

# Bio-Engineering Techniques to Revegetate Streambanks

## DORMANT CUTTINGS

Dormant cuttings are harvested from living woody plants. The cuttings are prepared from branches of woody plants when the plant is in a dormant state. The cuttings are collected from plants that can root easily, without special treatment, such as certain willow species, poplar and cottonwood. Buds must be present on the cuttings, particularly near the top of each cutting. Avoid flower buds ("pussy willows") if possible. The cutting can be prepared into various lengths.

Dormant cuttings are the primary plant material used in soil bioengineering and revegetation techniques including: live staking, brush layering, live siltation, brush mattress and live bundles (fascines).

Collect cuttings during winter/early spring before leaves appear for spring and early summer plantings; and collect cuttings in late summer/early fall after plants have become dormant for fall plantings.

Cut branches 1/4 to 2 inches in diameter and leave as long as possible since many projects require cuttings at least three to four feet long. Branches can be cut to size at the time of installation. The potential for drying during storage is reduced when the cuttings are stored in longer pieces.

Proper storage is necessary to maintain a viable cutting. If collection occurs while daytime temperatures remain below 31° Fahrenheit (F); freeze or refrigerate until planting. If daytime temperatures exceed 31° F during collection, cuttings should be refrigerated. Frozen cuttings can be stored with a small amount of snow to reduce drying. Refrigerated cuttings should be stored at 31° F to 40° F and 60 to 70 percent humidity. Monitor the condition of the cuttings regularly to detect problems such as desiccation, sprouting or mold.

Cuttings should be taken directly from storage to the planting site. Only the plant material required for each day should be removed from storage, particularly if the weather is windy and/or warm. The cuttings should be stored away from direct sunlight, heeled into moist soil, or stored in water until planting.

prepared by: Gay Muhlberg, ADF&G Habitat and Restoration Division  
Nancy Moore, ADNRC Plant Materials Center  
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## **BUNDLES - (FASCINES)**

The bundle consists of dormant cuttings bound together to create a log like structure that will grow. The bundle is used to revegetate and stabilize slopes, secure the toe of streambanks or provide a transition from one revegetation technique to another (such as a brush mattress with live siltation). Bundles are planted in shallow trenches and provide immediate physical protection to a site before plant growth begins.

Bundles are formed by tying together several dormant branches 1/2 to 1 1/2 inches in diameter. The growing points of the branches are oriented in opposite directions to create a relatively uniform diameter bundle. Typically, bundles are 4 or more inches in diameter and at least 3-4 feet in length. The bundle is tied together with biodegradable twine. Longer bundles can be created by overlapping branches as the bundle is formed and tying the bundle together with twine, approximately every two feet.

Collect plant materials during winter/early spring and store frozen or refrigerated until installation or late summer/fall and install immediately (Dormant Cuttings, Revegetation Technique 1 of 17).

Plant as soon as the soil can be worked but no later than July 1; or plant in late summer/early fall before the ground freezes.

Install bundles horizontally in a shallow trench (that slopes down and back into the bank). Drive at least two 18-inch dead stakes or live stakes through the bundle to secure it firmly. If the slope is steep and the erosion potential is high, drive additional stakes downhill and immediately in front of the bundle. Cover at least half of the diameter of the bundle with soil and tamp into place. Do not cover the bundle entirely.

Bundles can be planted end to end or slightly overlapping to form a continuous planting; in parallel rows that follow the contour of the bank; used to secure the toe of a slope or used as a transition from one revegetation technique to another. Spacing of the bundles will vary with site conditions and the overall revegetation design.

## GRASS ROLLS

Grass rolls are often used to revegetate shorelines and streambanks where grasses and grass-like plants have been the primary vegetation type and where seeding is impractical due to fluctuating water levels or other factors. Clumps of sod are placed tightly together in a sausage like structure and held together with burlap and twine. The roll is then anchored in place. This technique reintroduces herbaceous vegetation to a site while simultaneously providing some structural stability. Ultimately the sod will root and provide structural and biological protection to the site.

Construct the grass roll by laying out a length of burlap and placing dumps of sod tightly together down the middle. Wrap the sides of the burlap over the sod dumps to make a sausage-like roll. Tie the roll every few inches with twine. Cut holes in the burlap wrap to expose the sod shoots. Try to create the grass roll onsite so that the length of the roll matches the length of the area being planted.

Install the sod roll in a shallow trench along the ordinary high water (OHW) line after the toe of the slope has been protected. Anchor the grass roll securely into the bank. Earth anchors will be required for installations along streams and rivers. Stakes may be adequate for anchoring a grass roll in low-energy environments such as protected lakeshores. Revegetate the slope uphill from the sod roll.

The upstream and downstream ends of the grass roll need to be tied into a stable streambank, undisturbed vegetation, or other revegetation techniques.

Fertilize the top of the grass roll with 5 pounds of 8-32-16 fertilizer per thousand square feet of surface area. A slow release fertilizer may work very well for this application.

## LIVE STAKING

Live staking is a simple technique that installs a dormant cutting (Dormant Cuttings Revegetation Technique 1 of 17) directly into the ground. This technique often provides a transition from a larger revegetation project to existing vegetation or is utilized where single stem plantings will provide adequate plant cover, slope stability and fish habitat. Live staking may be combined with other soil bioengineering techniques. Live stakes are often used as an anchoring device for bundles, brush mattress and erosion control mats. Planting sites should be selected carefully. Live staking requires moist soils; mortality will be high if the live stakes are planted at sites without adequate soil moisture.

Prepare live stakes from dormant cuttings. Cut stakes 10 to 24 inches long 1 1/4 to 1 1/2 inch in diameter. (Slightly larger diameter cuttings will also work). Discard flower buds ("pussy willows"). Only certain species begin to flower before leaves appear. At least one or two buds (these buds are not as full as flower buds and produce only leaves) must be present near the top of each live stake.

Plant as soon as soil can be worked but no later than July 1; or plant in late summer/fall before the ground freezes.

Plant stakes upright at 1-3 feet on center (43,560 – 4,840 cuttings/acre). Stakes should be planted as vertically as possible, placing at least 3/4 of the stake below ground so that only one or two buds are left exposed above the ground.

Rebar may be used to create a planting hole for longer stakes particularly when planting in compact and gravelly soils. Lightly pack the soil around the stake so that no air pockets remain. Watering the stakes will help remove air pockets that may have formed around the stake, particularly when rebar has been used for a planting tool.

A moist substrate is needed during the period the live stake is rooting and becoming established, at least 4-6 weeks after planting. Topsoil not required. Success rates for drier sites may be increased if larger cuttings are used.

## **LIVE SILTATION**

Live siltation is a revegetation technique used to secure the toe of a slope and provide fish rearing habitat. This technique provides vegetative cover at the water level and can be constructed as either a sacrificial planting or as a live system.

Collect dormant branches a minimum of 3 feet long with side branches still attached (Dormant Cuttings Revegetation Technique 1 of 17). If a live system is planned, Feltleaf or Pacific willow is recommended. Any woody plant material can be installed for a sacrificial system.

Install a live siltation system by constructing a v-shaped trench approximately two feet deep. Lay a thick layer of willow branches in the trench so that one-third of the length of the branches are angling out towards the stream. Place a minimum of 40 willow branches per yard in the trench.

Backfill over the branches with a gravel soil mix and secure the top surface with large washed gravel, bundles (fascines), or coir logs. Both the upstream and downstream ends of the live siltation construction need to be securely tied into a stable streambank to reduce the potential for the system to wash out. More than one row of live siltation can be installed. Live siltation typically is installed at the ordinary high water (OHW) level.

A sacrificial system can be constructed below the OHW level. If it is impossible to dig a trench, the branches can be secured in place with logs, armor rock, bundles (fascines) or coir logs.

The live siltation system is particularly valuable for providing immediate cover and fish rearing habitat while the adjacent vegetation becomes established.

## COIR LOGS

Coir logs are constructed of interwoven coconut fibers that are bound together with biodegradable netting. Commercially produced coir logs come in various lengths and diameters. The product needs to be selected specifically for the site. Fiber logs composed of other sturdy biodegradable materials may function equally as well.

Applications for coir logs occur in many streambank, wetland and upland environments. The log provides temporary structural (physical) protection to a site while vegetation becomes established and biological protection takes over. The logs can provide a substrate for plant growth, protect plants growing adjacent to the log, can be used as a transition from one revegetation technique to another, and can be used to secure the toe of a slope.

Install the logs ensuring they are in contact with the soil along their entire length. In most cases, the log should be partially buried and at no time should it span any open space that may occur between rocks, logs or uneven ground. Tie logs together that have been placed end to end and stake into place. Flowing streams, particularly those carrying ice during breakup, could rip the log out of the streambank, if it is not adequately anchored. Wooden stakes, curved rebar and earth anchors have all been used to securely anchor these logs.

Coir logs can be seeded or sprigged when they are placed in locations that will provide adequate moisture for plant growth. The surface of a log can be seeded and fertilized. Small holes can be created in the surface of the logs and sprigs (plugs) of suitable plant species can be transplanted into the log. These plantings should be fertilized.

Fertilize seeded logs with 20-20-10 fertilizer. Transplants can be fertilized with 8-32-16. Some experimentation is needed to determine whether granular or liquid fertilizer works best. Do not over fertilize, additional fertilizer applications can occur later if needed. Typically new seedings are fertilized at a rate of 10 pounds per 1,000 square feet of seeded area, transplants can be fertilized at half that rate or 5 pounds per 1,000 square feet of transplanted surface area.

## **BRUSH LAYERING**

Brush layering is a revegetation technique which combines layers of dormant cuttings (Dormant Cuttings Revegetation Technique 1 of 17) with soil to revegetate and stabilize both streambanks and slopes. Cuttings are placed on horizontal benches that follow the contour of the slope. The benches are cut to angle down and back into the slope. Construction of this technique can be easily mechanized, particularly on fill slopes.

Brush layering is one of the best revegetation techniques for stabilizing streambanks since the branches are placed directly into the slope and provide reinforcement to the soil. Relatively steep slopes can be treated with this technique if a biodegradable revegetation fabric is used to hold the soil in place between the plant layers. Different species of woody cuttings that root adventitiously (Plant Species List Revegetation Technique 17 of 17) can be mixed in the layers; rooted plants can also be added (Hedge - Brush Layering Revegetation Technique 4 of 17).

Collect dormant branches 34 feet long, 1/4 to 2 inches in diameter and store frozen or refrigerated until planting.

Plant in the spring/early summer, before July 1; or in late summer/fall

Installation: Secure the toe of the streambank with one or more techniques including root wads, live siltation, coir logs, spruce tree revetments, or armor rock. Begin layering at the bottom of the slope. Along a stream the first brush layer typically occurs at the ordinary high water (OHW) level.

A bench is cut two to three feet deep so that it angles slightly down and into the slope. Branches are placed on the bench, slightly crisscrossing. The cut ends are placed into the slope with the tips extending beyond the edge of the bench no more than 1/4 the total branch length.

Plant 20-25 branches per yard. Place 24 inches of soil on top of the branches and tamp into place.

Build layers until the desired bank height is achieved. Fill slopes can be created at the same time a brush layer is installed. On a cut slopes and existing streambanks each layer is excavated at the time the brush layer is installed

Installing a brush layer below OHW may create fish habitat and plant cover but the plants may not survive if inundated for long periods.