A property owner's guide to controlling erosion using native vegetation for Arrow Lakes



Prepared for;

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How to use this document

This guide provides a list of plants and planting techniques as well as some bioengineering techniques for erosion control around the Arrow Lakes. There is an introduction to the role vegetation can play in preventing erosion, and a list of ecologically suitable plants that could be used to improve riparian habitats in the drawdown zone. The list includes the latin and common name(s), the form and habit of the species, rooting characteristics, planting conditions, aesthetic features, wildlife values and any special treatments to enhance survival or performance. Lists of area suppliers and local experts who have agreed to be contacted are provided. The reference section lists written and verbal references as well as useful web sites and catalogues that were made available to the author for inclusion in this document. My apologies to any potential suppliers that were omitted. Readers should read the important notice before using this guide.

Important Notice

This paper was written with the Arrow Lakes area in mind, but it draws on references on slope stabilization using vegetation and bioengineering from many sources (see references). The similarities between erosion control problems around the world are greater than their differences. However, most sources, especially those involving suggestions for activities and planting schemes that homeowners can use to control erosion on their own properties are prefaced by a disclaimer. This document is no exception:

The author:

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Introduction

The use of vegetation to control erosion has been practiced in many countries for centuries. Erosion control occurs in natural settings throughout the west Kootenays, on the hem of talus fans, on steep sandy or fine textured slopes, and on river banks. How can homeowners use some of these natural techniques, and improve on them? There are a number of methods for anchoring a slope with vegetation through the use of bioengineering techniques. What are some of the factors to consider?



Texture and layering of materials

Frequency of exposure to high water

Existing vegetation

Aspect and slope

Surface and groundwater movement from upslope

Choice of suitable plant species, planning for succession and stabilization through use of bioengineering methods is the key to successful erosion control. Soil type, slope, aspect, characteristics of surface run-off and managing plant succession from early colonizers to later mature stages are important features to consider in slope stabilization. Some typical slope features that lend themselves to slope stabilization using vegetation and bioengineering are illustrated below:

Unstable slope characteristics

Unstable slopes represent extreme situations for most plants. Soils that have instability problems are not usually soils at all, but only incipient soils. They may be overly steep and they may be subjected to inundation or gullying. Most unstable slopes usually have a combination or only one or two of the following features

- The surficial materials that would be expected to support plants for stabilization purposes usually have a poor structure with an uneven ratio of sand:silt:clay. They may have too much of either one of the three.



- Unstable steep slopes usually have very little incorporated organic material in the first 20 cm of soil that would retain moisture and support roots. They often have a very poor ground cover such as shallow rooted grasses or trees with a serious windthrow problem.

- Unstable steep slopes usually have a low to non-existent cover of existing vegetation that would be expected to shade new plants or provide soil development.

- Unstable steep slopes may be too coarse-grained, ranging from coarse textured sandy fans or escarpments to bouldery talus slopes.

- Unstable steep slopes are often open and exposed in summer, and very hot. Conversely, they are quite cold in winter with poor thermal protection.

- Unstable slopes are likely to be subjected to minor to major avalanche or snow press in winter into late spring. Because of the lack of vegetation, they suffer erosion and losses of fine textured materials during spring meltwater freshet.

Matching plants with the particular slope problem at hand

Matching stock and species to slope stabilization problems requires an interpretation of the features of the slope, and a choice of the species and techniques that will be most successful in stabilizing the slope over the long term.

General planting techniques for unstable slopes

Soil amendments and site preparation is necessary for slope stabilization to be successful. Successional plantings may be necessary, as well. Several bioengineering techniques are useful for stabilizing slopes. They depend on the use of a combination of installation of physical structures, often composed of natural materials to provide proper water drainage off the slopes, and good planting spots for vegetation that is going to prevent further erosion. All of these techniques have their limitations and drawbacks, but they have been used widely in Europe for decades, and are gaining use in Canada because of the superior economics and the need to move away from the use of concrete. The drawings and descriptions below are based on Dr. Hugo Schiechtl 's book "Bioengineering for land reclamation and conservation" [1] A discussion of these techniques with illustrations drawn from Schiechtl is included below.

Placement of stabilizing plantings and removal of hazards



Problems:

Use stabilizing plantings in these two sites →

Consider shrubbier well rooted, plantings at the top of the slope



There are a number of basic techniques: use of live material drainage systems (fascines) or rock drains (gambions), gulley erosion control, steep slope control, buttressing systems for areas exposed to river bank erosion, and methods for containing a flat or gently sloping area that is periodically inundated. Some illustrated methods for site preparation and stabilization using plantings and bioengineering techniques are shown on the following pages.

[1] Translated by N.K. Horstmann. University of Alberta Press. 1980

For stream channels and gullies



In order to stablize gullied slopes or streams that feed into the river, live branches can be anchored in a trench with a stake, and tied. Tips of the branches should be allowed to protrude from the trench. Fill the trench with gravel mixed with soil, enriched with peat or other organic material. This should be done in early spring. Suitable species include red osier dogwood, alder, willow, and mountain maple.

Figure 1: Anchored live branch gully (adapted from Schiechtl 1980).

Larger gulley stabilization, and creek stabilization can also be achieved through the use of rock troughs, illustrated below (adapted from Schiechtl 1980).



Figure 2: A rough bed channel, using rocks and pegs and flanked by live fascine drains. (adapted from Schiechtl 1980).



Use of the above method, illustrated in cross section results in a channel within the slope that prevents surface run-off erosion and encourages “creek-edge” vegetation development.

Figure 3: Rock stabilization with fascine drains (see below). (Drawing adapted from a photograph in Schiechtl 1980).

Drains: The use of live branch material or rock in drainage channels is another less involved method for ensuring water drains from a slope without removing parts of it. These methods usually involves the use of diagonal trench cut across the slope which is then filled with a type of live branch drainage ‘tile’, bound with wire (fascine drain) or loose (branch drain), or rock (gambion drain), wrapped in a mesh or wire cylinder. Stones or gravel can be used. The addition of live drains can help channel water down the slope, irrigate plantings or cuttings at the root level and help to prevent downslope movement of materials. This can be done in a number of ways. Variations on these drain types are numerous, the branch and fascine drain is illustrated in cross section is illustrated below.

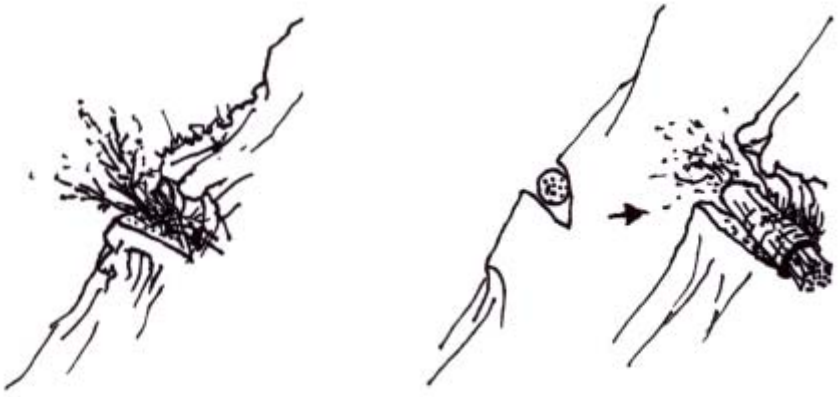


Figure 4: The brush drain (left) and the fascine or gambion drain (right) adapted from Schiechtl (1980).

The fascine (live) drain is simple; live material is bound with single strand wire and laid in a trend. This structure can give rise to shrub development, if dormant rooting material is used (see below). The fascine or gambion can be used, or developed further to stabilize a severe slope for future planting. Species useful for brush drains include species of willow, mountain maple, alder, red-osier dogwood, thimbleberry, etc. For very steep slopes where anchoring is required, the following options are possible;

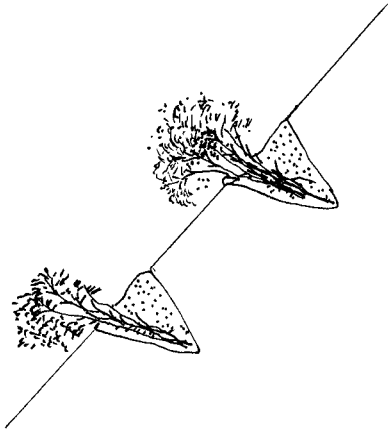


Figure 5: Anchored drains (adapted from Scheichtl 1980)

Use of live dormant deciduous stakes can be used to prevent movement of or steep slopes

Brush layer construction for steep slopes

The method illustrated at left is used to stabilize steep slopes.



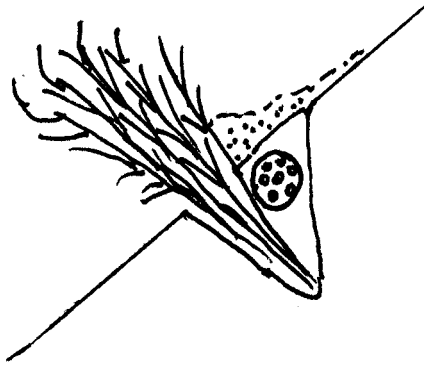
Using this method, troughs are cut into the slope at a diagonal, often crosshatched pattern with the floor of the trench at a gentle downward angle. Live brush cuttings are placed in the trenches and sand, peat and soil are used to fill the troughs.

Figure 6: Bush layer construction for steep slopes (adapted from Scheichtl 1980)

Suitable species for brush layering depend on the stability and soil conditions of the slope. If the materials are very sandy, snowberry is a good candidate, and can stabilize a steep sandy slope very well. Cuttings or potted stock grown from seed can be used.



Figure 7: Soapberry on a steep east-facing slope



The drawing at the right, adapted from Schiechtl, (1980), illustrates a fascine or gambion drain, where a trench is dug and live branches, cuttings or rooted materials laid on the floor of the trench, and a cylinder (shown in cross section here) of gravel rolled loosely in chicken wire is laid along the length of the trench. Variations and details of this drain style can include a fascine drain, which uses bound, live material to anchor the bush cuttings and add humic material to materials that may be limited in organic material. Variations are shown on the next page.

Figure 8: Brush layer stabilized with a rock gambion (adapted from Schiechtl 1980)



Figure 9: Variations in the brush layer method. Rooting material is stabilized with rock (left), a fascine or gambion (center), and stake and pole anchoring device (adapted from Schiechtl 1980).

In Figure 9 above, the poles are cut from live material (i.e. mountain maple) and laid in the trough over the brush layer (adapted from Schiechtl 1980). The live stake can also be cut from the same species or from mountain alder and used to stabilize the brush layer while rooting takes place.

Wattle fencing is an old method of using live material to weave a physical barrier against down slope movement of fairly loose materials.



In the illustration to the left (Figure 10) stakes are driven into the slope and live branches, usually of willow or dogwood are woven among the stakes. Fine textured soil or sand often drifts over the surface of the branch cuttings. Burial resistant species include common juniper, scotch pine, paper birch, Oregon grape, bitter cherry, red raspberry and others

Figure 10: Wattle fencing (adapted from Schiechtl 1980)

Cross sections of this technique and variations on it are shown below (Figure 11).

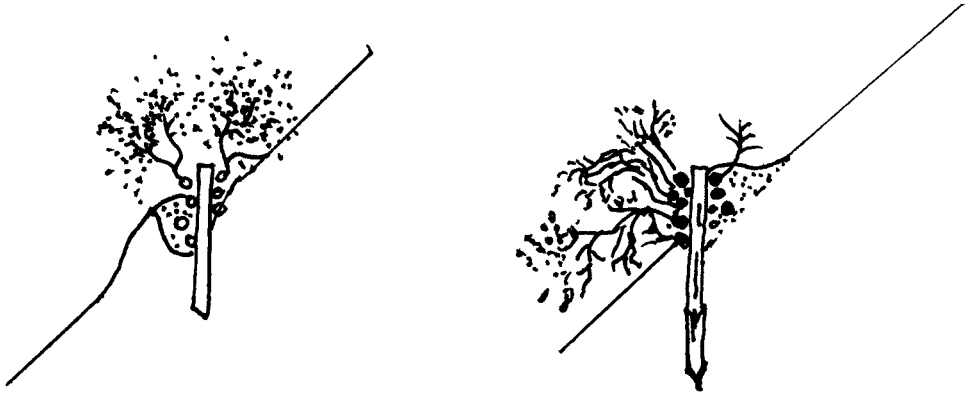
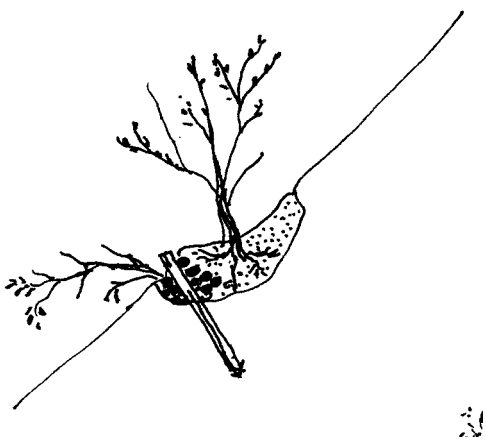


Figure 11: Cross sections of different soil configurations on wattle fencing (adapted from Schiechtl 1980)

Wattle fencing can also be used to establish larger trees on a slope, which is reinforced with live stakes. The stake is necessary to prevent slippage if a juvenile tree is planted, as illustrated in Figure 12 below. A rock at the base of the stake and upslope can be used to help prevent subsurface movement

Furrow groove method Several species of potted and bare root or burlap-wrapped trees can be used for this method illustrated in Figure 12 (left).

Grooves are made along the slope and live fascines are staked in place. The grooves should follow a cross-hatched or herring-bone pattern on the slope. Soil can be amended from the original materials with compost, peatmoss, etc. Species choice should be matched with the site characteristics, eg, if well drained, use dry-tolerant birch, Douglas-fir or bitter cherry. On north-facing slopes, western red cedar, western hemlock, mountain maple. Stocky trees with an equivalent root to shoot ratio are recommended.



This method can be combined with brush layering.

Figure 12: Furrow groove planting (adapted from Schiechtl 1980)

Rock fall planting

Stabilizing rocky slopes poses challenges not met in other slope stabilization problems. Rock falls represent the extreme; they originate from exposed bedrock and are usually being added to on a regular basis. They have very little or no soil, exposures are intense, and there are physical limitations to root establishment. Natural vegetation invades and stabilizes talus slopes from the sides of the talus fan, usually, and there are several examples of large trees growing in blocky rock with almost no soil. Figure 13 below is an example of warm west facing talus slope that has fine enough material as to allow for invasion by trembling aspen, grand fir, Douglas-fir, birch, juniper, roses, and snowberry. Several native plant species are known to tolerate and thrive in these growing conditions, including soapberry, snowberry, ocean spray, horizontal and common juniper (Figure 14 below), shrubby penstemon, falsebox, and in slightly finer materials at the top of slopes, birch and trembling aspen.

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Figure 13: Talus slope colonization and stabilization by native plants

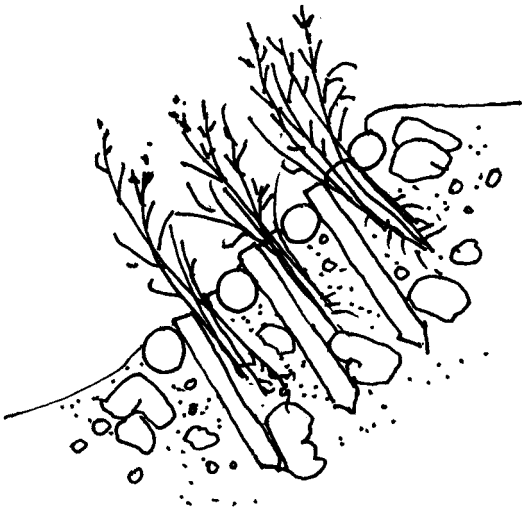
A moist climate such as the west Kootenays, water seepage through the rock and the absence of competition from other plants allows many species to colonize bouldery slopes



Figure 14: Prostrate form of common juniper on a rock fall

Watercourse stabilization

Crib wall construction has been used on steep slopes influenced by river or lakeshore erosion and as a living physical barrier to down-slope movement of materials for decades.



A live wooden crib wall is illustrated below in Figure 15 (left). Dead wood is used in combination with live plant material, and the growing plants gradually take over the function of the rotting wood (Schiechtl 1980). The poles and stakes add organic material to the structure as the structure ages.

Figure 15: (left) Double -walled live wooden crib (adapted from Schiechtl 1980)

Joint planting

Rocky terraces or slopes can originate from river deposits and usually have a matrix of finer textured materials. Methods used to stabilize a rocky slope all have to take advantage of the potential stability that rock itself provides.

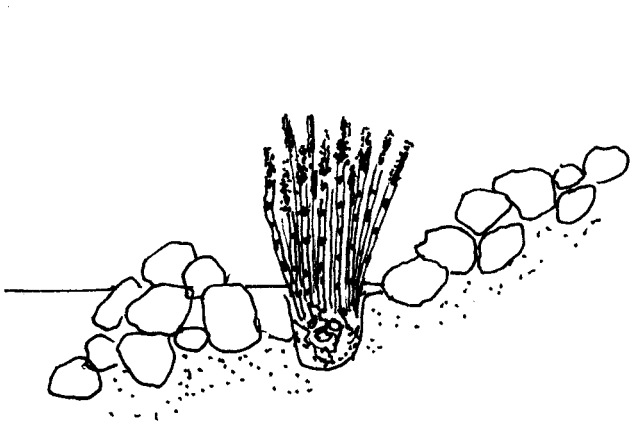


Figure 16 illustrates a technique called joint planting. Rocks are arranged to form an organized slope with spaces for planting in between. Live cuttings are placed in the cracks. As these types of rock plantings are usually at the toe of slopes and subjected to periodic flooding, water tolerant species such as willows and red-osier dogwood are often used.

Figure 16: Joint planting (adapted from Schiechtl et al. 1980)

Reed bed construction

Figure 17 shows a reed bed construction.



In this method, wetland or open shallow water plants are placed in shallow rock troughs at the waterline. For some areas where inundation is unpredictable, species that can tolerate long periods of either dry or wet conditions should be used. Species other than reeds can be used, of course. Some examples are Lodgepole pine (in larger beds), water-tolerant grasses, rushes, reed canary grass, willows, red ozier dogwood, wax current and others.

Figure 17: Reed bed construction (adapted from Schiechtl et al. 1980).



Equisetum hyemale – scouring-rush

Species used in slope stabilization

The following section is a review of selected native species with particular usefulness in slope stabilization. It is not an exhaustive list, and there are several non-native species that are just as valuable and aesthetically pleasing. The natives plants listed here are well adapted to riparian, creek bed and steep slope stabilization, however, and once established seldom require additional horticultural effort, with some exceptions. The descriptions provided in the section below were compiled from several existing documents, and all of these are listed in the references section. Table 1. (on the following page) is a list of the species and the type of materials they are most suited to. The species accounts given below describe cultural characteristics (e.g. cuttings, versus seed). The author assumes that only non-destructive methods will be used for propagation of native plants, unless the user has access to native plants on their own property. It is illegal under section 2 of the Tree Cone, Seed, and Vegetative Material Regulation of the Forest Practices Code of the BC Act to dig up live native plants on crown land.

Table 1: Soil types most suited to native plant species used for slope stabilization

	Species	Coarse textured materials	Steep Slope	Fine textured materials	Inundation zones
Trees	*lodgepole pine*			x	x
	trembling aspen	(x)*	x	x	
	western red cedar			x	
	black cottonwood				x
	western hemlock		x		
	paper birch				
Shrubs	*Douglas maple*	x			
	mountain alder	x	x	x	
	saskatoon	x	x		
	kinnikinnick	x	x		
	redstem ceanothus		x	x	x
	snowbush		x	x	
	red-osier dogwood		x	x	x
	beaked hazelnut	x	x	x	
	ocean spray	x	x		
	common juniper	x	x		
	Douglas juniper	x		x	x
	tall Oregon-grape	x	x	x	x
	falsebox	x	x	x	
	shrubby penstemon	x	x		
	mallow ninebark		x	x	
	bitter cherry	x	x	x	
	wax currant			x	x
	northern black current				x
	red raspberry	x	x	x	
	baldhip rose	x	x	x	x
	Scouler's willow		x	x	x
	soopolallie	x	x	x	
	high-bush cranberry		x	x	
Herbs	*hair bentgrass*			x	x
	goat's beard			x	x
	lady fern		x	x	x
	beaked sedge				x
	blue wildrye	x	x	x	
	western fescue	x	x	x	
	large-leaved avens			x	x
	lupine		x	x	
	small flowered wood-rush				x
	giant wildrye			x	x
	bluebunch wheatgrass		x	x	
	pinegrass				
	speargrass	x	x		

* (x) occasionally suited

Species Accounts



Mountain maple holding back a loose, sandy 75% slope

Trees

Species name: *Pinus contorta var. latifolia*



Common name(s): lodgepole pine

Family: *Pinaceae*

Form: Medium sized conifer, 20-35 m tall; slender trunk; short, open, pyramidal crown. Can have a very bushy habit as a juvenile. In closed stands the lower branched are often gnarled and bare, especially in closed stands.

Leaves: Evergreen needles, in bundles of 2, apple green, appearing dark olive green in winter, pointed, stiff and often twisted, somewhat square in cross-section, 2-7 cm long; seedlings have an initial cluster of 3-6 needles.



Cones: Short cylindrical to asymmetrical and lop-sided, 2-5 cm long, tawny, armed with prickles; often remain closed and hanging unopened in clusters when mature.

Culture: Widespread and common from low elevations to treeline in a wide variety of soils and drainage conditions, from rock outcrops to deep, rich soils to saturated organic deposits or periodically innundated, bouldery river courses. Cones require heat to open and germinate, not often sold in nurseries. Can tolerate seasonal high water, very effective as a foreshore backdrop to cottonwoods, as well as very dry well drained slopes. It is useful for boundary screening in rows or in drifts.

Problems: When growing on shallow bouldery materials on steep slopes with undercutting, it is very prone to windfall. This species is best for stabilization of flattish areas, river or lake shore edges, possible with stream inlets into the main channel. Pines are also susceptible to a wide variety of fungus and insect pests. Larvae hatch from eggs deposited in terminal buds and devour the young growing shoot tips in the spring.

Species name: *Populus tremuloides*



Common name(s): trembling aspen

Family: *Salicaceae*

Form: Small to medium sized deciduous tree, to 30 m tall; short, rounded crown; extensive male or female clones (single individual trees with many trunks) formed by a network of root suckers; lacks resinous buds.

Bark: Smooth, very beautiful, with a waxy appearance; greenish grey to white, with black scars where branches previously grew; does not peel.

Leaves: Nearly circular, with abruptly pointed tips and irregularly round-toothed edges; deep green above, paler below, turning bright yellow in autumn. Clones turn colors at different times in the fall.



Flowers: In male and female catkins on separate trees; hanging (4-7 cm long); appearing before leaves.

Fruits: Slender, cone-shaped capsules containing many tiny, light brown seeds with white fluffy hairs.

Culture: Grows from the subalpine to low elevation on a wide variety of sites, ranging from moist, open forests to the edges of dry grasslands. Usually requires movement of water though soils (i.e. good drainage). The best growth is on moist but well drained and porous, e.g. see Table 1; aspen can colonize the edge of talus slopes if there is enough fine textured material. Rapid early growth and a comparatively short lifespan, although it may live as long as 200 years. Trembling aspen is a significant contributor of nutrients to the soil. Rooting can be extensive in clones, with excellent stabilization capability. Important cavity nesting tree for

many birds, including hairy woodpecker, three-toed woodpecker, and yellow-bellied sapsucker. Aspen is an important source of browse for ungulates.

Problems: Establishment of young trees requires adequate moisture following planting and can become either too dry or waterlogged. *Populus* sends up frequent suckers beyond the perimeter of the crown. Therefore, these moisture-seeking root systems can clog sewers and drainage systems



Species name: *Populus balsamifera ssp. trichocarpa*



Common name(s): Black cottonwood

Form: Large deciduous tree to 40 meters in height, straight trunks, open and irregular crowns.

Bark: Gray, deeply furrowed when mature, smooth when young, long resinous buds with a characteristic fresh scent in the early spring.

Leaves: Triangular to heartshaped with pointed tips, turning bright yellow in the fall.

Flowers: Dangling bead-like capsules that split apart and release cottony white hairs. Is the cause of some allergic reactions.

Fruits: Slender, cone-shaped capsules containing many tiny, light brown seeds with white fluffy hairs.

Culture: Very common on edges of the gravely outwash of creeks entering into lakes in the southern Interior of B.C., at low elevation, and on sandy terraces above the Columbia River. It also occurs on wetland edges. Withstands periodic flooding. Important stabilizer of river banks and important for fish habitat; it supplies habitat for caddis fly, mayfly and many other insects that are fed upon by fish and birds. It also is a significant contributor of shade and organic material at the rivers edge. Downed logs provide shelter and stability to spawning channels. Used by several cavity-nesting birds, as well as beaver, moose and other ungulates. Excellent growth from live cuttings from both branches and root segments. Sprouts readily from stumps; cuttings of these sprouts are easily rooted. Good candidate for brush layering and fascines. Can easily be grown from seed as well. One of the first native deciduous trees to be grown commercially for harvest. Highly valuable species for reclamation projects, highly flooded lands and other wet habitats. Useful for watercourse stabilization and can be used in large-scale reed bed type construction.



Problems: Establishment of young trees requires adequate moisture following planting. Cotton in the spring is an allergen.



Species name: *Thuja plicata*



Common name(s): western red cedar

Form: Large conifer, to 40 m tall: clear tapered trunk, to 3 m in diameter, buttressed at base; crown conical when young, becoming irregular, often with a dead or broken top with age; drooping branches with upturned ends. Long-lived, up to 800 years.

Leaves: Evergreen, short, blunt, scale-like leaves, shiny yellowish green; in pairs and of 2 types (one pair folded and the other flat; in flattened, fan-like sprays of small branches; very aromatic when crushed.

Cones: Many, small, elliptic, brown 12 mm long, each composed of a few scales; in clusters on branch ends.



Culture: Grows on moist and wet sites at low to mid elevations and occasionally at lower subalpine elevations; tolerates saturated soils with stagnant water table, prefers rich, moist sites; shade tolerant; low resistance to drought and frost. Useful for stabilizing back-eddies where creeks enter the main channel. Cuttings taken from branches nearest the base of the tree can be taken in the fall and reared in a cold frame over winter for planting into pots in the following spring, and may be suited for fascines and branch layering if rooted.

Problems: In closed stands, an understory is completely excluded and very few species will grow underneath a grove of dense cedar. Pot culture of this species takes some care and attention.

Species name: *Tsuga heterophylla*



Common name(s): western hemlock

Form: Large conifer, 30-50 m tall, clear trunk, short, open, pyramid crown with a flexible drooping leader.

Leaves: Evergreen needles, flat, blunt, yellowish-green, short and unequal in length, arranged in flat feathery sprays.

Cones: Elliptic, purplish-green turning light brown when mature, 1-3 cm long: scales thin with wavy edges: hanging on short stalks.

Culture: Grows on a variety of sites at low to mid elevations in Columbia Mountains; prefers acidic soils with thick humus; seedlings often found on decaying logs and stumps; very shade tolerant but not frost or drought resistant. Useful for stabilization of foreshore of creek channels leading into the main channel or lake, as long as organic material is incorporated in the soil.



Problems: Must be watered during growing season until established.

Species name: *Betula papyrifera*



Common name(s): paper birch, silver birch

Form: Small to medium sized deciduous tree, to 30 m tall; often forming clumps from a single base with an oblong crown. Drops dead branches continuously, especially as it matures.

Bark: Characteristic white, peeling and fissured 'paper-thin' bark with blackened bud scars from the loss of older branches. Twigs appear brown to copper-colored in winter, distinguishing birch from aspen at a distance.

Leaves: Oval with pointed tips and corrugated appearance and toothed edges. Turns a burnt orange color in autumn. Leaf litter is dense and can smother understory plants.



Flowers: Male and female catkins on the same trees, emerging at the same time as leaves.

Fruits: Small hairy winged fruits, they spin as they fall.

Culture: Occurs on a wide variety of parent materials and textures but prefers well-drained sandy or silty soils. Can hybridize with water birch (B. *papyrifera* variety *subcordata*); which may be particulary useful for stabilizing stream beds that enter lakeshores. Somewhat short-lived (average 60 – 70 years, with a maximum of 140 years). Seedlings relatively easy to transplant if watered. Good candidate for stabilizing sandy banks or sand-gravel banks. Trees will pollard easily; eg prune to main stems and sprouts will create a bushy re-growth from

the remaining branches. The buds and insects that grow in the bark fissures are used extensively by foraging songbirds. Sprouts and juvenile shrub-stage trees are eaten by moose and deer. Dead tops of larger trees often used for cavities by pileated woodpecker and flicker, and subsequently by secondary cavity nesters that rely on the cavities of larger animals.

Problems: Prone to dieback of upper crowns when materials slump over top of the base of the trees. This is a common occurrence on steep unstable sandy slopes. Trees can be rejuvenated if the dead portions of the crowns are pruned. Bark is flammable.

Shrubs

Species name: *Acer glabrum* Torr. var.



Common name(s): Douglas maple, Rocky Mountain maple

Form: Small tree or shrub that grows up to 9 m. Deciduous with opposite branches; short trunk with smooth reddish-brown to gray bark.

Leaves: Simple, opposite, palmate shaped with three to five coarsely toothed lobes. Paler on underside, turning yellow to orange or crimson in the fall.

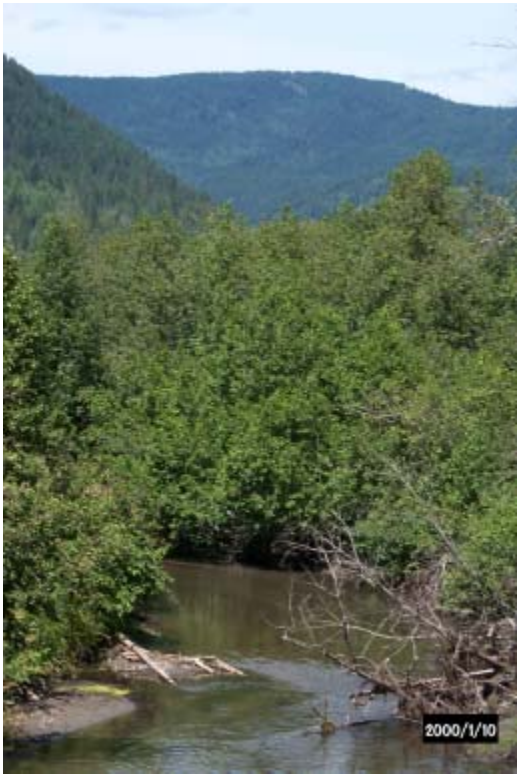
Flowers: Male and female flowers usually occur on separate trees and can be found in hanging clusters at the end of branchlets. Four petals and four sepals; yellowish-green; blooms in spring.

Fruits: Pairs of winged seeds 2-3 cm long, greenish-brown, strongly wrinkled and indented. Attached in a V-shape at an angle of 45^{o} or less.

Culture: Found on dry to wet sites at elevations between 1200-1800 m. It grows best on on moist slopes and along streams in open forests and clearings, particularly on warm southerly aspects. Some shade is required for establishment. Most commonly found on silty to sandy or gravely and rocky well-drained soils. Flexible stems can withstand heavy soil/snow pack. Sprouts easily from root crowns following a disturbance. Cuttings also can be used for brush layering. Useful for live fascines.

Problems: *Acer* seed has both physiological and seed coat dormancy, which are often difficult to overcome. Many species are classified as being in deep dormancy. Perfected procedures are not available for all species of this genus. Cuttings or potted material from the nursery are usually the most successful method. Pole cuttings can be successful if care is taken to plant the stem section (of a branch) right side up, and smash the bottom end a bit to promote rooting. This can be done in late fall, or early spring.

Species name: *Alnus incana* spp. *tenuifolia*



Common name(s): mountain alder

Form: Many-stemmed meandering shrub or small deciduous tree, 2-10 m tall, often grows in clumps; wooly hairy to hairless twigs, club-shaped buds on short stalks; yellow-brown bark with distinct horizontal slits (lenticels).

Leaves: Broadly elliptic, rounded to somewhat heart-shaped bases, rounded blunt tips and shallowly lobed, double-toothed edges; green above, pale and hairy below.

Flowers: Small and inconspicuous, in separate male or female catkins developing before leaves; male catkins long and drooping; female catkins short, woody, cone-like.

Fruits: Narrowly winged nutlets in egg-shaped cones on very short stalks.

Culture: Widespread and locally abundant at low to subalpine elevations along streams, at edges of ponds, lakes and swamps and in other poorly drained sites. Excellent slope stabilization species for a variety of uses, especially flats that are frequently inundated. Can be combined with rocks using joint plantings or brush layering. Useful for live fascines.



Problems: None

Species name: *Amelanchier alnifolia* Nutt.



Common name(s): saskatoon, Juneberry, serviceberry, shadbush

Form: Shrub to very small tree, stems are smooth, with dark grey to reddish bark. Wood is very strong and tolerates being buried for short periods. Deep rooting once established

Leaves are rounded at edges but tips are serrated. Pretty, reddish fall coloring, often first to drop in fall

Flowers are white, abundant, slightly fragrant, can be very showy in spring.

Fruits are a dark purple berry, can be sweet if grown in amended soil and watered infrequently. Dried fruits prized by birds, especially grouse and Stellars' jays in winter, also deer, sheep and elk can browse stems heavily in winter.

Culture: Tolerates dry, open eroded sites, full sun, can be grown in rocky to sandy soils, prefers some compost when planted in sands and gravels. Prefers gentle slopes and breaks in slope between steep face and extended toe of slope. Can be pruned to create bushier habit. Tolerates being planted in fascines (see page 9) and wattle fences (see page 12). Can be planted in raw materials or later after grass or clover covers soils. Shrubs from 1-gallon pots are best able to establish and must be watered in the first season. Can be valuable as nurse plant for Douglas-fir seedlings. May be useful for live fascines in dry situations, but probably requires some irrigation.

Problems: Can develop powdery mildew and entomosporium leaf and berry spot. May be controlled with dilute solution of baking soda.

Species name: *Arctostaphylos uva-ursi*



Common name(s): kinnikinnick, bearberry

Form: Trailing evergreen shrub, usually not over 20 cm tall; brownish-red bark; long, flexible, rooting branches often form large mats.

Leaves: Alternate, oval to spoon-shaped (up to 3 cm long) with smooth edges; leathery, dark green and somewhat shiny above, paler below, hairless.



Flowers: Small, urn-shaped and pinkish white; drooping in few-flowered clusters at branch tips.

Fruits: Bright red berries like miniature apples, with large, very hard seeds; edible but with a somewhat dry, tasteless pulp.

Culture: Widespread and common at low to alpine elevations on sandy and well-drained exposed sites, dry rocky slopes, dry forests clearings and hummocks in shrub-carrs. After the second year, the stems (stolons) produce adventitious, feeding roots, which seldom grow deeper than the duff layer. The berries are used by birds and bears. Bears will rip out large patches of the plant. Considered one of the finest native evergreen ground covers. It has excellent capability for surface stabilization but cannot be expected to stabilize deeper materials. Very beautiful when grown on the crests of slopes

Problems: This species can be air-layered, or propagated by cuttings, but does not respond well to being dug up and moved to other sites on the same property.

Species name: *Ceanothus sanguineus (*Pursh)



Common name(s): redstem ceanothus, wild lilac

Form: Deciduous, erect shrub that grows 1-3 m tall. Immature stems are greenish, while mature stems darken to a purplish-red. Considered an excellent pioneer shrub for soil stabilization on steep dry slopes and for improving soil fertility due to its deep root system and nitrogen-fixing ability.

Leaves: Alternate, thin, and finely toothed with an oval to elliptic shape. This deciduous shrub has characteristic three main veins on the leaves. They are dark green, and smooth above, while pale below.

Flowers: Cream to white in colour; small, borne at the end of the stems in a short spray.

Fruits: Three-lobed capsule with a single shiny, brown seed per cell.

Culture: Grows best on moist, well-drained sandy soils that are low in organic material. Tolerates low to mid-elevations in open or partial shade. Prolific seed producers. Often sprouts after the crown is damaged or destroyed. Preferred by deer and can be heavily used. Alternatively, C. *velutinus* (snowbrush) is also a good stabilizing species (see below). Both can be started from seed collected in the Columbia valley. Directions on seed collection and treatment (P. Woodward, pers.com. 2002) are to collect the seed capsules by hand as they start to break open (usually in August). Store the capsules dry at 21 – 28 C for several days, then extract the seed. The brown seeds are the viable ones. You can store the seed in dry paper at 3 degrees C, for several years. To sow, soak the seed in 80 – 90 degrees C water or dip in boiling water for 10 seconds to 5 minutes then cold stratify for 90 days. OR: soaking in sulphuric acid for 30 minutes or dipping in gibberellin may also help.

Problems: It is hard to find this shrub in the average native plant nursery. No particular problems, though it is very easy to grow once established on dry sandy or gravely soil. May be suited to brush layering.

Species name: *Ceanothus velutinus* (Doug. *ex* Hook.)

Common name(s): snowbush, snowbrush ceanothus, sticky laurel, buckbrush

Photo credit(s)**:** © 1998-99 Charles Webber, California Academy of Sciences.

Form: Spreading evergreen shrub that can reach 6 m. Roots have nitrogen-fixing ability good for nutrient-deficient soils.

Leaves: Evergreen, alternate, broadly elliptical; three-veined from the base, finely toothed. They have a shiny, waxy appearance and a strong spicey balsamlike odor. Sticky above, greyish hairy to smooth below, evergreen.

Flowers: Compound clusters of fragrant, white fruits.

Fruits: Enclosed in a roundish to triangular capsule with a distinct three-lobed top, containing three shiny seeds.

Culture: Found in elevations from 1100-3000 m. Grows abundantly on south facing slopes. Grows best in deep, medium-to-coarse textured, well-drained soils but will tolerate many soil types. Used heavily by birds and ungulates

Problems: See above

Species name: *Cornus stolonifera, C. sericea*



Common name(s): red-osier dogwood

Form: Many stemmed, deciduous shrub, 1-4 m tall, freely spreading from stems that become prostrate; branches opposite; stems usually bright red and gorgeous in the sunshine in midwinter.

Leaves: Opposite, oval and mostly sharp-pointed with 5-7 prominent parallel veins that converge at leaf tip.

Flowers: Small, white to greenish, in dense flat-topped clusters at ends of stem.

Fruits: Clusters of small, white (often blue tinged), berry-like fruits, each with a large, somewhat flattened stone; bitter.

Culture: Grows at low to mid elevations in swamps, moist to wet upland forests, openings and clearings. Very well suited to stream and lake shore stabilization, but also can be used to stabilize fine materials in rock-falls as long as there is some moisture percolating through the rock. Easy to obtain and culture cuttings, especially by removing suckers from the main plants during the spring and growing in pots for planting in the early fall. Choice moose browse. The berries are consumed by birds. Considered one of the most valuable native shrubs for habitat reclamation, wildlife cover, and other environmental plantings. This species is a first rate stream course stabilizing species.



Problems: If insufficient fine roots accompany the suckers when they are removed from the main plant, they won't take very well to transplanting. Cut the plants back and keep them in the shade with frequent watering.

Species name: *Corylus cornuta* Marsh.



Common name(s): beaked hazelnut, Hazelnut, Wild filbert

Form: Bushy shrub to small tree (2 to 5 m tall), multi-stemmed and loosely spreading. New twigs are quite hairy, while older twigs are brown and slender. The bark is smooth, light brown and may have a white striping.

Leaves: Alternate, broadly oval with a sharply pointed tip, and saw-toothed edges. They are bright green in the summer, turning yellow in the fall.

Flowers: Tiny and inconspicuous. Male and female flowers are separate, and appear well before the leaves. Female flowers are borne at the end of the current year's twigs, and have bright red stigmas. Male flowers are drooping yellowish catkins, 10-15 cm long, borne on the previous year's wood.

Fruits: Clusters of 2-3 smooth round nuts with very hard shells. They are enclosed in a prickly tubular light-green husk. The protruding end of the husk resembles a beak, giving beaked hazelnut its common name.

Culture: Found in open woods, thickets, pastures, and clearings. If drainage is sufficient (i.e. gravels) it does well on floodplains. Beaked hazelnut is most commonly propagated by seed, which must be gathered in late August or early September as the husks begin to turn brown, before the industrious squirrels get to them! Store them a few days to dry the husks completely. Remove the husks. Two to six months of chilling in a moist environment (e.g. covered with humus or peat moss) is required for germination. In the West Kootenay, beaked hazelnut occurs typically on moist, well-drained sites and is valuable as a soil binder on fine-textured, steep slopes. The edible hazelnuts are a preferred food of Stellar's Jays, chipmunks and squirrels.

Problems: Beaked hazelnut may impede successful regeneration of upland conifer forests. While very useful for erosion control and slope stability, it may not be the most appropriate choice in areas where natural conifer forest is a desirable and likely outcome.

Species name: *Holodiscus discolor* (Pursh) Maxim



Common name(s): ocean spray, creambush, rock-spirea, arrow wood, iron wood

Form: Native, deciduous, spreading shrub growing up to 4 m tall. There are usually several thin main stems and slender arching branches. The wood of ocean-spray is very hard (hence 'iron wood' and 'arrow wood') and was used traditionally for digging sticks and arrow shafts. Deer and elk will browse the branches in the winter, while the leaves are generally considered unpalatable in the summer.

Leaves: Alternate, oval to oblong triangular, 4-7 cm long with shallow lobes to deep teeth, and prominent veins.

Flowers: Showy, profuse, white or cream-coloured, borne in large (up to 30 cm), drooping terminal clusters. They may persist well into the autumn. The name 'ocean spray' describes these masses of creamy plumes. They are an important source of nectar for many butterflies, bees and other insects.

Fruits: Small, brown, hairy and 1-seeded. The presence of clusters of seeds over the winter is one of the best clues for winter identification. Used by chickadees, pine siskins and several other small songbirds.

Culture: Best grown from hardwood cuttings, salvaged plants or seeds. Seeds should be collected late in the season and sown thickly into nursery beds outside, or stored for 4 ½ months in a cold place to break their dormancy. Ocean spray is very hardy, does well on disturbed, open sites and has good soil binding qualities. Tolerates very bouldery conditions well. Ocean spray is a colourful reclaimer of open or disturbed land.

Problems: Seeds have a low germination rate, so plant thickly. Ocean spray is also intolerant of saturated soils. Before the new flowers come out in the spring, the old flower heads look a bit dowdy but they can be pruned back without discouraging the next crop of blooms.

Species name: *Juniperus communis*

Common name(s): common juniper, dwarf juniper

Photo credits: 1) USDA plant database, www.cnr.vt.edu 2) Joy Spurr, National Wildlife Foundation, www.enature.com



Form: Shrub; prostrate, trailing-branched to rounded, up to 1.5 – 3 m tall.

Leaves: Mostly in 3's, needle-like to narrowly lance-shaped, usually stiff, very sharp pointed, whitish above, dark green below.

Flowers: Absent



Fruits: Female cones berry-like, bluish-black, very fleshy, maturing second season; may have a slightly pungent odour.

Culture: Grows in low to alpine elevations in dry open forests, grassland fringes, rocky outcrops and openings. Requires good drainage.

Problems: Although junipers are tough plants, occasional problems may be caused by pests such as aphids, bagworms, beetles and blight. Spider mites are a problem as well, and winterkill can make plants look unsightly. Does not tolerate shaded areas and is also not drought tolerant. It is magnificent, otherwise.

Species name: *Juniperus scopulorum*



Common name(s): Rocky Mountain juniper, Douglas juniper

Form: Shrubby evergreen tree to sprawling shrub up to 10m tall; wide, irregularly rounded crown and knotty, twisted trunk. Reddish-gray brown bark divided into narrow, flat ridges breaking into thin, shredded, fibrous strips.

Leaves: Small, grayish-green, scale-like leaves, opposite, barely overlapping, but covering branch in 4 rows.

Fruits: Bright to dark blue, fleshy, berry-like cones with grayish tinge.

Culture: Widespread and common at low to mid elevations plateaus, on dry rocky or sandy soils, grassy slopes, dry open forests, most commonly on warm, dry south-facing slopes. Can tolerate inundation, and prefers bouldery very dry soils. Can be propagated by branch cuttings using the same method as for western red cedar. Well suited to brush layering using rooted stock and tolerates being partially buried.

Problems: Propagation from seeds is less reliable. Can look scraggly if not pruned. Along with common juniper, Rocky Mountain juniper also causes a skin reaction in some gardeners.

Species name: *Mahonia aquifolium (Pursh) Nutt. (Berberis aquifolium)*



Common name(s): tall Oregon-grape, barberry

Form: Low growing but erect, stiff-branched shrub, grayish brown wood, very strong and tolerates being buried for short periods. Very tenacious stoloniferous roots, shallow but very tough and sticky (i.e. binds soils, especially fine textured ones).

Leaves: Very shiny upper surface, shiny to dull beneath, 5 – 9 leaflets, barbed and sharp. Evergreen in winter, so a welcome sight on south facing slopes in the spring. It's supposed to be excellent winter forage but I've never seen it get eaten by anything! Readers, let me know!

Flowers: Bright sulphurous yellow clusters, fragrant. Will open when brought into the house early.

Fruits: Dark blue, dusky berry can be used to make wine, jelly, or coolers.



Culture: Tolerates rocky to sandy dry, open eroded sites, full sun, will grow on steep slopes. Prefers sand pockets in rock, or plain sand. Will sprout from segments of stolon left in the soil. Tolerates being planted in fascines (see page 4) and wattle fences (see page 5). Can be planted in raw materials or later after grass or clover covers soils. Shrubs from 1-gallon pots are best able to establish and must be watered in the first season. Will tolerate all degrees of exposure to light and is therefore appropriate for a variety of garden settings.

Problems: Field-collected transplants sometimes do poorly, and are slow to establish. Not very shade tolerant. Can be invasive. Hard to work around while weeding because it is so prickly, and if you are weeding it out, it tends to pull plants out some distance away.

Species name: *Pachistima myrsinites*



Common name(s): falsebox, Oregon boxwood

Form: Shrub; erect to prostrate, evergreen, 60 cm tall, reddish-brown, 4-ridged branches.

Leaves: Opposite (or nearly so), oval to elliptic, 1-3 cm long, shiny, thick and leathery with toothed edges, slightly rolled under. Also evergreen but short in stature and is therefore usually found under the snow. Can be the only thing in south facing clearings and openings that are green in midwinter.

Flowers: Numerous, very small, maroon flowers in small clusters along branches, fragrant, blooms in spring.

Fruits: Small, oval capsules, mostly with a white, fleshy covering and 1-2 dark brown seeds.



Culture: Widespread and very common at low to mid elevations in coniferous forest, rocky openings and clearings. Oregon boxwood stems can be layered and roots easily, and the shrub can be propagated easily through stem cuttings. Seeds are dispersed by gravity, with no evidence to suggest they are dispersed by any other means.

Problems: None

Species name: *Penstemon fruticosus* Buckl. (*C. luxurians* Rydb.)

Common name(s): shrubby penstemon



Photo credit: Pat Woodward, Pacific Rim Native Plants

Form: Compact small (to 40 cm tall) sub-shrub with many stems. It is evergreen, or partially evergreen, forming a spreading mound of up to 60 cm.

Leaves: Opposite, 2-3 cm long and narrow, with smooth or slightly toothed edges.

Flowers: Spectacular, mauve to purple, large tubular snapdragon-like flowers with a white-haired throat. They are borne in pairs in the late spring, forming a mound of flowers.

Fruits: Inconspicuous capsules.

Culture: May be grown from seed into flats and planted out in the spring. It also roots readily from softwood and semi-hardwood cuttings taken from June to September. Shrubby penstemon is known for it's exceptional hardiness and easy propagation. It grows in full sun, on dry sites with very little water. It is very common on interior B.C. roadways on rock faces, especially north-facing ones and can appear as a flash of blue as you drive past. Plant it near the top of a slope and it will seed itself downwards over the years.

Problems: Doesn't tolerate wet soils very well.

Species name: *Physocarpus malvaceus* A.Nelson



Common name(s): mallow ninebark

Form: deciduous shrub up to 2 m tall, with shedding grayish-brown bark on older branches. Mallow ninebark can form dense thickets, providing shelter and cover for a variety of birds and mammals.

Leaves are hairy, 3 to 5 five-lobed with toothed margins. The dark green upper surface may be leathery, with obvious veins. The lower leaf surface is lighter. Ninebark leaves start to turn colour early in August, turning bronze-red by early autumn.

Flowers are borne in rounded 1 ½ " white clusters at the ends of the branches. Individual flowers have 5 petals and a creamy-yellowish centre with many long stamens.

Fruits are usually paired, with hairy, tiny reddish seedpods.

Culture: Ninebark fits well in the wild garden, open woodland, or shrub-grass meadow. Easily propagated from hardwood cuttings. Cuttings should be made in late winter before the buds begin to swell. Softwood cuttings and root cuttings can also be successful. Once planted out, it will establish itself in thickets. Its extensive root system, rapid growth and ability to grow on dry disturbed sites make mallow ninebark useful for erosion control. Seeds are eaten by songbirds and small mammals. Suited to the furrowed groove method or wattle fencing.

Problems: Mallow ninebark can spread quickly if frequently disturbed. The seed heads are a bit unsightly (see photo), but the bark is very interesting and the leaves have a nice fall colour.

Species name: *Philadelphus lewisii*

Common name(s): mock-orange



Form: deciduous shrub up to 3 m tall, with many stems, with reddish-brown somewhat shiny bark. Can form dense clumps which flower profusely and aromatically in spring.

Leaves are paired, slightly toothed, 3 veined, and rough (referred to as sand-papery) to the touch.

Flowers are four oblong white petals, large, showy and beautifully scented, hanging in clusters at the branch ends.

Fruits oval woody capsules with many cylindrical seeds.

Culture: Mock orange fits well in the wild garden, open woodland, or shrub-grass meadow, and tolerates open rocky slopes Easily propagated from hardwood cuttings. Cuttings can be taken from late summer and treated as hardwood cuttings, and can be started from seed. Some sources say that the seeds require stratification for eight weeks in warm coarse sand at 20 degrees C, and then planted in warm sand. Broadcast seeding on a hot slope can be reasonably successful as well.

Problems: Seems to dislike being transplanted, but if adequately watered can survive, better to start from cuttings taken from young wood in mid-July.

Species name: *Prunus virginiana* (Dougl.) Walp.

Common name(s): choke cherry

Family: *Rosaceae*

Form: Deciduous, native small tree or shrub, 2-5 m tall with spreading or ascending branches. Often straggly in appearance, may form small tree. It often forms dense thickets.

Leaves: Oblong to oval, tapering to a long pointed tip with fine rounded teeth along the edges. Dull green above, greenish below,

Flowers: White, or slightly pinkish in long clusters the end of branches. Each individual flower has 5 rounded white petals, numerous stamens, in clusters of 5-7. Flowers are faintly scented.

Fruits: Small, spherical, shiny purplish red or black cherries with a single large stone and thin, bitter flesh. Fruits have been traditionally used as a laxative. Birds and some small mammals also eat them. The fruit matures in August or September.

Culture: Choke cherry is best propagated from seed collected when very ripe. Clean the seeds by immersing them in water to float off the pulp. Seeds need cold stratification for 3-4 months to germinate. This is best done between 1-5° C in a sand/peat mixture. Propagation can also be done from softwood stem or root cuttings. Seedlings can be planted out at 1-2 years, in the fall or very early spring as bare root, balled or burlapped specimens. Seedlings will readily establish themselves and are a good soil stabilizer for disturbed or degraded sites. Suited to the furrowed groove method.

Problems: Insect pests such as aphids, borers, and tent caterpillars are associated with all cherry species. Choke cherry is also susceptible to trunk and root rot.

Species name: *Ribes lacustre*.



Common name(s): wax currant, western red currant

Family: *Grossulariaceae*

Form: Native deciduous shrub that grows from .5 to 2.0 m tall. It has numerous reddish brown branches covered with sharp prickles. Larger thorns are on the leaf branch bases.

Leaves: Shaped like little maple leaves, toothed edges, not glandular or hairy.

Flowers: Red to pink, glandular and hairy flowers in hanging clusters.

Fruits: Dark purple currant berries with gland-tipped hairs.

Culture: Currants are reproduced mainly by seed. Seeds require thorough scarification to induce germination. Prefers moist sites and tolerates wet soils, it can be used to stabilize foreshores and slopes above water, especially cooler slopes. Browsed by moose. Once established can form a dense low cover with no maintenance, tends to deter trespassers, along with Devils' club.

Problems: Hard to work with cuttings or small plants and to weed around.

Species name: *Ribes hudsonianum*



Common name(s): northern black current

Photo credits: Arctic Wild Harvest Company, www.arcticharvest.com/Phototour/wildf/wildf1_33.asp

Form: Erect, deciduous shrub, 0.5-2 m tall, without thorns; smooth bark.

Leaves: Maple-leaf shaped, 5-9 cm across; 3-5 rounded lobes; toothed edges; many resin dots on the undersurface of the leaves.

Flowers: White flowers born on a semi-upright 6-15 cm long stalk, the individual blooms are saucer-shaped

Fruits: Black berries, with a waxy bloom, usually speckled with a few resin dots, edible and choice, especially if the plants have lots of water.

Culture: Grows at low and mid elevations in moist and wet forests, seepage areas and wet openings. Can be propagated from suckers and root sections, or from cuttings. Very important dried winter berry for over-wintering birds, eaten by bears. Can be winter browsed by moose. Can be used to stabilize foreshore with some inundation or fine textured rich soils that are infrequently inundated where slow moving streams enter the main water body. May be suited to live fascines, but known to be suited to the furrowed groove method.

Problems: None

Species name: *Rubus idaeus*



Common name(s): red raspberry

Form: Erect, deciduous shrub, to 1.5 m tall, with prickly, or bristly to almost unarmed stems and shredding yellow to cinnamon-brown bark; similar to cultivated raspberry.

Leaves: Divided into 3 saw-toothed and sharply pointed leaflets on flowering canes, with the end leaflet being the longest. Apple green in color. Drops leaves early in the fall.

Flowers: White, drooping; borne singly or in small grape-like clusters.

Fruits: Raspberry-like cluster of red drupelets; falling intact from plant, smaller and can be tastier than domestic raspberries.



Culture: Grows at low to sub alpine elevations, in clearings and other disturbed habitats; less common in mature, dry to wet, open forests. This species is extremely resilient to disturbance, seems to thrive on having its rooting medium stripped away, especially in a moist climate. Sprouts from roots and is easily divided. Will tolerate inundation *and* extreme drought. Well suited to brush layer construction. Berries are choice for a number of wildlife species and makes a nice jam. Thrives on burned sites and fairly resistant to herbicides, i.e. if herbicides are used on a site with R. *ideaus,* it is likely to increase in cover over time. May be well suited to use in live fascine drains.

Problems: Can be invasive.

Species name: *Rosa gymnocarpa*



Common name(s): baldhip rose, little wild rose

Form: Slender, deciduous shrub, erect to 2 m tall; usually with many soft, straight prickles, occasionally not prickly, especially on younger stems, which are usually covered with stalked glands.

Leaves: Compound leaves with 5-9 toothed leaflets, smooth on both sides, oblong-oval shaped, thin, pale green and sometimes glandular on the undersurface along the midrib.

Flowers: Pale pink to rose, small (1-2 cm across) with 5 broad petals; borne singly at end of branches on glandular stalks.

Fruits: Orange to scarlet, pear-shaped, fleshy hips; without attached sepals.

Culture: Grows at low to mid elevations in dry to moist, open forests and openings; absent from arid sites. Easily propagated from suckers. Very useful for midslope stabilization and relatively drought tolerant once established. Other roses such as prickly rose, *Rosa acicularis,* and nootka rose, *Rosa nutkana,* could be used similarly, especially by use of the furrowed groove method.

Problems: Can be hit hard by various leaf roller insects, and viral diseases.

Species name: *Salix spp.*



Common name(s): willow, several species are usefull.

Form: Variable; tall, spindly, to short, dense shrubs and multi-stemmed trees. Shiny or often velvety leaves. Bark can be interesting in winter.

Leaves: egg-shaped to narrowly oval shaped, with a tapering bases and smooth to weakly toothed edges; young leaves often densely velvety; older leaves often dark green above, sparsely hairy below with short pressed-down hairs.

Flowers: Often with dangling catkins (i.e. pussy willow flowers) appearing before the leaves unfold in the spring, usually only on the previous year's branches.

Fruits: Silky, stalks 0.8-2.2 mm long.

Culture: Cuttings can be taken from mid-fall to early spring. Stems should be more than 1 cm wide, and cut at a 45° angle at the lower end in 30-50 cm lengths. They can be planted directly on site, or hardened off and stored just above freezing before planting out. It can also be grown from seed or root suckers. Willows can contribute to stream bank stability, and is useful for stabilizing steep banks on drier sites. If taking cuttings, just match the donor to the receiving site. Scoulers' willow is more tolerant of dry sites than other willows, and it can be an effective nurse plant for Douglas-fir. Can be heavily browsed by all ungulates.

Problems: Difficult to identify to species, if that is important. Some willows are not very shade tolerant.

Species name: *Shepherdia canadensis*



Common name(s): Soopolallie, soapberry, buffalo berry

Form: Spreading, deciduous shrub, 1-2 m tall; brownish branches covered with small, coppery colored dots. Young branches covered with many rusty spots.

Leaves: Opposite, oval shaped leaves with dark green upper surfaces, and silvery-whitish hairs and rusty brown spots (scales) below.

Flowers: Inconspicuous and yellowish brown, borne in clusters of 1 to several on stems, before leaves open; male and female flowers on separate plants.

Fruits: Bright red, clear, oval berries; juicy but bitter.

Culture: Grows at low to sub alpine elevations in dry to moist open forests, often with lodgepole pine in bouldery, dry soils in openings and clearings. A nitrogen-fixing species, good for extremely dry sites, but benefits from some moisture. Supposed to be a browse species for deer and elk, but only used when little else is available.

Problems: Can be a bit homely in appearance, if grown in shade.



Species name: *Vibernum edule*



Common name(s): high-bush cranberry

Family: *Caprifoliaceae*

Form: Straggling to erect, deciduous shrub, 0.5-2.5 m tall; smooth, reddish bark.

Leaves: Opposite, with 3 shallow lobes and sharply toothed edges, hairy beneath; turning brilliant deep red in autumn.

Flowers: Clusters of small white flowers borne on short stems from between a pair of leaves.

Fruits: Clusters of red or orange, berry-like drupe with a large flattened stone; edible, juicy, acid and tart. Makes a terrific jelly.

Culture: Grows at low to mid elevations in moist to wet forests, seepage areas, swamps and clearings; generally absent from arid basins. Choice summer fare for squirrels and other small mammals and birds. The berries make a fine jelly. Good for seepage tract stabilization on the edge of areas receiving moisture. Good for water course stabilization and for fine textured slopes. Prefers richer soils, can be combined with red osier dogwood and black cottonwood.

Problems: Prefers some shade to full exposure to the sun.

Herbs and Grasses

Species name: *Agrostis scabra* Willd. *(Agrostis hyemalis* (Walt.) B.S.P. var. *tenuis* (Tuckerm.) Gl. *Agrostis geminata* Trin*.)*



Common name(s): hair bentgrass, ticklegrass, winter bentgrass

Family: *Poaceae*

Photo credit: © Anna Roberts (photo from Parish et al. 1996)

Form: Short (20-70 cm) densely tufted perennial grass. Its stems and leaves are rough feeling. (Scabra means rough in Latin.) Hair bentgrass colonizes recently disturbed sites; dry, rocky slopes; moist meadows. It thrives in open, sunny locations. It can tolerate seasonal submergence from fluctuating water levels.

Leaves: Mostly basal, very narrow (1-3 mm wide) and rough. Livestock eats leaves early in the season before the flower heads emerge.

Flowerhead: Delicate and open-branched, with most of the branches upright. It has a purplish appearance. The small spikelets occur at the end of the branches. They have a single tiny floret (1-2 mm), nestled inside two small (2-3 mm), equal glumes.

Seeds: Very small, and can be dispersed over long distances by wind. The seeds then establish themselves on bare mineral soil.

Culture: Hair bentgrass reproduces primarily by seed on exposed soil. It can be seeded in the early spring or late fall. Plants usually produce seed in their second season. It needs water in the establishment phase, after that it can tolerate a range of inundation. Once established, a small group of plants can effectively spread their seed over a larger area. Hair bentgrass has been used successfully in reclamation projects in areas disturbed by mining or disturbed by sulfur emissions. It could be used in the reed bed construction method or simply seeded on unstable stream edge or shore areas.

Problems: Seed is not always available but is easy to collect.

Species name: *Aruncus dioicus*

Common name(s): goat's beard

Photo credit: Plate 28 of Wildflower Genetics by Anthony J.F. Griffiths and Fred R. Ganders (Flight Press, Vancouver, 1983). ISBN 0 919843 00X. Aruncus is the plant on the right.



Form: Perennial herb, 1-2 m tall, from a stout, short creeping rhizome; with several robust flowering stems.

Leaves: Alternate fan like, individual leaves are sharply toothed with tapering tips; dark green and usually hairless on the upper surface of the leaf, and hairy and paler below.

Flowers: Tall flower stocks, very airy in appearance, consisting of many tiny, white; densely packed flowers along a branched, spike-like inflorescence; male and female flowers on separate plants, and the males are showier.

Fruits: Small, erect follicles with spreading tips on long, drooping branches.

Culture: Grows at low to subalpine elevations in wet, moist forests, openings, seepage areas and moist clearings. Has potential to stabilize flattish organic areas subjected to periodic flooding. Using rock to stabilize a planting area is advised in areas with any fluctuation in the water table, to start. Available in pots from some nurseries. Can be used in water course stabilization in the inundation (i.e. lowest) part of the buttressed area. Easy to grow from seed collected in the wild.

Problems: Requires shade.

Species name: *Athyrium filix-femina*



Common name(s): lady fern

Form: Many erect to spreading leaves in a vase-like cluster, to 1.5 m tall, with old leaf stalks at base, from a stout, scaly rhizome. Older leaves sometimes have a 'broken' appearance.

Leaves: Fronds all fertile, deciduous; stalks short, fragile, with scaly bases; blades soft, narrowly to broadly lance-shaped, tapering at both ends (with a diamond-shaped profile), feather-like.

Sori: Elongate and curved, borne on undersides of leaflets, partly covered by a flap-like indusium attached at side of sorus.

Culture: Grows at low to sub alpine elevations, in moist to wet forests, thickets, openings, slide tracks, streambanks, meadows and clearings. Also tolerates fine textured sands with high moisture holding capacity. Easy to divide from clumps in the fall. Good superficial slope stabilizing species

Problems: Very invasive, once established may exclude other species. It dies back completely in the winter, leaving a soggy mess at its crown. It is best composted soon after dying.

Species name: *Calamagrostis rubescens* Buckl. (*C. luxurians* Rydb.)

Common name(s): pinegrass

Family: *Poaceae*

Photo credit: © Michael Champion



Form: Attractive, strongly tufted perennial grass that grows 50-100 cm tall. Tufts can be up to 1 meter across. Roots are fibrous and there are long rhizomes. Can be sod forming and extremely competitive. It can grow in open areas, but is shade tolerant, growing in open and closed forests. With up to half of its biomass under the ground, pinegrass can bind the soil against erosion.

Leaves: Narrow (2-5 mm wide), 8-40 cm long, and rough to touch. It is an important source of early spring forage for deer and elk, though its palatability decreases through the summer.

Flowers: Narrow, 6 to 15 cm long, with the florets on short upright branches. The inflorescence may be slightly purplish when young, drying to light tan. Pinegrass normally spreads by rhizomes and produces flowers (and therefore seed) only in open areas. It flowers from mid-June to mid-September.

Seeds: Small and light and dispersed by the wind.

Culture: Seeds can be planted in the fall or spring. They require light to germinate, so barely cover with soil. No scarification or other special treatment is required. A preferred method of propagation is through division of existing healthy tufts. Pinegrass responds well to light “maintenance” burning, which also increases its palatability to wildlife. It also tends to increase with the removal of the forest canopy.

Problems: Susceptible to heavy grazing, and decreases after clipping in mid-July. Is a strong competitor, and can displace less aggressive species - both an advantage and a disadvantage.

Species name: *Carex rostrata*

Common name(s): beaked sedge

Family: *Cyperaceae*



Form: One of the most common sedges; in large clumps, to 120 cm tall, from short stout rhizomes and long creeping runners, sometimes forming dense sod; stems thick at base, light brown, spongy, conspicuously clothed with old leaves; sheaths not shedding nor becoming web-like.

Leaves: Smooth with regular knobby septa; upper leaves longer then stems, thick and flat, to 12 mm wide, yellowish-green.

Flowers: Long, cylindrical, unisexsual spikes; 2-4 overlapping, male spikes at top of stem with densely flowered, erect female spikes below; lowest bract leaf-like and longer than spikes.

Fruits: a nut-like achene with 3 angles, the perigynium is large (4-7 mm long), with round body and an abrupt short beak. These rounded fruits emerge from the flower head as shiny, pale green knobs with a reddish-brown tip; 3 stigmas; spreading at maturity.

Culture: Grows at low to mid elevations; prefers perennially wet areas. Useful for creating a wetland area if there is not much inundation but maintains a steady supply of standing water. *Carex rostrata* areas are used by nesting shore birds, combines well with water birch on sandy, gravely foreshores. Use of a large scale reed bed construction may be helpful to initially stabilize an area.

Problems: Needs stable, standing water but can be quite dry by fall, as long as the planting site fills in. Only available from specialty sources. Can be divided from owned stock.



Species name:
Elymus glaucus (Raf.) Buckl.

Common name(s):
blue wildrye

Family: *Poaceae*

Form: short-lived, native perennial 50-150 cm tall, often growing in small tufts of only a few stems. It may have short rhizomes and/or stolons. Blue wildrye, as its name suggests, is a light blue-grey colour, especially early in the season.

Leaves: May be up to 30 cm long, 5-10 mm wide. They are flat, lax, and usually rough to the touch.

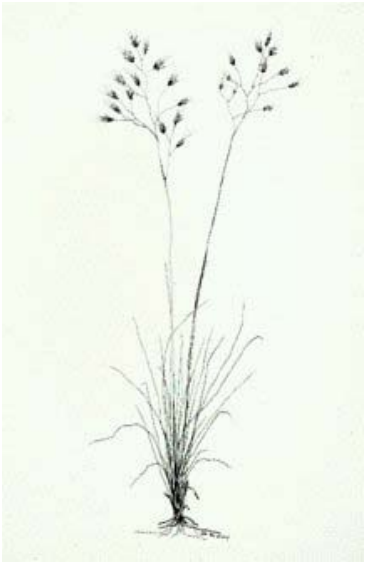
Flowers: Erect stiff spikes, 5-15 cm long with a braided appearance. Blue wildrye usually (though not always) has curved or straight hairs sticking out from the flowers (awns) about 2 cm long.

Seeds: Awned. Plants generally produce an abundance of seed, which can be harvested (with care) for replanting. Seed from local sources will generally be better adapted than commercially produced seed.

Culture: Blue wildrye is usually associated with moist open woods and stream-edges, though it is drought-tolerant and widely used for revegetation on disturbed severe sites. Seeds have good germination rates and relatively rapid seedling growth. It can also be grown in pots and transplanted out after a year. Useful for initial stabilization of surface material, and can be broadcast seeded. Eaten by deer in the spring.

Problems: Plants are intolerant of heavy grazing. This shouldn't be a problem on steep slopes. Blue wildrye isn't very competitive, and thus not terribly persistent, usually decreasing in abundance after a few years. Disturbance, however, favours Blue wildrye.

Species name: *Festuca occidentalis* Hook.



Common name(s): western fescue

Family: *Poaceae*

Photo credit: © This drawing comes from http://www.dnr.state.wi.us/org/land/er/factsheets/plants/images/wfescue.jpg

Form: tuft-forming perennial native grass 25-110 cm tall. Tufts are formed with hair-like leaves. Roots are fibrous.

Leaves: Soft, extremely narrow (1 mm), 10-20 cm long, inrolled and grow mostly from the base.

Flowers: Openly branched, with drooping individual branches. Each spikelet has between three and five florets. Each floret ends in a bendable awn – a bristle-like protrusion that is as long or longer that the lemma (the 'seed-like' part of the flower.)

Seeds: Small and awned.

Culture: Seeds can be broadcast and lightly covered with soil. Best seeded in the early spring. Western fescue has been used extensively for restoration in the Pacific Northwest, California, as well as in northern British Columbia.

Problems: None known. Starting from seed is not as successful as starting from plugs, which can be acquired from some native plant nurseries.

Species name: *Geum macrophyllum*



Common name(s): large-leaved avens

Family: *Rosaceae*

Form: Rhizomatous, perrenial herb, 30-70 cm tall, with hairy stems.

Leaves: Low growing, basal leaves in a cluster, feather like, top leaves usually a little shorter than the bottom older ones.

Flowers: Bright yellow, “butter-cup”-like, saucer-shaped; solitary or in a few-flowered cluster at tip of stem; from centre of the plant.

Fruits: Little nut like structures clusters of hairy seeds, with persistent styles bearing an S-shaped bend (hook) near tip.

Culture: Grows at low to subalpine elevations in moist and wet forests, seepage areas, openings and clearings. Often found on the drier edge of wetlands, and is quite useful for stabilizing organic soils in flat wetlands on the edge of wetlands from being displaced by flooding. Can tolerate seasonal submersion.

Problems: There may not be a good source for this species, but is easily divided from existing stock and is common in the Arrow District.

Species name: *Lupinus arcticus*



Common name(s): arctic lupine

Form: Perennial herb, 80 cm tall, with many branched stems emerging from a woody rootstock.

Leaves: Palm-shaped leaves, bright green and smooth on the upper surface but hairy beneath.

Flowers: Pea-like, deep blue to lavender with whitish to pinkish markings at base of wing petals; the flower head is a long pyramid-shaped cluster. Very showy and long-lived.

Fruits: Pods covered in silky hairs.

Culture: Scattered at low elevation, on plateaus, in moist areas but also drier areas, clearings and disturbed soils. It grows best in fine textured sands. Can colonize large areas. Favourite of bees and butterflies. Good slope stabilization species through direct seeding. Seed is easily collected, just snip the old flower heads off and dry by hanging upside down in a warm, dry place with good air circulation. When seed pods are dry, the seed is ready to be started for a late summer planting, or can be over wintered in the fridge. Nipping the seed with a serrated knife sometimes helps germination. Very easy to grow.

Problems: Can be invasive.

Species name: *Luzula parviflora*



Common name(s): small flowered wood-rush

Form: Perennial, 20-80 cm tall, from a rhizome; stems solitary or in small tufts, round in cross-section, sometimes tending to become horizontal.

Leaves: Basal and along stem, large (0.5-1 cm wide) and flat, with a few long white hairs on edges.

Inflorescence: Solitary flowers, with 6 purplish-brown petals in a nodding, open inflorescence.

Fruits: Brown capsules, each with 3 small seeds

Culture: Grows at mid to high elevations in open forests and disturbed sites. Useful for wetland and stream bed stabilization. Sometimes eaten by moose and other ungulates. May be grown with cattail (*Typha latifolia*) and rushes. May be grown from divisions. Useful for reed bed construction.

Problems: Must have some moisture during the growing season.

Species name: *Leymus cinereus* (Scribn. & Merr.) A. Love. *(Elymus cinereus* Scribn. & Merr.)

Common name(s): giant wildrye, basin wildrye

Photo credit: © Valerie Huff 2001



Form: Tall (1-2 m), coarse, bright green to bluish-grey native grass. Grows in tufts that may be a metre or more wide. It often has short thick rhizomes connecting clumps of grass. The extensive, coarse and fibrous root system protects the soil against erosion, and can help stabilize soil on embankments and on severely disturbed sites.

Leaves: Wide (10-20 mm), long (up to 45 cm), coarse and flat.

Flowerheads; Large, stiff and compact spikes up to 20 cm long. Spikelets are usually three per node (ranging from 2 to 7) with 3 to 6 florets per spikelet. They rarely have awns.

Seeds: Produced in large quantities, and are usually ripe by late September. They should be stored at 20° C for planting early the next spring.

Culture: Giant wildrye can be direct seeded from collections made in July or August from wild plants. As the germination rate may be low, high seeding rates are recommended. It is also possible to grow plants in containers and plant them in the fall. Some native plant nurseries supply plugs, if ordered in advance. Once established, giant wildrye is a good competitor, and spreads both by seeds and vegetatively. Established communuties of giant wildrye can be divided in the fall and planted to new areas.

Problems: Seedheads can become infected with ergot (Claviceps purpurea), especially in wet years. Can get very large and is quite coarse to handle.

Species name: *Pseudoroegneria spicata* (Pursh) A. Löve (*Agropyron spicatum* (Pursh) Scribn. & J.G. Sm.,
Elymus spicatus (Pursh) Gould)



Common name(s): bluebunch wheatgrass

Form: Bluebunch wheatgrass is a native perennial grass, between 60 and 130 cm tall, forming clumps (bunches) up to 1.5 m wide. The plant may be green or somewhat bluish in appearance drying to a lovely blonde.

Leaves: Green to slightly bluish, and grow mostly off the stem. They are flat or loosely inrolled, up to 4 mm wide, and often slightly hairy on the upper surface. The previous years leaves are often visual at the base of the plant. If you look closely where the leaves meet the stem, you can see well – developed clasping lobes called auricles.

Flowers: Appear in early summer on erect, slender spikes 8-16 cm long. Spikelets are attached directly to the stem, and do not overlap. Each spikelet has 5 to 8 individual florets. In our area, the florets rarely have awns (the little bristles that stick out.)

Culture: Seeding is best done in early spring or late fall, at a rate of 7-9 kg per hectare. On steep slopes and harsh, open sites, this rate should be increased. From seed, plants take two to three years to flower. It can also be grown in containers and transplanted. Plugs are also available if ordered in advance from some native plant nurseries. These are proving to be most successful.

Problems: Bluebunch wheatgrass is slow to establish and not tremendously competitive against other species when starting. Once established, Alistair McLean thought this species could easily out-compete knapweed. Because it is quite palatable to animals, it is also susceptible to heavy grazing. This isn't usually much of a problem on the steep slopes, but you may want to watch for this.



Species name: *Stipa comata* Trin. & Rupr. *Hesperostipa comata* (Trin. & Rupr.) Barkw.

Common name(s): needle-and-thread Grass, speargrass, western speargrass, common speargrass

Form: Erect, densely tufted perennial native to British Columbia from 30 to 70 cm tall.

Leaves: 10-30 cm long and 1-2 mm wide, usually curling inwards and somewhat rough. Leaves are mostly basal, in a distinct tuft. Needle-and-thread grass is an important forage for wildlife in spring, before the flowerheads appear.

Flowers: Start to appear in mid-June. The flowerhead is relatively narrow, between 7-20 cm long. Spikelets grow on very short branches, and each spikelet has a single floret that tends to droop as the seed matures. Most noticeable about the flowerhead are the awns that give this grass its name. The awns can be up to 15 cm long and are often bent or twisted along their length.

Seeds: Sharp and can burrow through your socks!

Culture: Needle-and-thread can be propagated by seed or by tillers. Seed either in the fall (preferred) or spring at a rate of 9 kg/ha (228 seeds/m^2). Once established, the extensive root system holds the soil together, helping to reduce erosion. Needle-and-thread takes a long time to recover from a burn, but responds well to mechanical treatments.

Problems: The sharp awns (the needles) can irritate mouths, eyes, ears, tongue and skin of grazing animals (and children).

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http://www.ecy.wa.gov/programs/sea/pubs/95-107/under01.html

Photocredits are listed adjacent to the photographs, unless taken by the senior author.

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Glossary of terms

The following glossary of terms was adapted and amended from the Washington Department of Ecology ‘s website link: http://www.ecy.wa.gov/programs/sea/pubs/95-107/glossary.html and should be cited as Myers, Rian D, Michele Lorilla, and Jane N. Myers. 1995.
Surface Water and Groundwater on Coastal Bluffs: A Guide for Puget Sound Property Owners.

Backshore
The portion of the shoreline located landward of the berm crest, only wetted in very high tides or storms, technically between "ordinary high water" and the highest water line.

Bank
The rising ground bordering the sea, a river, or lake. Also see BLUFF and CLIFF.

Beach
The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach is the extreme low water line. A beach includes FORESHORE and BACKSHORE.

Bedrock
A general term for the rock, usually solid, that underlies soil or other unconsolidated, surficial material.

Bioengineering
In soil applications, refers to the use of live plants and plant parts to reinforce soil, serve as water drains, act as erosion prevention barriers, and promote dewatering of water laden soils.

Bluff
An unvegetated high bank composed largely of unconsolidated deposits with a near-vertical face overlooking a body of water.

Bluff Crest
Upper edge or margin of a shoreline bluff.

Bluff Face
The sloping portion of a high bank.

Bluff Toe
The base of a bluff where it meets the beach.

Catch Basin
A structure usually buried, where surface water is captured and conveyed into pipes and/or where piping (often of different sizes) is connected.

Cliff
A high, very steep to perpendicular or overhanging face of rock rising above the shore.

Coastal Zone
The sea-land fringe area bordering the SHORELINE where to coastal waters and adjacent lands exert a measurable influence on each other.

Culvert
A pipe or concrete box structure that conveys flow from open channels, swales, or ditches under a roadway, driveway, fill soil, or surface structure.

Curtain Drain
Drainage trench that is excavated into an impermeable soil layer to collect groundwater that is perched on that layer. Trench is backfilled with drain rock (gravel) that is enclosed in a geotextile. A perforated pipe is placed within the drain rock backfill to collect and convey the groundwater to a suitable discharge point.

Drainage (soil)
The rapidity and extent of the removal of water from the soil by surface runoff and by down-draw flow through the soil. Also, the natural and artificial means for improving this removal by a system of surface and subsurface channels and piping systems.

Drain Rock
Rounded gravel ranging in diameter from 11/2 to 3" with no fine particles, used in drainage trenches.

Erosion
The wearing away of rock or soil and the movement of the resulting particles by wind, water, ice, or gravity, but usually excluding MASS MOVEMENTS.

Extreme High Water (EHW)
The average height of the highest tidal waters reached during the year over a 19-year period.

Fascine Drain made of live plant material laid in a trench and usually tied at intervals with wire.

Foreshore
The lowest segment of a beach, between lowest tide and the berm crest, covered by most daily tides, technically between the "lowest low water" line and the "ordinary high water" line.

Groundwater
Water collected or flowing under-ground usually in the interstices of soil or rock fractures. Typical soils containing groundwater are relatively permeable soils such as sand and gravel.

Gully
Large intermittent drainage channel developed from the erosion forces of drainages occurring from surface water runoff.

Hardpan
A hard, relatively impervious, layer of SOIL lying just below the surface. Sometimes synonymous for TILL.

Hummocky
Having an uneven, jumbled or erratic appearance characteristic of landslide movement.

Impermeable
Having a structural density that does not permit fluids to move through it freely.

Infiltration
The movement of water or solutions into or through a rock or soil through its INTERSTICES or fractures; the flow of rain water into soil material.

Interstices
Openings or spaces in rock or soil that are not occupied by solid matter.

Inundation: flooded by water with variable frequency

Mass Movement
A unit movement of a portion of the land surface down a slope as a SLIDE, a flow, or SOIL CREEP in which gravity is the main driving force.

Materials Soils or weathered parent materials, such as gravel, sand etc.

Natural Landscape Elements
The natural watercourses, topography, hydrology and vegetation which comprise a particular site.

Percent Slope
The direct ratio (multiplied by 100) between the vertical and the horizontal distance for a given slope; e.g., a 3-foot rise in a 10-foot horizontal distance would be a 30 percent slope.

Poorly Sorted
Unconsolidated deposits that consist of particles of many sizes mixed together in an unsystematic manner so that no one size fraction predominates.

Relief Drains
Series of drainage trenches laid out in a pattern to lower water levels to a specific elevation. Construction is similar to an interceptor drain.

Rill
A tiny drainage channel cut in a slope by the flow of water. Can develop into a gully with continuing erosion.

Runoff
That part of the precipitation that appears in uncontrolled surface ground floor, drains, or sewers.

Saturated
A condition in which the INTERSTICES of a material are filled with a liquid, usually water.

Sheet Flow
A thin layer of water moving across a surface without the formation of concentrated streams of water.

Shoreline
The intersection of a specified plane of water with BEACH; it migrates with changes of the tide.

Slide
A MASS MOVEMENT resulting from failure of SOIL or rock along a rotational or planar surface.

Slope
The inclination of the land surface from the horizontal percentage of slope is the vertical distance divided by the horizontal distance, then multiplied by 100.

Slope Erosion
The wearing away of rock or soil from a slope crest, face, or toe due to water, wind, ice, or gravity. Typical slope erosion from water results in RILL or GULLY erosion features.

Slump
A SLIDE characterized by a rotary movement of a generally independent mass of rock or earth along a curved slip surface.

Soil
In engineering work a soil is any earthen material, excluding hard bedrock, composed of 1) loosely bound mineral and organic particles, 2) water, and 3) gases. In agriculture, a soil is the loose surface material capable of supporting plant growth, and having properties resulting from the integrated effect of climate and living matter on the decomposition of bedrock and surficial deposits.

Soil Creep
The gradual and steady downhill movement of soil and loose rock material on a slope.

Strata
A layer of soil.

Surface Water
Water standing, ponding, or flowing on the ground or other surface feature.

Swale
Shallow open earth channel used to intercept and route surface water flows to a discharge location.

Tightline (solid pipe)
Typically used to describe a solid wall, rigid or flexible pipe used to transport water from one location to another, either buried or positioned along the ground surface. A tightline does not have slots or holes like a perforated pipe.

Till
POORLY SORTED and generally unstratified sediments, deposited directly by and underneath a glacier. Usually very hard and compact, with good bearing capacity and low permeability.

Toe of Slope
See BLUFF TOE.

Trench
In drainage applications, temporary ditch excavated in the ground to install drainage system components.

Undercutting
The removal of material at the base of a steep slope or cliff or other exposed rock by the erosive action of waves, running water, or sand-laden wind.

Upland
A general term for elevated land above the beach which lies above the EXTREME HIGH WATER level.

Wetlands (Biological)
Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surfaces or the land is covered by shallow water.

Wetlands (Jurisdictional)
Land forms which support under normal conditions a predominance of hydrophytic (wetland) vegetation, hydric (wetland) soil types, and wetland hydrology. Typically, they are jurisdictionally defined as: "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (Federal Interagency Committee for Wetland Delineation, 1989)".

Plant suppliers surface mail and email addresses (and websites where available)

Agri Supply (1986) Ltd
1935 East Trans Canada Highway
Phone (250) 372-7446
Fax (250) 372-1606
Irrigation and landscaping materials

.
Art-Craft Landscaping
7547 Wycliff Rd., Cranbrook
Phone (250) 489-1512
Fax (250) 489-1512
e-mail dreamscape@telus.net
Native plants, ornamentals, grasses. (Please call for appointment)

Art Knapp Plantland and Florist
1994 Sringfield Rd. Kelowna
Phone (250) 860-5633
Fax (250) 860-7172
e-mail artknappkelowna@shaw.ca
http://www.ArtKnapp.com/index.html
Chain store with wide selection of interior zonal plants, some xeriscape plants, and native plants.

Aqam Native Plant Nursery
Garry Graham Nursery Manager
7470 Mission Road
Cranbrook, B.C. V1C 7E5
Phone (250) 427-4300
Fax (250) 426-8935
e-mail aqamrockies.net
Growers of native plant species for revegetative and reforestation projects.

Beltane Nursery
2915 Hwy 3 Creston
Phone (250) 428-2062
Fax (250) 428-2096
Wide variety of native and non-native species, some xeriscape type plants.

Blue Geranium Garden and Tree Service
Ellwyn McKague
416 Brennand Rd.
Kaslo, B.C.
Phone (250) 353-2143
Fax (250) 353-2133
e-mail emm@netidea.com
Some native species, perennials, fruit trees.

Blue Mountain Nursery Company Ltd
1871 Pleasant Valley Road
Armstrong, B.C.
Phone (250) 546-8181
Fax (250) 546-8181
Local nursery with some native species.

Byland's Garden Centre
1600 Byland Road
Kelowna B.C.
Phone (250) 769-7272
Fax (250) 769-6162

Columbia Valley Greenhouses
8195 Old Waneta Rd.
Trail, B.C.
Phone (250) 368-8191
Fax (250) 368-8193

Columbia Valley Greenhouses
1415 Columbia Ave.
Castlegar, B.C.
Phone (250) 365-8461

Columbia Valley Greenhouses
345 Van Horne
Cranbrook, B.C.
Phone (250) 489-3328
General supply chain store with many ornamentals, bedding plants and some native species.

CRV Greenhouses
MacKenzie BC
http://www.perf.bc.ca/crv/
Specialize in Cattail plugs

Ellysium Gardens Ltd
Elysium Garden-Nursery
2834 Belgo, Kelowna, BC V1X4K5
(250) 491-1368 .
Uncommon perennials

Four Seasons Greenhouse
Fred Dutoff
5531 Slocan River Rd.
Winlaw, B.C.
Phone (250) 226-7254
Fax (250) 226-7254
Perennials, shrubs, trees, bedding plants,and native species.

Fraser's Thimble Farms
175 Arbutus Rd.
Salt Spring Island, B.C.
V8K 1A3
Phone/Fax (250) 537-5788
www.thimblefarms.com
Specializing in native, rare, and unusual plants.

Georama Growers
2870 Georama Rd.
Nelson, B.C. V1L 6Y7
Phone (250) 352-3468
1-800-590-9504
e-mail georama@netidea.com
www.georamagrowers.com
Local nursery with a wide selection of landscaping plants and supplies.

Island Seed
Po Box 4278 Depot 3
Victoria, B.C.
V8X 3X8
Canada
For southwestern gardeners; mainly vegetables and flowers, no native plants, some heirloom varieties

Linnaea Nurseries Ltd.
3666 – 224th Street
Langley, B.C.
V2Z 2G7
Phone (604) 533-8281
Toll free 1-888-327-7705
Fax (604) 533-8246
Email: linnaea@telus.net
Native plants, ornamentals, native seed and reclamation services

Pacific Rim Native Plant Nursery
44305 Old Orchard Road
Chilliwack, BC V2R 1A9
CANADA
Phone (604) 792 9279
Fax (604) 792 1891
e-mail plants@hillkeep.ca
www.hillkeep.ca
Almost exclusively native plants, good selection of hardy ferns, shrubs, trees and perennials and excellent advice on growing conditions and techniques for landscaping on unstable, dry slopes.

Peel's Nurseries Ltd. B.C. Native Plants
11610 Sylvester Road
Mission, B.C.
Canada, V2V 4J1
Phone (604) 820-7381
Fax (604) 820-7382
Email: peels@uniserve.com
http://peels.hypermart.net
Many native plants, ranging from rooted cuttings and seedlings to container and B&B material.

Rilkoff's General Store
4415 Hwy 3 West
RR#1, S850e, Comp.8
Grand Forks, B.C. V0H 1H5
Phone (250) 442-2510
Fax (250) 442-5384
Native and non-native plants species, bedding plants, bulbs, able to special order large lots.

Sagebrush Nursery
Wild Harvest Inc.
Richard Kendrick
RR#2, Site 13, Comp. 10
38206 93rd Street (Island Road)
Oliver, B.C. V0h 1T0
Phone (250) 498-8898
Fax (250) 498-8892
e-mail rkendric@sd53.bc.ca
Wide selection of native plants, xeriscapes,and native grasses. (By appointment only please)

The Perennial Gardens
13139 – 224th St.
Maple Ridge, B.C.
V4R 2P6
Phone (604) 467-4218
Fax (604) 467-3181
Email: info@perennialgardener.com
www.perennialgardener.com
Specializes in ornamental species, including native plants. Usually can't order from them after April.

Two Thumbs Up
Evelyn Gingrich
2330 Pass Creek Road
Castlegar V1N 4T4
Phone (250) 365-3157
e-mail twothumbsup@look.ca
Perennials, starters, and rocks of all shapes and sizes.

Valley View Garden Center
Jill Cook
5855 Spencer Rd., Grand Forks
250-442-3405
Fax (250) 442-3484
e-mail jcook@sunshinecable.com
Perennials, anuals, shrubs, trees, pond supplies, some natives.