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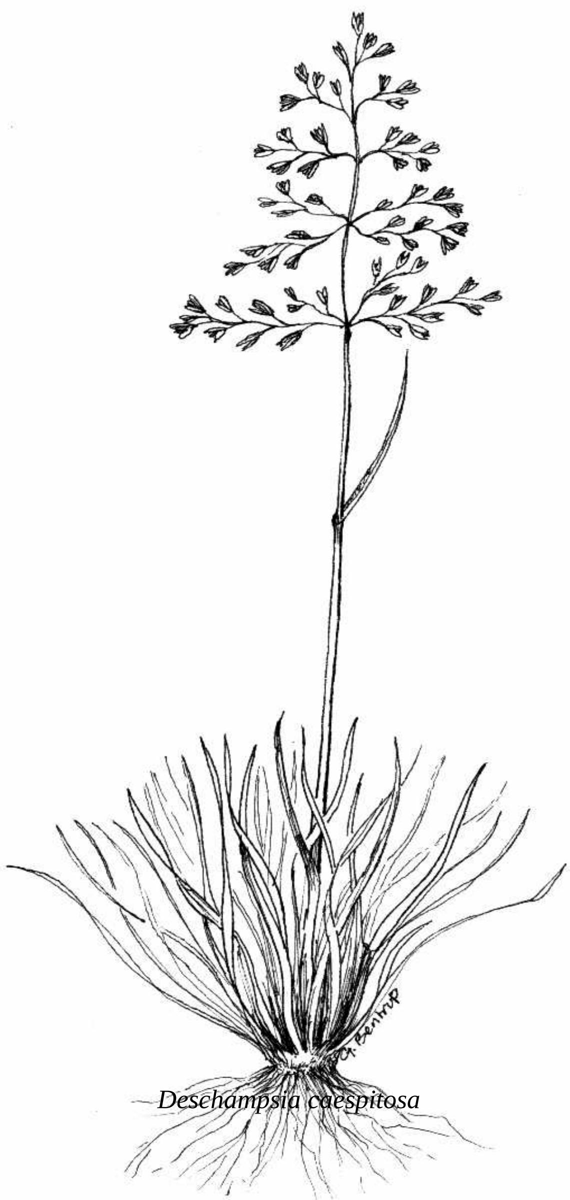
USERS GUIDE TO DESCRIPTION, PROPAGATION AND ESTABLISHMENT OF WETLAND PLANT SPECIES AND GRASSES FOR RIPARIAN AREAS IN THE INTERMOUNTAIN WEST



Deschampsia caespitosa

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USERS GUIDE TO DESCRIPTION, PROPAGATION AND ESTABLISHMENT OF WETLAND PLANT SPECIES AND GRASSES FOR RIPARIAN AREAS IN THE INTERMOUNTAIN WEST

INTRODUCTION

Establishment of riparian plant species depends upon proper selection of species, plant material procurement and handling, planting location, and establishment techniques (Hoag 1993). The success of a project is dependent on the complete integration of these steps. When planning a project, it is important to observe the existing vegetation and their respective locations in relationship to the stream and water table (*Figure 1:* ***Riparian Planting Zones***).

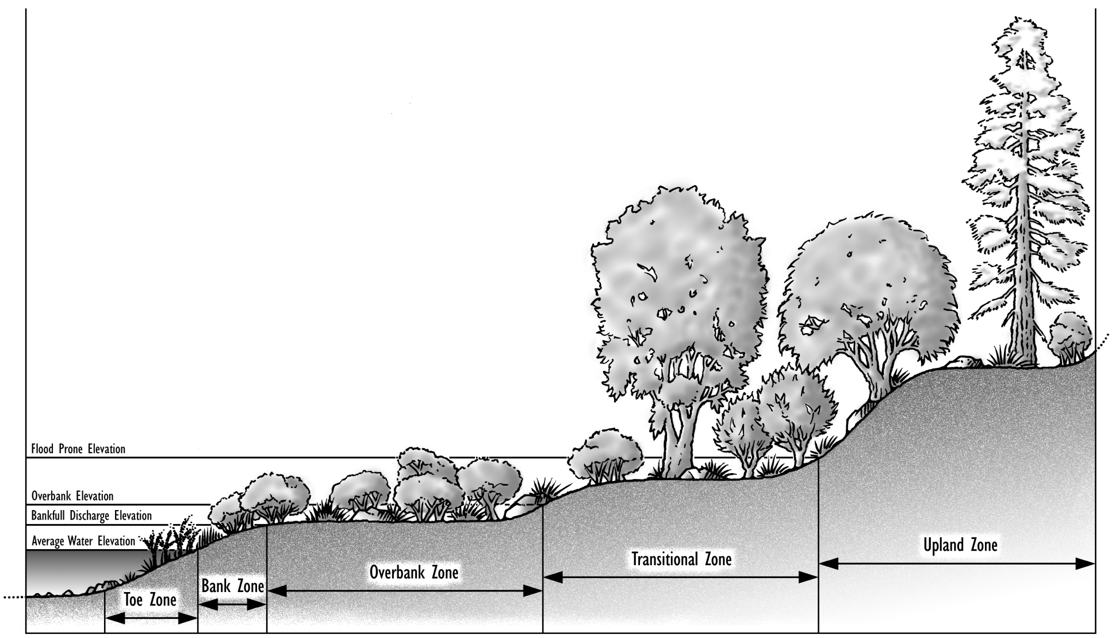

Figure1: Riparian Planting Zones can be used to determine where riparian species should be planted in relation to the waterline. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent. (From Hoag 1999, Hoag 2001)

Herbaceous species may be used in conjunction with or without woody species depending upon site potential. A reference site similar to the project site should be located to determine site potential. Attempt to match as close as possible the different species that naturally grow when planting the project site. This is the biological benchmark one is striving to create. Look for wetland herbaceous plants that can survive in standing water. Wetland plants like bulrush (*Scirpus* spp.) and cattail (*Typha* spp.) can act as a buffer to reduce the velocity of streamflows that intercept the bank. They can survive and thrive in areas where woody plants will not grow. Wetland herbaceous species can be found throughout the streambank cross section, although most emergent aquatics will be found in the toe zone (Bentrup and Hoag, 1998). Hoag (2001) provides additional details on water levels in the riparian planting zones. The toe zone is actually split up into hydrologic zones because the emergent vegetation is attuned to specific water regimes. *Figure 2* displays the hydrologic zones found in the riparian planting zones which more specifically identify planting zones for the herbaceous species. Bankfull discharge elevation is at the top of hydrologic zone 3. Zones 1,2, and 3 are part of the toe and bank zone. Zone 4 is found in the overbank zone. Zone 5 is part of the transitional zone. Zone 6 is the upland zone.

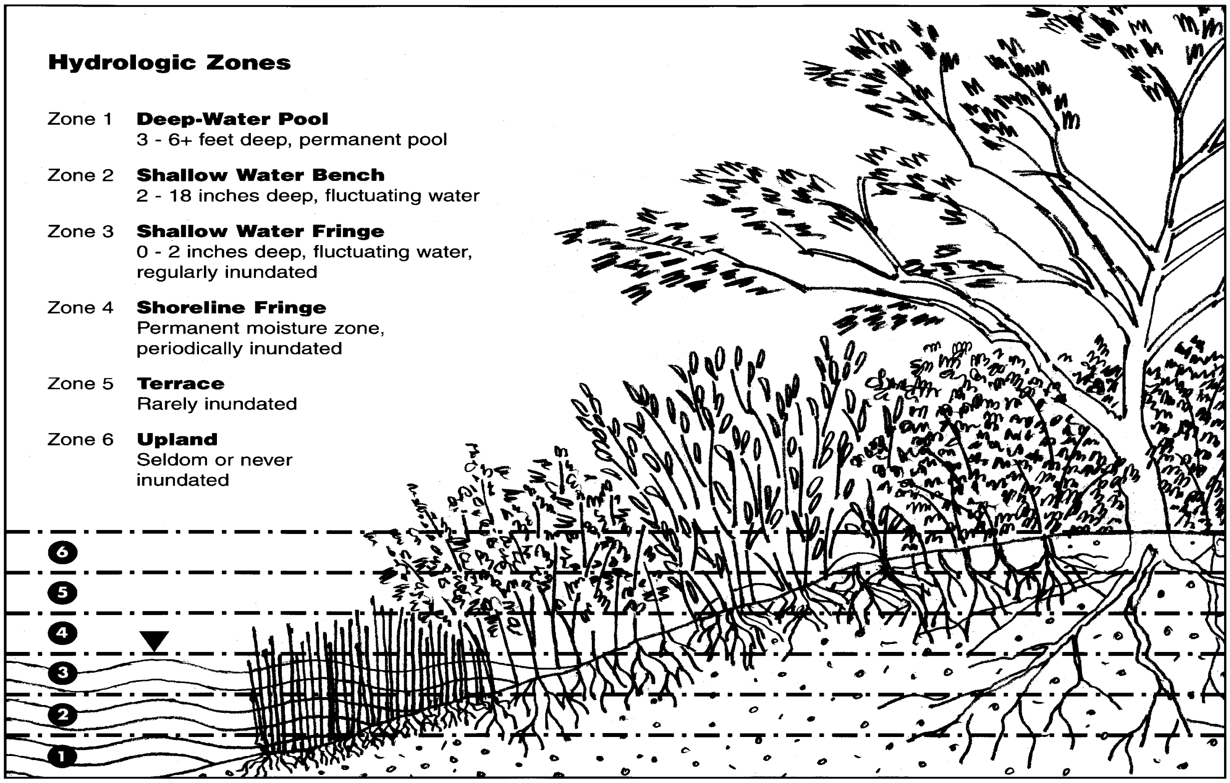

Figure 2: Hydrologic zones for planting herbaceous species in the Intermountain West. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent (Ogle and Hoag 2000)(Drawing by City of Boise).

SPECIES DESCRIPTIONS AND PROPAGATION TECHNIQUES

The following information describes riparian herbaceous species, their typical habitat, greenhouse propagation requirements, and field propagation methods. Greenhouse propagation requirements are procedures that should be used to produce seedlings for transplant. These procedures generally require greenhouse space, greenhouse equipment and supplies, some greenhouse propagation skill, and adequate time to grow the plants before transferring to your project location (Hoag 2000).

Appendix A contains a table of herbaceous species for the Intermountain West. This provides some of the common species, characteristics and applicability for use in riparian areas. It also contains the hydrologic zones for each herbaceous species.

Appendix B provides plant datasheets and illustrations of species descriptions, habitat, wildlife benefits, and propagation and planting techniques. Not all of the species listed in Appendix A have a plant datasheet. New plant datasheets will be posted on the Internet as they are developed so they can be downloaded and added to this Technical Note. Most of the wetland plant datasheets can be found in Appendix B of The Practical Streambank Bioengineering Guide (Bentrup and Hoag, 1998). The entire Guide or just the plant datasheets can be downloaded in *.pdf format from the following site:

http://www.nhq.nrcs.usda.gov/BCS/PMC/pubs/IDPMCpubs-wet.html

Another reference that provides information on plant species that are not covered by the plant datasheets is Plant Guide Handbook (Ogle 1997). The Plant Guide Handbook includes plant guides on a variety of plants. This Guide provides information on the description, uses, and management of herbaceous and woody plants.

General Seeding

Seeds can be used to increase the diversity of the site. Seeding in disturbed sites will decrease weed invasion that typically occurs on exposed soil. Seeded areas take longer than transplants to establish, so seedlings should not be considered as immediate erosion control plantings. Over the long term, however, seeding can provide additional root masses and aboveground biomass that will help reduce streamflow energy and promote sediment deposition (Bentrup and Hoag, 1998).

Seeding Wetland Plants

Many wetland plants are very difficult to seed in the wild. Wetland plant seeds usually need three things to germinate: 1) heat, 2) water, and 3) light. The need for light means that wetland plant seeds should be seeded on the soil surface and they should not be covered with soil (Grelsson and Nilsson 1991, Leck 1989, Salisbury 1970). Drilling the seed will cover the seed especially if packer wheels or drag chains are used.

Many species have a very hard seed coat that takes up to one year or longer to break down enough for the embryo to germinate. Many species require special stratification treatments to prepare the seed for planting. These treatments include everything from acid wash to mechanical scarification, from pre-chilling to extremely high temperature soil conditions. Occasionally, depending on species, dormant seeding (seeding during the late fall or early winter after the plants have gone dormant) can be successful.

Not having absolute control of the water going into the wetland or riparian area is the most common mistake that occurs when seeding wetland plants. As water enters the system, the newly planted seeds may float to the water surface and move to the water’s edge where wave action will deposit the seed in a very narrow zone. The seed will germinate and the stand will generally be successful as long as the hydrologic conditions are maintained for the various deposited species (Hoag and Sellers 1995). With good water control, the seeds should stay in place and the stand will cover the wetland bottom instead of just around the fringe (Hoag 2000).

Some species seeded in a greenhouse setting need a cold-hot stratification environment for successful germination. This requires the seed to be placed in cold storage at 32-36º F for 30-60 days and then planted in moist soil containers at air temperatures of about 100º F. Heat is an essential requirement for germination and growth of wetland plant species (Hoag et al. 1995).

Using direct seeding of herbaceous plants as the primary means of revegetating a site requires more attention to planning and control of site hydrology during the establishment period to be successful. In addition, it is important to understand the specific germination/stratification requirements of the targeted species. Successful establishment of herbaceous vegetation by direct seeding is possible. Examples include the establishment of Tufted hairgrass (*Deschampsia caespitosa*) wetlands in Oregon and multiple species herbaceous depression wetlands in Delaware. However, direct seeding of herbaceous species is not typically used as the primary means of revegetation. It is primarily a method to increase the overall species diversity in a wetland, particularly around the perimeter and to establish populations of specific target species (Hoag 2000).

Revegetating a site with herbaceous species plugs of greenhouse grown material has a much higher establishment rate than seeding or collection of wildlings (plugs collected from wild populations) (Hoag and Sellers 1995).

<u>Seeding Grasses</u>

There are three main factors to consider when planning the seeding phase of the revegetation operation. These factors include season of seeding, seeding rates, and method of application. Grasses are normally located in hydrologic zones 4, 5, and 6. Colonizer species are often found in hydrologic zones 2 and 3. Season of seeding is important because some seeds may require stratification before germination. Seeding rate concerns both economics and plant competition. Too much seed on a site puts unnecessary cost into the total process and, at the same time, a thinner stand will emerge because of plant competition for nutrients. Ideally, the site should have been prepared the previous fall if a spring seeding is desired. Usually spring seedings are planted between periods of wet and dry weather. If spring seedings are to be effective, they should generally be made as early in the spring as possible and prior to spring rains. There may be a problem getting heavy equipment onto the site to prepare a seedbed in the spring following a wet winter that has saturated the soil profile. Site preparation should generally occur the summer, fall or early winter prior to seeding. In some cases, seeding can occur during periods in late winter when the site is frozen if wet conditions later in the spring are considered a serious problem.

Seeding rates should provide adequate seed for a good stand and limit the reduction of future stands because of too much competition among seedlings. Increased seeding rates may increase initial plant densities, but there is usually an inverse relationship between initial high density and survivability the first year after establishment of the stand. Poorly prepared seedbeds require higher than normal seeding rates; however, increased seeding rates will not compensate for poor seedbed preparation. Seeding rate computations are based on pure live seed (PLS) per square foot (MSU and NRCS 1990). As a general rule of thumb, smaller seed generally requires higher seeding rates than larger seed.

The two methods of direct seeding are broadcast and drill planting. A primary consideration when either broadcasting or drilling seed is seeding depth. Generally, small seeds are planted at shallower depths, around ¼ in, and medium to large seeds at depths of ½ in or deeper. Planting depth is also determined by soil texture. Finer soil textures are generally planted shallower than coarse textured soils like sand and gravel.

If the seedbed is relatively uniform and rough, broadcast planting is recommended. This type of seedbed can be prepared on most highly disturbed sites and road-cuts. Dry method - hand cyclone seeders, air guns, or blowers are good inexpensive means for broadcast applying grass and legume seeds. Care should be taken to insure an even distribution of light and heavy seeds over the areas to be seeded. One advantage of broadcast seeding is that many species and types of seed can be contained in the seeding mixture. Mixtures are recommended because they increase the chance of success and improve vegetation diversity. Many species have heavy, awned or fuzzy seed. These seed types can clog a drill, making seeding a tedious process. A primary requirement for successfully establishing stands of vegetation using the broadcast planting method is that the seed can be adequately covered following sowing by harrowing or packing. Using a cultipacker or heavy sheepsfoot roller is an acceptable method to cover seed. These implements compress some seed to approximately an inch depth while others are only slightly covered or very near the soil surface. Double the seeding rates normally used for drill planting, when using the broadcast method (MSU and NRCS 1990).

Drilling seed into a prepared seedbed also has advantages. Drills are most effective when only a few species are included in the mixture. Large and small seeded species can be placed in separate boxes, and depth bands can be set to plant the seed at a specific depth. Spacing of seed is also more controlled with a drill. Good stand establishment can be accomplished with row widths of 6-14 inches (15-36 cm).

Seeding rates are dependent upon many factors including planting method, species, site conditions, climate, and others. Appropriate seeding rate information can be found in a variety of publications which include, but are not limited to, Idaho Plant Materials Technical Note 24 (Ogle 1998) and the Montana Field Office Technical Guide.

Wildlings (Wild Transplant Collection)

Wetland plants are readily transplanted because of their tremendous root systems and the fact that the remaining plants will fill in the harvest hole rapidly. One rule of thumb is to dig no more than 1 ft^2 (0.09 m^2) of plant material from a 4 ft^2 (0.4 m^2) area. It is not necessary to harvest deeper than 5 to 6 in (13 to 15 cm). This depth will provide enough root mass to ensure good establishment at the project site. It will also retain enough of the transplants' root system below the harvest point to allow the plants to grow back into the harvest hole in one growing season assuming good hydrology and some sediment deposition (Hoag 1994, Bentrup and Hoag 1998). Transplants can be taken at almost any time of the year. Collections in Idaho have been taken from March to October with little or no difference in transplant establishment success. If plugs are taken during the summer months, cut the top growth to about 4 to 5 in (10 to 13 cm) above the potential standing water height or 10 in (26 cm) whichever is higher. Research at the Aberdeen, Idaho Plant Materials Center (Aberdeen PMC) has shown that covering the cut ends with water will not necessarily kill the plant, but will significantly slow establishment rates. The plants may die if left covered for extended periods of time (Hoag et al. 1992). Cutting the tops also increases the survival rate of transplants that are transported long distances (Hoag 1994).

Leaving the soil on the plug increases the establishment rate by about 30%. Beneficial organisms that are typically found on the roots of the wetland plants are important in the nitrogen and phosphorous cycles. These organisms that may not be present at the new site. Leaving soil on the plug however, will increase the volume of material that needs to be transported. There is a good chance that weed seeds could be transported in the soil if collected from a weed-infested area. Washed plugs reduce weed seed transport and can be inoculated with mycorrhizae purchased from dealers if the project objectives require it. The collection location should be inventoried to help determine whether the soil should be left on the plugs or washed off (Hoag 1994).

If 1 ft^2 (0.09 m^2) of plant material is harvested, it is possible to get 4 to 5 individual plant plugs from the larger plug (Hoag 1994). The plugs can either be chopped with a shovel very rapidly or the plugs can be cut relatively accurately with a small saw so they will easily fit into a predrilled, set diameter hole. To get the right length of plug, lay the large plug on its side on a sheet of plywood and use a saw to cut the bottom off level and to the desired length. After this, stand the plug up and slice smaller plugs off like a cake.

Make sure the length of the plug is related to the saturation zone at the planting site. The bottom of the plug should be in contact with the saturation zone. Match the amount of water with the wetland plant species. *Figure 2* displays a hydrologic planting zone diagram that outlines the various hydrologic regimes. See Appendix A for information on the hydrologic zones that species will tolerate.

Wetland Transplant Establishment

Natural wetland systems have high species diversity. When selecting plant species for the project wetland, try to imitate a nearby natural wetland. Identify the specific hydrology in areas where individual plant species grow. Note water depth and imagine length of plant inundation. Determine the plant hydrology. Rarely will a natural wetland be totally stagnant through time. Generally, there is water flowing into the wetland from either surface or groundwater. In surface systems such as ponds or lakes, spring and fall overturn as well as wind mixing, help to circulate the water.

The next step is to prepare the planting area. The easiest way to plant plugs is by flooding the planting site. Saturated soil is much easier to plant in than dry soil. This also ensures that the watering system is working prior to planting. The soil should be super saturated so that a hole can be easily dug with a bare hand. Hand planting is more successful with fine soils than with coarse soils. Take the plug trays and place them in a Styrofoam cooler (lid is not required). Cover the roots with water while in transit. At the planting site, drain off most of the water so the cooler will float. Use the cooler to move the plugs around the wetland as you plant. Select a spot in the wetland to place a plug. Reach into the water and dig out a hole deep enough for the plug. Push the plug into the hole and pack soil around it with your hand. Make sure all of the roots are covered with soil. Be careful to not dislodge the plug and expose the roots when moving around the planting area. Start at one end of the planting site and work toward the opposite end.

Aberdeen PMC research on plug spacing has indicated that many wetland plants will typically spread about 9 to 12 in (23 to 30 cm) in a full growing season. Research plots at the PMC were planted on 18 in (46 cm) centers. Although it takes fewer plants to cover an area at a wider spacing, it was found that plantings at wider spacing have less overall success than those planted at closer spacing. The exact reason for this is unknown, but it could be a sympathetic response to plants of the same species. If the project budget does not allow for the purchase of enough plants to cover the wetland bottom, plant the plugs on 18 in (46 cm) centers, but plant them in copses or patches that are about 10 ft (3 m) square. Space the copses about 10 ft (3 m) apart. The copses can be planted to different species according to the hydrology. Over time, the plants will spread into the unplanted areas.

The planting window for wetland plants is quite long. At the Aberdeen PMC, plugs have been planted from April through late October. Planting plugs in the fall and winter resulted in frost heaving of the plugs so that only about 1/3 of the plug remained in the ground. The availability of water is critical. Wetland plants like it hot and wet. They tend to spread faster with warmer temperatures. It will take the plants longer to initiate growth if planted in the spring, but results in a longer establishment period. Fall planting will generally result in lower establishment success because of the shorter growing season and potential frost heaving damage.

Wetland plants can be successfully established in a variety of soil textures. Wetland plants have been successfully established in areas that are heavy clay with no organic matter all the way up to coarse gravels. The biggest problem in gravelly to rocky soils is digging the holes. The soil texture will often limit the equipment available to dig the holes. In clay bottoms, a small bulldozer or tractor with a ripper tooth can be used to dig lines across the bottom about 8 in (20 cm) deep where wetland plugs can be placed.

Fertilizer is not generally necessary. However, the need for fertilizer depends on the site, soils, and the nutrient level of the water coming into the wetland. If the bottoms have been cut down to the subsoil and all of the naturally present nutrients have been removed, fertilization may be necessary unless the water coming into the wetland has a high nutrient load.

After planting, slowly release the water into the wetland. Young plants have not fully developed the aerenchymous material necessary for them to survive in anaerobic soils and standing water. After planting, be careful not to raise the water level to more than about 1 in (2-3 cm) above the substrate. Too much water at this time may stress the new plants. Maintain the water at about 1 in (2-3 cm) for about one week. This will inhibit the germination and growth of any terrestrial species that may be present in the planted wetland. The water level can then be lowered to the substrate surface for 15 to 20 days. This will expose the mud surface, stimulating wetland seeds that were brought in with transplants to germinate and increase the rate of establishment and spread of the transplants. Then raise the water level 1-2 in (3-5 cm) for another week. Then lower the water to the substrate surface for another 15-20 days. After this period, slowly raise the water level to 4-6 in (10-15 cm) for 3-5 days. Continue to gradually increase the water depth to 6-8 in (15-20 cm). The aerenchymous tissues in the plant shoots are what supply the roots with oxygen so be careful not to raise the water over the top of the establishing emergent vegetation.

If the plants are not showing stress, continue to carefully raise the water level to 12-20 in (30-50 cm) if possible. These suggested water level depths must be modified based upon the species used. Some species will not tolerate inundation at these suggested depths or durations. When in doubt, defer to the hydrology conditions on natural reference sites where the species occurs. The goal here is to inundate the transition zone between wetland and upland as much as possible to control invading terrestrial species. After about 20 days, lower the water level to about 2-3 in (5-7 cm)(Hammer 1992).

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. The key thought here is to fluctuate the water level. Natural wetlands rarely have a constant water level. Many species cannot tolerate a constant water level and will begin to die. Species more tolerant to standing water will increase. The plant diversity that was so carefully planned may be lost.

Management during the establishment year is critically important to ensure that the plants do not get too much or too little water. Weed control is important especially during the establishment year because of the low water levels and exposed, unvegetated areas. A good weed control plan needs to be in place before planting. Monitoring the planting for 3-5 years after the establishment year will help maintain the planting and it will provide useful information for future plantings.

<u>Sodding</u>

A sod mat, as large as 8 foot square and at least 6 inches deep, is cut from a donor riparian-wetland area and placed into areas with matching hydrologic conditions. The mat is cut from the wetland with shovels and a front-end loader modified with a sharp-edged steel plate. Mats are loaded onto flatbed trucks for transport to the recipient wetland. The sod mats are then placed together in a bricklaying fashion on the soil surface of the prepared site. Do not leave gaps between the sod mats (NEDC, 1998). Secure sod mats with wooden stakes.

Best results are achieved if the soils are moist but well drained at the time of cutting. This reduces weight, helps the mat stay intact, and reduces “sticking” of the mat as it is being transferred on and off the transfer plate (NEDC, 1998).

Avoid areas that have unwanted weeds. Incorporation of seeds of unwanted species can be a significant drawback to the use of this method. Observation of proposed collection sites over a growing season can help to identify potential problems (Bentrup and Hoag, 1998).

Since relatively large areas of the donor wetlands are impacted, this method should be used primarily as a salvage technique (NEDC, 1998).

Sodmats from natural riparian-wetland areas may be transplanted successfully at any time, but early season provides the best opportunity for more root growth, plant development, and stand establishment.

Rhizomes

Rhizomes are the underground horizontal stems produced by some herbaceous plants such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and sedges (*Carex* spp.). Rhizomes can be dug and divided into sections, taking care to keep at least one viable growth point or node on each section. Care must be taken to ensure that collected materials are young and healthy, generally indicated by firmness of the material (Bentrup and Hoag, 1998).

Collect materials early in the spring before plants break dormancy or at the end of the growing season when the energy stored in the material is at its' greatest. The material can be planted at this time or stored in sand or peat. The rhizomes should be kept shaded and at a cool temperature (40° F) until planting time (Bentrup and Hoag, 1998). The growth node should be sticking up when planting these materials.

For more information on planting rhizomes, see the section on Wetland Transplant Establishment, page 7.

SUMMARY

A wetland restoration or development project should include baseline data, a good study design, evaluation criteria and methods, a monitoring and maintenance plan, and a management plan. Clear objectives and goals provide benchmarks against which the project will be assessed. The most common cause of failure for most vegetation projects is the lack of clear and definable goals and objectives.

Some replanting may be necessary to ensure a fully vegetated streambank or wetland in a short time frame. Use native locally grown seed or plants if possible, to improve the chances of successful stand establishment. Bentrup and Hoag (1998) provide maintenance and monitoring recommendations.

Prescribed grazing is recommended if the site is located in a rangeland or pastureland management unit. Defer grazing for at least one growing season for stand establishment. Temporary fencing and offsite water developments may be used to facilitate rest on the site. Long-term grazing management should ensure systems that control the time period and length of time that livestock are allowed to use the area to assure the planting will meet all management objectives.

All wetland restoration or development project plans should be developed to meet NRCS Standards and Specifications guidelines. Of all the factors that affect a wetland project, hydrology is the most important. In some cases, the vegetation phase of the project should be postponed until the hydrology of the site is fully documented, mapped, and understood.

Contact Chris Hoag, Wetland Plant Ecologist (208)-397-4133 or email: chris.hoag@id.usda.gov for more information or assistance.

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