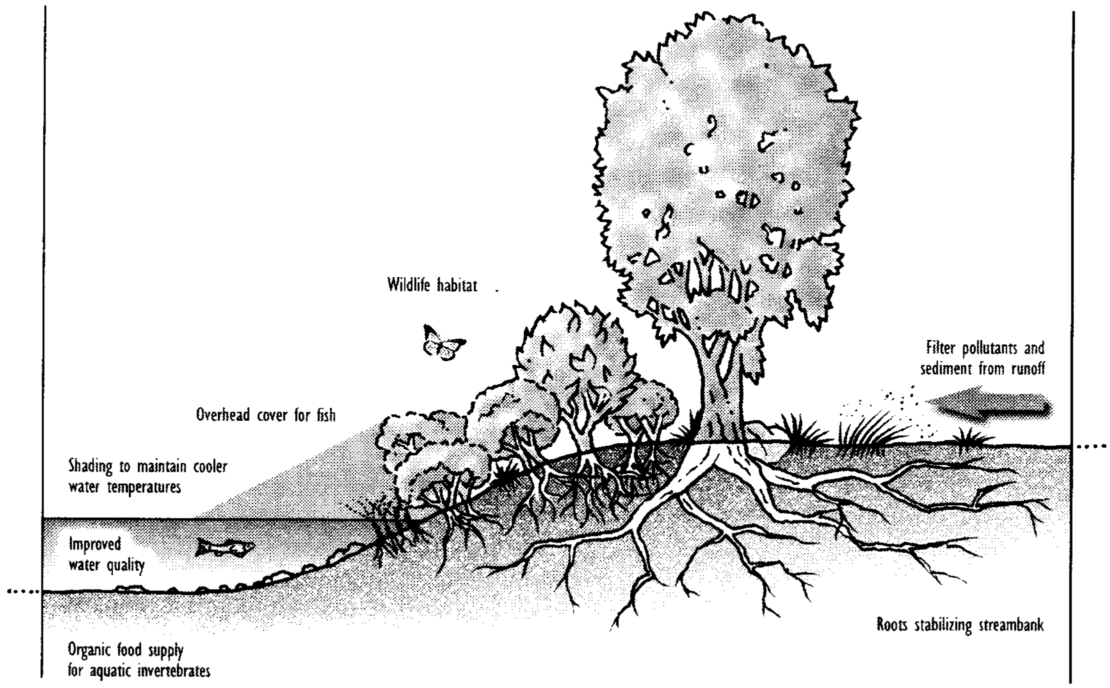

Figure 1 - Benefits of riparian restoration

Riparian revegetation produces many benefits (Figure 1), including:

?? Reducing stream bank erosion by reestablishing the root matrix
?? Reestablishing the riparian plant community
?? Improving fish and wildlife habitat
?? Providing shade on the water to maintain lower water temperatures
?? Increasing biodiversity of plants and animals
?? Improving water quality

There are two different types of plant materials used in riparian restoration: 1) dormant, unrooted hardwood cuttings used in bioengineering applications and 2) live plants used for filters, biodiversity and a variety of other purposes.

Dormant Unrooted Hardwood Cuttings

The plant materials most widely used in bioengineering treatments are dormant uprooted hardwood cuttings that are used in bundles, fascines, and other bioengineering structures (Fig. 2). Cuttings are preferred because of their availability, ease of harvest, ease of planting, and their ability to root. Willow, cottonwood, and red-osier dogwood are the most common species used because of their ease of rooting and planting as well as tolerance to saturated soils and even periodic inundation. Few other riparian woody plants easily root from hardwood cuttings and so must be propagated by seed. For a list of suitable species for stream bank bioengineering refer to Carlson (1992).

For restoration projects that will require a large amount of plant material over several years, cuttings from donor plants can be brought back to a nursery for multiplication. This is particularly useful for remote projects, such as high elevations, where field collections would be difficult. Mother plants are established in nurseries to provide a source of cuttings. Stooling beds are hedge-like rows of mother plants that are established in bareroot nurseries. Single mother plants can also be established in large containers. Besides the convenience, cuttings collected at the nursery often perform better than wild collections. For example, over 90% of narrowleaf cottonwood (*Populus angustifolia*) cuttings collected from stooling beds rooted whereas wild cuttings had only 62 to 85% rooting success (Dreesen and Harrington 1999).

There are three size classes of cuttings that are used in riparian bioengineering structures (Table 1):

Propagation cuttings - These cuttings are relatively small (Table 1) and are used only in nursery propagation. Dormant hardwood cuttings are most commonly used although softwood cuttings from tips of actively growing plants are necessary to propagate some species. Although propagation cuttings can be collected from donor plants near the project site, it is more efficient to establish stooling beds or mother plants at a nursery. Another option is serial propagation where cuttings can be harvested from the current year's crop.

Stem cuttings have an inherent polarity and will always produce shoots at the distal end (nearest the bud) and roots at the proximal end (nearest the main stem or root system). To distinguish between the top and bottom of hardwood cuttings, the bottoms are cut at an angle, which not only ensures that the cuttings are planted right side up but makes them easier to stick into containers or nursery beds. In nursery stooling beds, willow and poplar are collected as long cuttings or whips that are then cut into the proper length. If collected by hand, the basal cut is typically made just below a node where roots form more readily. When large numbers of cuttings have to be made, then bundles of whips are cut with a band saw. Bundles of cuttings are then secured with a rubber band and stored under refrigeration at 32 to 40 °F (0 to 4.5 °C) to keep them dormant until they are planted.

Table 1 - Type of cuttings used in riparian restoration				
Type of Cutting	**Diameter**	**Type of Wood**	**Pre-Rooted**	**Use**
Propagation	0.2 to 0.8 in. (0.5 to 2 cm)	Softwood or Hardwood	Yes	Live plants: Grown in bareroot beds or containers at nurseries
Branched	0.5 to 2 in. (1.3 to 5.1 cm)	Hardwood	No	Bioengineering: brush mattresses, fascines, vertical bundles at the project site
Pole	0.75 to 8 in. (1.9 to 20.3 cm)	Hardwood	No	Bioengineering: Individual placement at the project site

Branched cuttings - This class includes branches and stems that are relatively large (Table 1). Branched cuttings can be collected near the project site or from stooling beds in a nursery. If the project area is far from the nursery, the large volume of plant material needed may make it more practical to collect on-site. Branched cuttings often have the tops and flowering parts cut off before they can be used for some of the bioengineering treatments. They differ from propagation cuttings and poles in that side branches are left in place during processing (Carlson and others 1992).

Branched cuttings are very effective for stream bank erosion control when collectively used in brush mattresses, fascines, and vertical bundles (Fig. 2). Although branched cuttings typically have lower establishment rates than propagation cuttings, bioengineering structures made with branched cuttings are essential to initial stream stabilization.

Poles - Many riparian restoration projects fail because high water velocities rip the plants out before they have a chance to establish an extensive root system, or they die when soils dry out later in the summer and fall. Pole plantings provide a means to overcome both of these problems (Table 1). The basic idea is to plant long cuttings of dormant willow and cottonwood to a sufficient depth that they will stay in the water table throughout the year. These species have dormant root primordia underneath their bark so that roots will sprout along the entire buried section and the poles will establish quickly after outplanting. The other benefit is that these large diameter pole cuttings will remain anchored during floods.

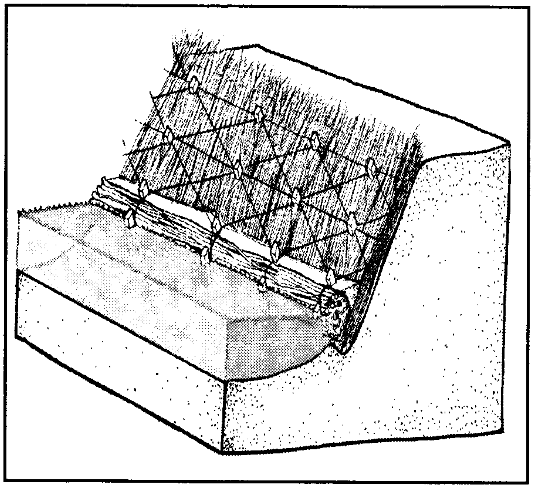

Figure 2 - Vertical bundles are one type of bioengineering structure that uses dormant unrooted hardwood cuttings.

Because of the large size of the plant material, mother plants can be established in the nursery to produce poles. Carlson (1992) concluded that establishing and managing "orchards" for producing poles should be a top priority for forest and conservation nurseries. Much of the research in this area has been done in the Southwestern US. At the Los Lunas Plant Materials Center in New Mexico, pole cuttings are grown in production blocks that yield large poles after 3 growing seasons (Dreesen and Harrington 1999). Another possibility that is being tried at the J. Herbert Stone Nursery in Oregon is to convert existing willow stooling beds over to pole production.

Nursery Plants

Container or bareroot plants add diversity to the riparian restoration area by ensuring the establishment of species that do not root readily from woody cuttings. Many people just assume than all willows or cottonwoods will root easily and so stick hardwood cuttings directly into the stream bank. Although many of these cuttings will sprout shoots initially, some will tend to dieback later in the season due to poor root egress or pathogenic cankers.

Propagation method - The choice of propagation method is important and both the biology of the species and the objectives of the restoration project must be considered. Many keystone riparian trees and shrubs including cottonwood and willow can be produced vegetatively, but some species or ecotypes are recalcitrant. For example, standard hardwood cuttings of Scouler willow do not root well, even in the nursery, and so this species must be propagated by other means (Dumroese and others 1997).

If it is possible to propagate a plant either by seed or vegetatively, then the amount of genetic variability that is desired in the crop must be considered. Sexual reproduction results in a mixture of genetic characteristics in the offspring, so each plant will appear slightly different from its parents and each other (Fig. 3). Because maintenance of genetic diversity is so important in ecosystem management, seed propagation is encouraged whenever possible because it is easier to capture and preserve biodiversity with seeds than with vegetative propagation. When harvesting seeds or cuttings, collections should be made from as many individual plants as possible to maximize genetic diversity. A general guideline is 50 to 100 donor plants.

Because of the higher cost of establishment and longer production times, bareroot seedlings are less commonly used for riparian restoration. However, bareroot plants are usually less expensive to produce, handle and transport than large container stock.

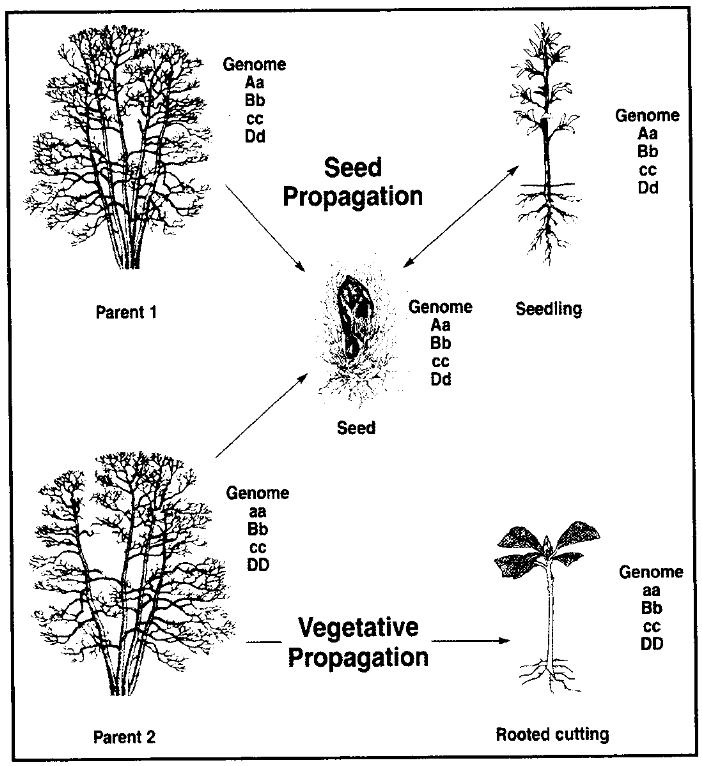

Figure 3 – Plants propagated from seed look different from their parents and each other because they contain a mixture of the genetic characteristics of the two parent plants. Vegetative propagation, on the other hand, produces exact duplicates of the parents.

Seedlings - Few riparian plants are grown as bareroot seedlings because often the seeds are difficult to handle or they have complicated dormancy. For example, cottonwoods and willows have very small seeds that are shoe lived and they are covered with fine hairs that resist water imbibitions making them difficult to propagate in bareroot seedbeds. Some nurseries do produce bareroot seedlings of riparian trees such as ash and oaks, and other species could be grown if the markets existed.

Rooted cuttings - Several riparian species are routinely propagated from short hardwood cuttings, especially cottonwoods and willows. Because they root easily and require less cultural attention than seedlings, rooted cuttings of these species grow rapidly and shippable plants can easily be produced in one season. Planting and cultural techniques for propagating poplars and willows are provided by Morgenson (1992).

Transplants - "Plug+Ones" are an economical way to grow large stock types for riparian restoration projects. In the last few years, container-to-container transplants are becoming more popular.

Container plants are preferred for riparian restoration projects because they are quick to produce, easy to handle, and often have better outplanting performance on tough sites than bareroot stock. For riparian projects, container stock can be divided into two categories: small and large. Most project managers prefer large plants because they have more expansive and aggressive roots and can better withstand water erosion.

Small Containers ("Plugs') - Woody shrubs, grasses and wetland plants are often grown in small containers (volumes less than 15 in' or 245 cm'). Plugs are used in bioengineering designs when the water is too deep or persistent to get woody plants established in other ways. Wetland plant plugs also promote the trapping of sediments that will rebuild the stream bank and will also increase the natural establishment of woody plant species. The fine root hairs of grasses or wetland plants, when combined with the larger deeper roots of woody plants, help bind the soil particles together and reduce stream bank erosion. Sedges *(Carex spp*.), spikerush *(Eleocharis spp.),* bulrush *(Scirpus spp*.) and rushes *(Juncus spp.)* are used extensively in riparian and wetland restoration because of their aggressive root systems.

Large containers- Container stock ranging in volume from 15 in 3 (245 CM) to 5 gallons (18.9 1) is becoming more popular in riparian restoration because they handle the changing water table and erosive effects of floods better than smaller plants. Large container plants have faster growth rates and produce immediate shade on the water, and allow sedimentation on the floodplain. Besides, when they die and fall over, they provide large woody debris in the stream to create fish habitat. This is particularly critical for salmon restoration efforts. In addition to improving the physical structure of the riparian zone, large container stock increases biodiversity and provides quick food and habitat for a wide variety of wildlife. The major limitations to plant size are the higher cost and difficulty in handling but the desire for "instant results" will continue to favor large stock.

Conclusions and Recommendations:

Assuming you are convinced that there is an increasing demand for riparian plants species, what should you do?

1. Pursue new markets. Time is critical as markets for native riparian plant material are developing rapidly. Therefore, nurseries must be aggressive and seek out new customers to introduce their products and services. Attend meetings of potential customers and use new marketing techniques like establishing a website on the internet.

2. Practice "Show and Tell". Many customers have no understanding of nursery procedures or potential so be sure to show potential customers what you can produce - both species and stock types. Invite potential customers to an open house at your nursery to show what types of plant materials you can grow. Showing is always better than telling, so try to grow some typical riparian plants, or establish stooling beds or mother plants ahead of time.

3. Emphasize "source-identified" and "locally-adapted". Many project managers, especially engineers and even other biologists, do not understand that revegetation projects have different objectives than other types of plantings. Explain the importance of using native plant material that is collected at their project area and adapted to the local environment. When growing sample plants, make sure that you have the proper sources for a specific project.

This section was taken from Plant Materials for Riparian Restoration by J. Chris Hoag and Thomas D. Landis. The full *paper will be published in the Native Plants Journal 2(!) in January 2001.*

Sources:

Carlson, J. R. 1992. *Selection, production, and use of riparian plant materials for the western United States.* IN: Intermountain Forest Nursery Association, proceedings, 1991, p. 55-67. Landis, T.D., ed. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-21 1.

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