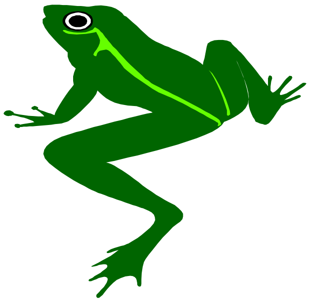
View From a Wetland

News and Technology for Riparian and Wetland Management



Interagency Riparian/Wetland Plant Development Project
Natural Resources Conservation Service
Plant Materials Center
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"...When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture." - **Aldo Leopold**

Introduction

This is the second in a series of annual newsletters produced by the Interagency Riparian/Wetland Plant Development Project. The objectives of this newsletter are to: 1) explain what the Riparian/ Wetland Project is all about, 2) provide information about riparian and wetland plants, 3) provide planting techniques for riparian and wetland plants, and 4) offer recommendations for where and when to use riparian and wetland plants.

Our first newsletter, produced in 1994, was a tremendous success. Response has been great, with requests for information about the Interagency Riparian/Wetland Development Project, our information series, and Tech Notes from 121 persons in 25 states and 3 countries. We also had 234 phone requests for information. We hope that this newsletter provides information that is important to our customers. Please feel free to call, write, or drop in at any time.

Riparian/wetland Project

The Interagency Riparian/Wetland Plant Development Project was established in 1991 when several federal, state, local, and private organizations decided they needed performance tested ecotypes of wetland and riparian species for commercial production, information on how to propagate and plant riparian and wetland plants, information on how to establish and maintain wetland and riparian vegetation in artificial situations, and other uses related to water quality improvement.

Wetland and Riparian plants we are currently researching include:

Herbaceous Plants
Nebraska Sedge *(Carex nebrascensis)*
Creeping Spikerush *(Eleocharis palustris)*
Baltic Rush *(Juncus balticus)*
Threesquare Bulrush *(Scirpus pungens)*
Alkali Bulrush *(Scirpus maritimus)*
Hardstem Bulrush *(Scirpus acutus)*
Water Smartweed *(Polygonum amphibium)*

Woody Plants
Coyote Willow *(Salix exigua)*
Geyers Willow *(Salix geyeriana)*
Booth Willow *(Salix boothii)*
Drummond Willow *(Salix drummondiana)*
Lemmon Willow *(Salix lemmonii)*
Yellow Willow *(Salix lutea)*
Pacific Willow *(Salix lucida ssp lasiandra)*
Peachleaf Willow *(Salix amygdaloides)*
Laurel Willow *(Salix pentandra)*
Narrowleaf Cottonwood *(Populus angustifolia)*
Black Cottonwood *(Populus balsamifera ssp trichocarpa)*

The Project has an aggressive technology transfer program to convey our research results as possible to professionals in the field. We have created a series of technical papers called the Riparian/ Wetland Project Information Series and a few NRCS Technical Notes. A list of the

Information Series papers and Tech Notes can be found on the back of this newsletter.

Release of performance tested ecotypes

In 1996, we plan to release up to 22 performance tested ecotypes for 5 of the species of emergent wetland plants listed above. These releases will be based on new alternative release methods, either Source Identified or Selected (See Idaho Tech Note 27) instead of releasing the plants as a cultivar or variety. The areas of adaptation for each ecotype will be based on LRR and MLRA boundaries (Land Resource Regions from Agricultural Handbook 296). Commercial seed production will not start until late 1996 or 1997 so seed will not be available for purchase until at least one year later.

Collection Tips For Herbaceous Wetland Plants

I want to create a wetland; should I collect seed and grow the plants I need or should I transplant them directly from the wild? This is a question we hear often. Both methods have their pros and cons. Which method is the best for your planting project will depend on a few factors.

1) Do you have the facilities to grow the plants? Do you have funds to contract greenhouse propagation of plants? While a greenhouse isn't absolutely necessary, it will allow you to grow the plants through the winter, making them ready to be planted out in the spring. One can grow plants from seed outside in pots, in small ponds, or artificial wetlands, but this limits you to either transplanting them out in the fall or waiting until the following spring.

2) When do you need the plants? Most herbaceous wetland species are going to require about one month of seed stratification, and about 3 or 4 months growing time before they can be transplanted. Therefore, if you need them in short order, you will need to make wild collection instead of growing them from seed. Fall plantings will work, but expect less survival and a slower rate of colonization than from late spring or summer plantings.

3) Do you have a source for seed or plants? Depending on land ownership of the collection site, you may not be allowed to dig up entire plants. Often, land owners/managers are more positive about seed collection. Also, if the population is small on a given site, and your needs are large, it is more environmentally friendly to leave the plants in place and collect the seed. Remember, collecting seed will add additional time to your project because you will have to collect in the fall before planting.

4) What are the labor costs? The economic feasibility of either collecting or growing will vary from project to project. If the volume of plants needed for the project is large, wild plant collections will require extensive physical labor. Remember that with either method, planting the plugs at the site will be very labor intensive; volunteers can significantly reduce these costs.

5) One last consideration is the rate of colonization. Here at the PMC we have found that greenhouse-grown plants consistently outperform wild collected transplants in their rate of rhizomatous spread in the first growing season or two. Given the same planting density, both propagation methods will fill in equally after a couple of seasons. So if the speed of colonization is an important factor, you may want to either use greenhouse grown plants or plant more densely.

6) Budget concerns must be considered when planning a project. Your decisions will be based on materials (plants, tools, containers, potting soil, etc.), labor, and transportation costs. Answering the following questions may help you with your budget decisions: What sorts of materials and facilities are available to you? What other materials will you need to purchase? How much help will you need? How many plants will you need? How far will you have to transport the plants? You should consider mileage costs, plant stress, distance from the contract greenhouse or collection site to the planting site. How many times will you have to handle the plants? In order to decrease plant stress and transportation and labor costs, the plants should be handled as few times as possible.

Consideration of these factors should help you in making the decision whether to collect seed and grow your own plants or to transplant wild growing plants.

Seed Collection Tips

How to collect

Seed collections can be made quite easily with only a paper bag and a pair of hand clippers. Just clip the seed head from the plant and put it in the bag. Or if you prefer, one can grasp the seed head and strip the seeds from the plant. Special care should be taken when collecting Juncus seed because they are very tiny and easily lost. If the seed heads of Juncus are held upside down, the seeds may be dumped out. When collecting Juncus we recommend carefully clipping the seed heads, being sure to hold them upright while transferring them to your collection bag. Another word to the wise, when collecting *Scirpus maritimus*, be sure to wear a pair of gloves! The seed heads of this species have tiny bracts that work their way into your skin and can be very irritating.

Be sure to keep the bags of seeds dry. Stir the seeds every few days so that they dry evenly and don't get moldy. Seeds can be kept in the paper bags until you are ready to clean them.

When to collect

Seed maturity will vary from place to place, species to species, and year to year. Generally, most species will be ready to collect from the end of August through September. It is best to go out to the site and check the condition and maturity of the seed several times before you harvest so that you can better time the collection. Ideally you'll want to collect the seed after it hardens, and just before it shatters or falls from the plant. Some species, such as Juncus, shatter readily while other species, such as Scirpus, tend to hold the seed for a long period of time.

When collecting seed, identification of the actual seed itself can be difficult. For example, with Juncus species, there is often confusion in differentiating the capsules from the seeds. The seed is about the size of fine ground pepper and is contained within the capsule. The capsule is large with dark streaks down the middle. Carex spp. produce seed that is protected by a leathery cover called a perigynia. To see the seed, the perigynia must be removed. Often, Carex spp. will not produce seed but the perigynia will look normal. When collecting Carex seed it is a good idea to open a few of the perigynia to check if the plants produced any viable seed so that you don't waste your time.

Wild Plant Collections

How to Collect

The only equipment needed to harvest live plant materials is a shovel, a few buckets, some coolers, and a good strong back. We like to dig a clump that is about 20 - 30 cm (8 - 12 in.) in diameter and no more than 15 cm (6 in.) deep. This size clump can later be divided into 5 or 6 individual plugs. Generally, you can harvest about 0.1 m^2 (1.1 ft^2) from a 1 m^2 (10.8 ft2) area without harming the plant community. Rhizomatous spread from remaining plants will fill the void created by the collection within one growing season.

You can either leave the soil on the roots of your harvested material or remove it. Leaving the soil on the roots can increase the survival rate, help to inoculate the new wetland site, and provide a seed source for additional species. However, leaving the soil on the roots will increase the weight and the logistics of moving the plants to the planting site.

When collecting, transporting, or storing, it is extremely important to keep the plants cool and moist. Place them in Styrofoam coolers as soon as they are dug up and add a enough water to cover the roots. The tops of the plants should be cut back. Leave just enough of the tops so that they will stick out of the water when they are transplanted. The tops assist in getting oxygen to the roots.

There are a couple of problems that arise when harvesting plants from a weedy area: 1) those weeds, either as seeds or roots in the soil, can then be transported to the transplant site, and 2) weeds may out compete the beneficial species in the void created by the harvest, causing the area to degrade even further. One should try and avoid collecting in weedy areas, especially those contaminated with purple loosestrife.

Whichever method you choose be sure to get permission and any permits that may be required in your area. Never take more than you need.

When to collect

Plants can be collected at anytime of the year, however, if you live in a cold climate, it may be difficult to dig the rhizomes out of frozen ground. Ideally, you should make your collections and transplant them as quickly as possible. This will reduce the stress on the plants, as well as reduce the number of times you will need to handle the plants, thus reducing cost. When transporting the plants, it is very important to keep them cool and moist. Styrofoam coolers work great for transport and storage containers.

Hydrology of Wetlands

Wetlands are dynamic ecosystems and they are highly dependent upon disturbance. Hydrology is perhaps the most important factor in determining wetland type and quality, and usually the "easiest" to manage or manipulate. Changes in water levels influence species composition, structure, and distribution of plant communities. Water management is absolutely critical during plant establishment, and remains crucial throughout the life of the wetland for proper community management.

When designing a constructed wetland project make sure that the design engineers thoroughly understand the importance of water control to the establishment, management, and overall function of the wetland system. If you don't build control into the system from the start, plant establishment may be severely inhibited and opportunities for future community management will be handicapped. Ideally, you should be able to control the amount of water coming in as well as going out.

After the initial planting of emergent vegetation, be careful not to raise the water level to more than 2 to 3 cm (about 1 in.) above the substrate. Too much water at this time may stress the new plants. Maintain the water at 2-3 cm for about one week, this will inhibit the germination and growth of any terrestrial species that may be present in the new wetland. The water level can then be lowered to the substrate surface for 15 to 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants (if used) to germinate as well as increase the rate of spread of the transplants. You can then raise the water level 3 to 5 cm (1 or 2 in.) for another week. Then lower the water to the substrate surface for another 15 to 20 days. After this period, slowly raise the water level to 10 to 15 cm (4 to 6 in.) for 3 to 5 days. Continue to gradually increase the water depth to 15 to 20 cm (6 to 8 in.). Remember that the aerenchymous tissues in the plant shoots are what supply the roots with oxygen so be careful not to raise the water over the tops of the emergent vegetation. If the plants are not showing any stress, continue to carefully raise the water level to 30 to 50 cm (12 to 20 in.) if possible. The goal here is to inundate the transition zone between wetland and upland as much as possible to control any invading terrestrial species. After about 20 days lower the water level to about 5 to 7 cm (2 to 3 in.). For the rest of the growing season, adjust the water level to maximize the desired community type. The key to determining the appropriate water level is to monitor the emergent wetland plant community. Raise the water level if weed problems surface. Lower the water level to encourage emergent wetland plant growth and spread.

Ideally, the water level should be raised to 10 to 15 cm (4 to 6 in.) or more before the onset of winter. This allows for free water between the ice and the substrate to protect the roots of the plants from freezing. Be extremely careful however, as you don't want to drown the plants. In many areas such as the Intermountain West, our water is tied to the irrigation season and therefore not available through the winter months. Our wetlands are dry for most of the winter, but recover with little damage in the spring.

During the second spring, raise the water level again to flood most of the transition zone. Maintain this level until warm weather sets in and new growth has started. Once the wetland vegetation starts to grow, lower the water to the level of the substrate for 5 to 10 days followed by 1 or 2 cm (1/2 in.) of water for 2 or 3 days. Again, lower the water to the surface of the substrate for 5 to 10 more days. This creates a warm moist mud flat situation, which is ideal for the germination and growth of any wetland seeds that may be in the wetland. When new plant growth is evident gradually raise the water level to 8 to 10 cm (3 to 4 in.). Again, for the rest of the growing season, adjust the water level to maximize the desired community type. Monitor weed incursion and emergent plant stress. Treat the fall and winter levels the same as for the first year.

Once the constructed wetland is established, the water levels can be manipulated to maintain the desired conditions for your system. Remember that the wetland communities are dynamic and require a fluctuating water level to function properly. (adapted from: Creating Freshwater Wetlands by D.A.Hammer)

Seed Preparation for Nebraska Sedge (*Carex nebrascensis*)

Have you ever planted Nebraska Sedge (Carex nebrascensis) and then waited and waited and waited for it to germinate? Well, you're not alone. After a few frustrating seasons here at the PMC, we decided to look into ways of increasing the speed of germination and the percentage.

We looked at numerous factors including: length of stratification, perigynia removal, scarification, the addition of activated charcoal (to get rid of any germination inhibitors), and sphagnum moss. These factors were investigated by themselves and in various combinations. The combination of treatments that consistently performed the best included lightly scarified seeds stratified for 30 days in a mixture of distilled water and sphagnum moss. After this treatment, the seeds were all placed in petri dishes with 24 hours of light and heated to about 94°F. Germination began in 5 or 6 days. It took 7 days for 50% of the viable seeds to germinate and 100% of the viable seeds germinated within 21 days.

Seed preparation tips

To start with, you'll need some sort of scarification device. We made a small topless box, about 4" X 6" and 1" deep, out of scrap lumber, lined the bottom with 100 grit sand paper (smaller grit would be fine) and cut a small piece of wood which would fit in the box and wrapped it with the same type of sand paper. We put about 60 to 100 seeds in the bottom of the box. The block is then drawn lightly back and forth over the seeds for about 10 to 15 seconds. Be very careful you don't over do it - it's very easy to damage the seed! As soon as you get the perigynia off - STOP! Next, you'll want to put the seeds in a waterproof container (yogurt cups work great). For a container the size of a cup, put about 8 grams of sphagnum wrapped in cheese cloth in the bottom of the cup (the cheese cloth will help keep the seed separate from the sphagnum making your job easier at planting time). Add your scarified seed, fill the container with distilled water, cap it, and place it in a dark part of a cooler or refrigerator at 34-38°F for 30 days. After this period, your seeds are ready to plant. Remember in order for the seeds to germinate, they need heat, light, and moisture.

This method will probably work for other wetland species as well. If you try this process on other species, give us a call and let us know how it worked. Good luck. (For more information, see Info Series No. 10 - Seed Germination Enhancement for *Carex nebrascensis* (Nebraska Sedge). (In Press)

The Beaver: A Riparian Zone Engineer

Are you thinking about restoring a degraded riparian area, but the labor costs are a bit out of your reach? Beavers may be the volunteer labor force you've been looking for. Beaver (*Castor canadensis*) can play a major role in the overall health and functioning of riparian ecosystems. Interactions between beaver and riparian vegetation improve fish and wildlife habitat, increase biodiversity, increase water quality, help to raise the riparian water table, increase infiltration into the local aquifer, and increase midsummer base flows.

In a degraded watershed where excess water and sediment are moved into an undersized riparian channel, streambank erosion will occur as the riparian corridor attempts to resize itself to handle the extra flow and sediment load. If the riparian vegetation in the channel has been reduced, destroyed, or removed, this resizing will increase the streambank erosion. The channel will start to downcut into the streambed. If the streambed has a hard pan or sits on bedrock, the erosion will tend to move laterally creating more meanders. As the streambed declines, the water level will drop which in turn tends to lower the water table, and this in turn will push the vegetative community towards more xeric species.

Enter the beaver!! When beaver are introduced into an eroding and downcutting riparian channel, their dams help to trap sediment, raise the water table, and provide a favorable environment for riparian vegetation recovery. Over time, the combination of beaver activities and healthy riparian vegetation aid in the rehabilitation of the riparian ecosystem.

Areas chosen for beaver reintroductions should have perennial flows no less than 0.5 cfs, channel slopes less then 14% (preferably less than 6%), adequate woody vegetation for food and construction material, and cooperation from upstream and downstream neighbors. The education of the adjacent landowners will be the most important and possibly the most difficult particularly in irrigation water storage areas.

After the beavers have been reintroduced, the new colony needs to be protected for the first 3 years while it is becoming established. After the colony is well established, some beaver may be harvested, but extreme care should be taken not to over harvest as this can lead to dam failure.

Riparian areas are very dynamic systems. Beavers have evolved over the millennia with many of these systems and can be a crucial component of the ecosystem. Beaver reintroductions are not a cure-all. They can be a tool used to help in the recovery of a degraded area. For riparian rehabilitation projects to be successful, all of the factors that have caused the stream to degrade in the first place need to be addressed (e.g. whole watershed degradation, overgrazing, removal of riparian buffer zones, stream channel alterations, etc.).

Persons interested in reintroducing beaver should contact their state Fish and Game agency or the Department of Natural Resources.

Muskrats and their role in habitat diversification

As discussed earlier, the beaver is a species, which has a great influence on its environment. By constructing dams, beavers alter plant and animal species compositions and hydrological regimes. The muskrat (*Ondatra zibethicus*) is another species that significantly alters its environment. Mustrats have evolved with wetland ecosystems and form a valuable component of healthy functioning wetland communities.

Muskrats commonly inhabit wetlands from near the Arctic Circle south to the Gulf of Mexico and from the Aleutian Islands east to the Atlantic coast. Muskrats are native to North America and were introduced into Europe and South America as a source of fur. Viable wild populations now exist in Western Europe, Scandinavia, Japan and Russia.

The breeding season extends through all seasons of the year in the southern United States, but is reduced to spring and summer months in more northerly latitudes. Average litter size is four to six young. One to two litters are produced annually in northern latitudes, and up to six litters are produced annually in the south. Females usually produce their first litter during the spring following their birth. However, precocial breeding has been reported in many areas.

Cattails (*Typha spp.*) are the primary food of muskrats, but almost any plant may be consumed. Muskrats usually transport their food to a protected site before consumption, but rarely store it. Although muskrats are primarily herbivores, they will eat crustaceans, frogs, fish, and when vegetation is in short supply, even other muskrats.

Muskrats live in huts (constructed of local vegetation) or burrows dug into banks. Huts are constructed by cutting and piling vegetation on elevated points, such as submerged logs or rocks, or floating mats of vegetation. They then burrow up from the bottom of the vegetation pile to create their living space. Smaller feeding huts are usually constructed 5 to 25 feet from the main dwelling hut, allowing them to increase their foraging range beneath the ice. Vegetation used for hut construction and for food is typically collected from the area surrounding the huts, creating a moat of open water. These areas of open water are commonly referred to as eatouts. Eatouts provide opportunities for aquatic plants to become established in areas that would normally have dense stands of emergent vegetation. Significant amounts of emergent vegetation can be removed during periods of high muskrat population densities.

Given their great reproductive potential, feeding habits, and hut construction behavior, muskrats greatly affect the species composition, density, and distribution of the wetland community. Huts serve as islands for plant species that may not otherwise be common within the wetland itself. One study in southwestern Michigan documented 26 plant species growing on muskrat huts. Biomass production for these species was 35 times greater on the hut mounds than in the surrounding marsh. Several of these species provide an important source of food for waterfowl. Selective grazing by waterfowl as well as nutrient deposition by defecation further influences the species composition on the muskrat huts.

Muskrat huts and eatouts are commonly used by waterfowl for eating, nesting, and loafing. Where muskrats are maintained at stable population levels, the open water areas around their huts can be beneficial to waterfowl as well as other wildlife species.

A ratio of 1:1, open water to emergent cover, is ideal for avian production. Where possible, wetland management should include muskrat harvests and water level drawdown to best achieve this 1:1 ratio. By drawing the water level down, stands of emergent perennials can significantly increase in density. Later, muskrats move in and open up the dense stands creating optimum habitat for many species of wildlife.

Although this is only a brief review of the ways in which muskrats influence the wetland environment, it should be clear that wetlands would be a very different place were it not for these aquatic rodents.

Dormant Cutting Storage Time

Willows and cottonwoods are easily propagated from dormant pole cuttings because they have root primordia located along the entire stem. These primordia, when in contact with soil, will sprout roots. They will sprout stems and leaves when exposed to sunlight.

Questions constantly arise about whether to harvest and plant immediately or harvest, store, and plant later. Harvesting the cuttings in the winter and storing them in a cooler at 28-34øF does not negatively affect establishment success. However, establishment success tends to drop after about six months of storage. One drawback to storage followed by fall plantings is that the cuttings tend to take much longer to establish when it warms up in the spring.

Our research also indicates that there is no significant economic advantage to using rooting hormones or fungicides when planting large numbers of large diameter cuttings. There appears to be some advantage to using rooting hormones if small diameter cuttings are all that are available.

We have the best success with harvesting the cuttings and immediately planting them in the spring. We have also had extremely high success with cuttings collected in spring and planted later in the summer. We have planted in late fall and early winter with lower success rates. We usually base our decision of when to plant on our labor pool and work schedules rather than the "best" time to plant.

Weed control for woody plantings in nursery situations

As part of the Riparian/Wetland Project, we have collected native willows throughout our service area and brought them back to the PMC to test each collection's response to typical cultural practices like weed control. This information will be important to nurseries and private growers when ecotypic releases are made to the public market and they start growing the releases for sale to private landowners, local, state, and federal agencies.

In pursuit of better weed control and a corresponding increase in growth, the PMC has tested a new product on the market referred to as weed barrier or fabric mulch. This barrier or mulch is made from black polypropylene material that is woven so as to allow water to pass through the material and into the ground, but will not allow weeds to grow up through it. It is treated to prevent UV light degradation for 5 to 7 years after which it will start to break down. The shrubs and trees at this time will have nearly full canopy cover.

Initial testing of the weed barrier product began in 1993. Ten species of native willows were collected and planted at the PMC, six in 1993 and the remaining four in 1994. In 1993, two tree-type (one tree-type was a cottonwood), three shrub-type and a creeping-type willow were planted in a cultivated field on the PMC farm with no weed barrier. A total of 1520 cuttings were planted.

In 1994, a total of 1161 more cuttings were planted. These 1994 cuttings were planted directly with weed barrier. We also retrofitted weed barrier over the 1993 cuttings at the same time. On average, the field received about 7.5 cm of water per week from irrigation and precipitation. The soil moisture under the weed barrier was 90% at 9" deep, while soil outside the barrier had a moisture content of about 10%. In 1994, we had a survival rate of 86% for the rows planted with weed barrier and 80% survival for the rows without weed barrier. Cottonwoods showed a jump of 12% in survival with the weed barrier. The greatest increase came with the creeping-type willows. They had an increase of nearly 15% in survival with the weed barrier.

Generally, weed barrier can be installed for under $0.40 per foot. For growing trees and shrubs in a nursery or cultivated situation, weed barrier or fabric mulch can increase the survival rate, increase the growth rate, decrease the labor requirements, and improve the aesthetics of the field.

Riparian Ecology and restoration workshops

As part of our technology transfer program, we have developed a two-day Riparian Ecology, Restoration, and Management Workshop. The first day is devoted to the classroom where we cover basic concepts, riparian zone vegetation, planning alternatives, plant acquisition, and bioengineering techniques. The second day is spent in the field where the course participants actually classify the site and install a series of bioengineering structures on an eroding section of stream.

We offered a total of 14 workshops in four different states in 1995. These workshops were extremely successful. In all, we instructed over 100 students who work for the NRCS, 15 with SCDs, 86 with other federal agencies, 67 state employees, and 60 private company employees. The reaction of the participants was overwhelming. Evaluations completed after the course indicated that one hundred percent of the participants rated their "overall reaction to the course" as very good to excellent. When the participants were asked about how well the course met their expectations, 95% said - good to excellent. For us, the best comment was on the "value of the course to their present job" where 99% rated it as good to excellent.

Based on this feedback, we are going to offer in April and May, 1996, two workshops in Utah, three workshops in Montana, and one or two workshops in Idaho. There may be some openings, so anyone interested in attending should contact us here at the PMC.

Bioengineering Techniques: Brush Mattressing, Fascines, Vertical Bundles, and Revetments

Bioengineering is often defined as increasing the strength and structure of soil by adding many layers of roots to bind the soil together to help protect it from erosion. It also includes the use of aboveground biomass that reduces wave and streamflow energy before it impacts the streambank or shoreline. Bioengineering techniques will not work in all cases, but they do provide cost effective alternatives for the landowner to consider.

Bioengineering techniques are designed to be used by the landowner who does not have a large budget, access to heavy equipment, rock riprap, concrete, or large diameter trees. These techniques can be used to install "biostructures" using naturally occurring woody vegetation growing on or near the planting location. This means less damage to sensitive riparian stream channels, fewer access problems to difficult stretches of streambank, and less cost to the landowner.

A few of the most commonly used bioengineering techniques are: brush mattressing, fascines, vertical bundles, and small tree or shrub revetments.

1) A brush mattress is a 4 to 8 inch layer of willow cuttings staked into a sloped streambank so the butts are below the low water line and the tops are above the high water line. Brush mattresses have been documented to offer the same protection as 6 to 10 inch angular riprap. This technique is moderately difficult to install mainly because it is very labor and materials intensive. However, it is significantly cheaper and less destructive than rock riprap.

2) A fascine or wattle is a cigar-shaped 8 to 10-inch diameter bundle of willows or dogwoods placed parallel to the water surface at the low water level. Fascines can be used alone or at the base of a brush mattress. Its main purpose is to protect the toe slope from low water erosion. This technique is easy to install and does not require a lot of plant material. However, it is fairly labor intensive specifically in terms of digging a trench to place the Fascines in, and to pound stakes through the Fascines to hold it firmly in place.

3) Vertical bundles are similar to wattles, except they are tied together with all the butts down and all the tops up. They are placed in a trench dug into the streambank perpendicular to streamflow. The purpose of a vertical bundle is to root into the bank and sprout to deflect moving water away from the streambank similar to a simple jetty. This technique is easy and quick with little labor and few materials needed.

4) Small tree and shrub revetments are basically 10 to 15 foot tall trees and/or shrubs lashed together so the trunks are parallel to the water surface and the line of trees is anchored into the streambank at the low water line. Almost any species of small tree or shrub that is bushy and has a main trunk that gets up to 3 to 5 inches in diameter can be used (e.g. juniper, hawthorn, chokecherry, Russian olive, Big Sagebrush, used Christmas trees, etc.). The numerous branches protrude into the water and deflect the current away from the streambank. The branches also reduce the velocity of the water and causes suspended solids to drop out. This technique is very easy, but moderately labor and material intensive.

These are just a few of a wide variety of techniques that incorporate the use of woody vegetation to reduce streambank and shoreline erosion. Often, bioengineering techniques can be used in conjunction with hard structures to soften their appearance and increase the structure's durability.

Additional Information

The following is a list of available technical papers:

Riparian/Wetland Project Information Series

No. 2 – Planning a Project: Selection and Acquisition of Woody Plant Species and Materials for Riparian Corridors and Shorelines.

No. 3 - Use of Willow and Cottonwood Cuttings for Vegetating Shorelines and Riparian Areas.

No. 4 - How to Plant willows and Cottonwood for Riparian Rehabilitation.

No. 5 - Collection, Establishment, and Evaluation of Unrooted Woody Cuttings to Obtain Performance Tested Ecotypes of Native Willows and Cottonwoods.

No. 6 - Seed and Live Transplant Collection Procedures for 7 Wetland Plant Species.

No. 7 - Use of Greenhouse Propagated Wetland Plants Versus Live Transplants to Vegetate Constructed or Created Wetlands.

No. 8 - Constructed Wetland System For Water Quality Improvement Of Irrigation Wastewater.

No. 9 - Design Criteria for Revegetation in Riparian Zones of the Intermountain Area.

No. 11 - Getting "Bang for your Buck" on your next Wetland Project.

No. 12 - Guidelines for Planting, Establishment, Maintenance of Constructed Wetland Systems.

Idaho NRCS PM Technical Notes

No. 6 - The Stinger, a tool to plant unrooted hardwood cuttings of willow and cottonwood species for riparian or shoreline erosion control or rehabilitation.

No. 23 - How to Plant Willows and Cottonwoods for Riparian Rehabilitation. (This Tech Note describes planting willows and cottonwoods in riparian revegetation in much greater detail and includes references from the scientific literature.)

For a copy, write or call:

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