MPERG Report 2012-3

Evaluation of Yukon Live Willow Staking

By

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MERG is a cooperative working group made up of the Federal and Yukon governments, Yukon First Nations, mining companies, and non-government organizations for the promotion of research into mining and environmental issues in Yukon.

Mining and Petroleum Environment Research Group

MPERG

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1.0 Background

Live staking is the cutting of lengths of branches or trunks of selected hardwoods such as poplar and willow and planting them in a disturbed area. Planting can be either by burying one end and most of the length of each stake or by forcing holes into the ground into which the end and most of the length of the stake is then pushed or pounded. An objective of live staking is to provide structural strength for the soils of disturbed areas through the development of a root matrix. It is a relatively simple technique and, when applied to small areas, does not require specialized equipment or expertise. It is therefore accessible to low-capital industrial and other users. These may include placer miners, local exploration companies, land developers and non-profit organizations restoring disturbed areas.

The practice of live staking willows at stream bank restoration projects has been carried out in the south-west and central Yukon since at least the late 1980s. Results have been inconsistent. Some plantings have responded well and others less so. Where evaluations of live staking have occurred, attention has focussed on site conditions (Snow et al, 2009). Little attention has been given to the species of willow used.

A reason for this is that willow species are most easily identified during spring, when they are flowering. However, willow used for live staking has to be harvested when it is dormant. This can be either in early spring prior to the flowering stage or in the autumn. People conducting the live staking usually cut stakes from willows near the site without determining the species. As the species being planted were not known, the relative success of the different species cannot be determined.

What can be determined, however, is which species have successfully survived. The goal of our project was to assess a number of live staking projects in the south and central Yukon and identify the willow species that had survived at each. We have developed a publicly available Fact Sheet demonstrating how to identify willow species recommended for live staking. This provides an opportunity for persons who might be considering live staking to identify preferred willows and to mark them with survey tape or paint for future use.

2.0 2012 Surveys

The sites selected for assessment represent regional variation It was decided to examine only sites that had been restored more than seven years previously since many live willow staking projects that appear to be successful after the first year or two, fail in the succeeding years. At most sites the species of willows used for staking were not recorded at time of the live staking. During the 2012 site visits, the willow species that had been staked were differentiated where possible from volunteer willow species.

The following sites were selected for assessment:

McIntyre Creek

Co-ordinates: 60 46.015/135 05.855

Eco-region: Yukon Southern Lakes

This site, near the mouth of McIntyre Creek and adjacent to the old Range Road dump, was restored in 2005. Live willows and balsam poplar were staked on both sides of a stream diversion berm and a wattle fence was constructed along the eroding streambank.

Porter Creek

Co-ordinates: 60 44.993/135 08.614

Eco-region: Yukon Southern Lakes

A small reach of Porter Creek at Rabbit's Foot Canyon was staked with live willows in 2002 during stream bank restoration that followed the removal of a beaver dam.

Mendenhall River

Co-ordinates: 60 47.087/136 17.58

Eco-region: Yukon Southern Lakes

Both sides of Mendenhall River were staked with live willows at the Alaska Highway crossing in 2003 as part of a culvert installation project. Besides the staking of willows, the horizontal layering of willow stems and wattle fencing was conducted.

Klukshu River

Co-ordinates: 60 17.226/137 00.01

Eco-region: Yukon-Stikine Highlands

Live willows were staked during the bank restoration of a fish habitat compensation channel on Klukshu River at the Haines Road crossing in 1988. This was the oldest restoration site assessed during the 2012 surveys.

South Fork of Rose Creek

Co-ordinates: 62 19.196/133 20.461

Eco-region: Yukon Plateau North

Both sides of a one-kilometer reach of the south fork of Rose Creek, along with two small tributaries, was staked with live willows in 2003. This was part of the dewatering of the freshwater reservoir at the closed Anvil lead-zinc mine near Faro.

Germaine Creek

Co-ordinates: 64 03.138/138 54.690

Eco-region: Klondike Plateau

A short stretch of the Klondike River bank and a gravel bar near the confluence of Germaine Creek, was staked with live willows and balsam poplar in 2004. This effort was part of a restoration demonstration project.

Engineer Creek

Co-ordinates: 65 05.456/138 22.493

Eco-region: North Ogilvie Mountains

Live willows were staked at a mineral exploration trail crossing of a tributary to Engineer Creek in 2004 during attempts to mitigate land disturbance.

3.0 2012 Survey Results

The summer of 2012 was wet and cool. Stream levels were high throughout the period of investigation.

McIntyre Creek

The diversion berm had been staked more-or-less horizontally on both sides of the berm with willows and balsam poplar. Near the top of the berm, on both sides, is a good growth of balsam poplar up to 2.5 meters tall, along with a few willows (1.5 meter tall *Salix pseudomonticola* and 1 meter tall *Salix niphoclada*). The *Salix pseudomonticola* had been browsed on, probably by moose. There were also a few 1 meter tall *Salix bebbiana*. These willows were probably a volunteer growth (not staked). The lower layers of staked willows on both sides of the berm were not so successful, with only a few surviving *Salix pseudomonticola* and *Salix niphoclada*.

The streambank stabilization project consisted of the construction of a wattle fence along with rows of staked willows and balsam poplar. Most of the wattle fence and staked willows have failed to survive. The willows (*Salix pseudomonticola* and *Salix alaxensis*) staked closest to the water are doing the best. Most of the fence and the upper staked rows were not successful, with only a few surviving *Salix pseudomonticola* and *Populus balsamifera*. The surviving willows and balsam poplar are less than 2 meters tall.

The successful willow species staked at the McIntyre Creek site are:

Salix alaxensis
Salix niphoclada
Salix pseudomonticola

Porter Creek

It was difficult to differentiate the three or four rows of staked willows from the naturally occurring growth of willows at this site. The staked willows all appeared to be *Salix pseudomonticola*. The volunteer willow species are *Salix planifolia*, *Salix arbusculoides* and *Salix niphoclada*. Both the staked willows and the naturally occurring willows are 2 meters tall or greater.

The successful willow species staked at the Porter Creek site is:

Salix pseudomonticola (only staked species observed)

Mendenhall River

Upstream from the culvert on the left bank, near the water, is a low (<1 meter tall) row of *Salix niphoclada.* Farther back from the water is a mixed row of *Salix arbusculoides, Salix pulchra* and *Salix pseudomonticola* (< 1 meter tall). In between the two rows are a few surviving staked *Salix pulchra*. The *Salix pseudomonticola* are doing especially well, and had many catkins.

Upstream from the culvert on the right bank, close to the water's edge, is a low (<1 meter tall) mixed row of *Salix pulchra* and *Salix niphoclada.* Farther back from the water is a row of clumps consisting of

Salix niphoclada and *Salix brachycarpa* (> 1 meter tall). All three of these willow species had catkins. In between the two rows are willow stakes that did not survive.

Downstream from the culvert on the right bank, near the water, is a mixed row of *Salix arbusculoides, Salix pulchra, Salix niphoclada* and *Salix pseudomonticola* (all < 1 meter tall). At the time of assessment they were partially submerged. About 30 meters back from the water is a row of clumps consisting of *Salix arbusculoides, Salix niphoclada* and *Salix pseudomonticola* (all about 2 meters tall). All of the willow species in this row had catkins. In between these rows are staked willows that have mostly not survived.

Downstream from the culvert on the left bank, near the water's edge, is a row of *Salix arbusculoides, Salix niphoclada* and *Salix pseudomonticola* (all < 1 meter tall). All of the willow species in this row had catkins. About 30 meters back from the water is a row of clumps consisting of *Salix arbusculoides, Salix niphoclada* and *Salix pseudomonticola* (all about 2 meters tall or greater). In between these rows are staked willows (*Salix niphoclada* and *Salix pseudomonticola*), many of which have survived.

The successful willow species staked at the Mendenhall River site are:

Salix arbusculoides
Salix niphoclada
Salix pseudomonticola
Salix pulchra

Klukshu River

Willows were staked in rows parallel to the channel back to about 3 meters from the water's edge. A dense growth of willows now grows in rows along this bank. Closest to the water is a tall row of *Salix alaxensis*. Farther back are mixed rows of *Salix niphoclada and Salix barclayi*. Also growing amongst the willow are *Populus balsamifera* (probably not staked). All willows growing from stakes are greater than 2 meters tall. The tallest willows are *Salix alaxensis*, up to 6 meters tall and 15 cm diameter at the base. The most dominant species are *Salix alaxensis* and *Salix barclayi*.

The successful willow species staked at the Klukshu River site are:

Salix alaxensis
Salix barclayi
Salix niphoclada

South Fork of Rose Creek

Very few stakes are still visible along the upper reaches of the revegetated section of Rose Creek. This length of the creek has a sparse to moderate riparian growth of balsam poplar and willows, primarily *Salix arbusculoides*. Also growing here are *Salix glauca* and *Salix bebbiana*. These willows were probably not staked.

The South Fork of Rose Creek has a more diverse mix of riparian willows including *Salix niphoclada, Salix pseudomonticola, Salix arbusculoides, Salix pulchra, Salix barclayi, Salix alaxensis, Salix gauca* and *Salix bebbiana* (the latter two species were probably not staked). *Salix alaxensis* and *Salix arbusculoides* are the most prolific willow species along this tributary.

Salix pseudomonticola, Salix arbusculoides, Salix pulchra, Salix alaxensis and *Salix glauca* (probably not staked) are the willow species currently found along South Fork of Rose Creek between the south and north tributaries. *Salix arbusculoides* and *Salix alaxensis* have been been browsed on by moose.

Salix arbusculoides, Salix alaxensis, Salix pseudomonticola and *Salix bebbiana* (probably not staked) are the riparian willow species along the north tributary along with *Populus balsamifera*.

Salix arbusculoides, Salix alaxensis and *Salix bebbiana* (probably not staked) are the willow species found along the South Fork of Rose Creek downstream of the north tributary along with *Populus balsamifera.*

Salix alaxensis and *Salix arbusculoides* are the willow species growing from stakes at the area of the dam breach, along with *Populus balsamifera*. Although most of the willows and poplars staked in this area have survived, many appeared dead but are regrowing from near the base of individual plants.

The successful willow species staked at the South Fork of Rose Creek site are:

Salix alaxensis
Salix arbusculoides
Salix barclayi
Salix niphoclada
Salix pseudomonticola
Salix pulchra

Germaine Creek

There appears to be a reasonably good success rate of the willows and poplars staked on the gravel bar in the Klondike River back channel, although many of the dead stakes could be missing because of the seasonal flooding and sediment deposition. The successful species are balsam poplar along with the willows *Salix alaxensis, Salix arbusculoides* and, to a lesser extent, *Salix planifolia.*

All balsam poplar planted in the palisades along the left bank of the river died. Only a few *Salix alaxensis* stakes were planted in the palisades and all have survived.

The successful willow species staked at the Germaine Creek site are:

Salix alaxensis
Salix arbusculoides
Salix planifolia

Engineer Creek

Salix arbusculoides and *Salix pulchra* stakes had been collected from the nearby riparian area and planted on both sides of the stream crossing in 2004. The 2012 survey showed a high success rate for both species.

The successful willow species staked at the Engineer Creek site are:

Salix arbusculoides
Salix pulchra

4.0 Conclusions

From the 2012 observations at the seven streambank restoration sites described above (all sites at least seven years old), the following willow species have been successfully used for live staking:

Salix alaxensis
Salix arbusculoides
Salix barclayi
Salix niphoclada
Salix planifolia
Salix pseudomonticola
Salix pulchra

Of these species*, Salix alaxensis, Salix arbusculoides* and *Salix pulchra* appeared to be most likely to survive (and in some cases thrive) in the most difficult streambank restoration sites. These are the preferred species for live staking in the south and central Yukon.

In most of these projects, the species of willows staked were not recorded at the time of staking; it was therefore not possible to determine the species of the dead stakes during the 2012 survey. As a result, a list of willow species to avoid when live staking cannot be provided.

It should be noted that, although the 2012 surveys focused on willow staking, balsam poplar was also observed to be successful at several of the sites.

References

Argus, G.W. 2000. A Guide to the Identification of Willows in Alaska, the Yukon Territory and Adjacent Regions. Ottawa, Canada.

Collet, D. M. 2002. Willows of Southcentral Alaska. Kenai Watershed Forum.

Snow, B., P. Tobler & T. Omtzigt. 2009. A review of several Yukon Revegetation projects and techniques. Prepared by Environmental Dynamics Inc. for MPERG Yukon EMR. 23 p. & Appendices.

Appendix A: Willow and Poplar Species Observed in 2012

McIntyre Creek	*Salix alaxensis*	felt-leaf willow
	Salix bebbiana	Bebb's willow
	Salix niphoclada	barren-ground willow
	Salix pseudomonticola	false mountain willow
	Populus balsamifera	balsam poplar
Porter Creek	*Salix pseudomonticola*	false mountain willow
Mendenhall River	*Salix arbusculoides*	little-tree willow
	Salix niphoclada	barren-ground willow
	Salix pseudomonticola	false mountain willow
	Salix pulchra	diamond-leaf willow
	Salix brachycarpa	small-fruit willow
Klukshu River	*Salix alaxensis*	felt-leaf willow
	Salix barclayi	Barclay's willow
	Salix niphoclada	barren-ground willow
	Populus balsamifera	balsam poplar
South Fork of Rose Creek	*Salix alaxensis*	felt-leaf willow
	Salix arbusculoides	little-tree willow
	Salix barclayi	Barclay's willow
	Salix bebbiana	Bebb's willow
	Salix glauca	gray-leaf willow
	Salix niphoclada	barren-ground willow
	Salix pseudomonticola	false mountain willow
	Salix pulchra	diamond-leaf willow
	Populus balsmifera	balsam poplar
Germaine Creek	*Salix arbusculoides*	little-tree willow
	Salix planifolia	plane-leaf willow
Engineer Creek	*Salix arbusculoides*	little-tree willow
	Salix pulchra	diamond-leaf willow

Appendix B: Site Photographs

Figure 1 Balsam poplar sprouting from horizontal stake near top of diversion berm.

Figure 2 A few false mountain willow and felt-leaf willow have survived near the bank of McIntyre Creek.

Figure 3 This row of false mountain willows have probably grown from stakes at Porter Creek.

Figure 4 A partially submerged row of diamond-leaf willows grows from stakes at the Mendenhall River.

Figure 5 A row of mostly little-tree willows grows from stakes at the edge of the Mendenhall River.

Figure 6 Thick stems of felt-leaf willow have grown from stakes at the Klukshu River.

Figure 7 Tall felt-leaf willow with Barclay's willow in foreground at the Klukshu River.

Figure 8 This diamond-leaf willow is growing from a stake along the south fork of Rose Creek.

Figure 9 These felt-leaf willows are growing from stakes near the freshwater dam breach on the south fork of Rose Creek.

Figure 10 This little-tree willow is growing from a stake on the Germaine Creek gravel bar.

Figure 11 Diamond-leaf willows growing from stakes at the Engineer Creek crossing.