Revelstoke Reach Riparian Restoration
COL-F17-W-1414 Final Report

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Fish and Wildlife Compensation Program
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Executive summary

The mid-Columbia region has lost much natural riparian habitat, in part due to reservoir creation. In Revelstoke Reach on Upper Arrow Lake near Revelstoke, BC, large areas where riparian forests could exist are currently dominated by reed canarygrass (*Phalaris arundinacea*). Reed canarygrass is effective at dust- and erosion- control, but creates vast uniform fields, offers limited wildlife habitat, and prevents establishment of native species. There have been various projects to restore native species and enhance wildlife habitat in Revelstoke Reach. To further this goal, in April 2017 we planted over 1300 live stakes from locally-harvested red-osier dogwood (*Cornus stolonifera*), willow (*Salix* spp.), and cottonwood (*Populus balsamifera* ssp. *trichocarpa*). We targeted four sites, planting stakes to initiate new habitat patches, or expand on existing patches, of native shrubs through competition and eventually shading of reed canarygrass.

In September 2017 we monitored the stakes for survival after one growing season. Overall survival across all sites averaged 40 % (which is similar to that found by other projects in the area), but ranged widely from 0 to 90 % survival. Dogwood stakes survived poorly (8.4 % survival) while cottonwood/willow stakes did much better (49 % survival). The drought in the summer 2017, plus planting in sites that were not very fertile or were frequented by horses and humans, likely negatively impacted stake survival. The survival of stakes planted in 2014 was also recorded. Cumulative survival since planting in spring 2014 had decreased from 50 % after the first growing season to 24 % after the winter and second growing season, then to 16 % after four growing seasons. In spite of this continuing decrease, the surviving shrubs are now a significant height above the grass and should begin to contribute to shading of reed canary grass.

The survival of the hand-planted live stakes from this and previous planting efforts confirms that staking can be effective in adding diversity to the drawdown zone, even when survival rates are modest. However, our results highlighted that even with an emphasis on quality planting efforts, issues such as human or livestock interference and extended drought will continue to negatively influence plant survival. We recommend increased outreach and education, plus physical protection of stakes areas if possible, to increase stake survival.

For this project, we offered an opportunity for public input before fieldwork began by partnering with the Columbia Shuswap Invasive Species Society and hosting an on-site open house in May 2016. We also received public input during the field component as we interacted with local users of the sites. Increasing outreach and community engagement is recommended.

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Introduction

Riparian habitats support diverse plant and animal communities (Bunnell et al. 1999, FWCP 2014), but are rare in the mid and lower Columbia Basin, due to human development including agriculture and reservoir creation. The creation of reservoirs in this region has inundated or altered approximately 266 km^2 of riparian habitat, with the loss over 17 km^2 of riparian forest in the Arrow Lakes area alone, which is the largest projected loss for all the dam units in the Columbia Basin (Utzig and Schmidt 2011). In addition to being rare, remnant patches of riparian habitat typically lack the diversity of plants seen in natural riparian communities.

In response, various organizations including BC Hydro and the Fish and Wildlife Compensation Program (FWCP) have initiated or supported restoration efforts to stabilize areas from erosion and restore habitat biodiversity to drawdown zone ecosystems (Keefer Ecological Services (KES) 2011, KBC 2015). Restoration of these habitats is within the scope of the FWCP, and Revelstoke Reach is one of six focal areas identified for action (FWCP 2014).

Revelstoke Reach is at the top of the Arrow reservoir system; as such, it has riparian areas that are rarely, or only briefly, inundated when the reservoir fills in late June / early July. These areas are currently dominated by invasive reed canarygrass (*Phalaris arundinacea*) and peppered with patches of willow (*Salix* spp.) and to a lesser extent, cottonwood (*Populus balsamifera* ssp. *trichocarpa*). While effective at reducing erosion and wind-borne dust, the creeping rhizomatous root systems produced by this reed canarygrass form a thick sod and a very dense stand of grass, thus preventing recruitment of native plants. Unfortunately, eradication of this species would be impossible in this system. Instead, native plant communities may be restored through planting of native species and controlling competing reed canarygrass until the desired species become established and can shade-out the reed canarygrass (Tu 2004, Geum Environmental Consulting 2007, Masse Environmental Consultants Ltd. 2014, N. Stafl, pers. comm.). While costly and incremental, establishment of a patch of native habitat, even a patch that is relatively small in nature, may be very beneficial to wildlife. For example, Machete Island is a small but very productive riparian area near the Revelstoke Airport (van Oort et al. 2011).

Much research has occurred on planting and establishment of native species in sites covered in reed canarygrass (e.g., Tu 2004, Kim et al 2006, Geum Environmental Consulting 2007), and work has already begun in restoring diversity to the Downie Marsh riparian area of Revelstoke Reach, with a community-based restoration project in 2014/15 and monitoring in 2015 (Kellner 2015, Kellner 2016). There have also been several other restoration projects in the Revelstoke area in the recent past. In 2010 the Illecillewaet greenbelt society planted many conifers in the lands they manage, to revegetate gravel roads, and they joined forces with the North Columbia Environmental Society (NCES) for a community weed-pull. The NCES also took part in a mass planting of willow stakes in 2013 to revegetate the banks of a spawning channel north of Revelstoke, and in 2017 WildSight's EcoStewards program added numerous shrubs to the area near the Illicillewaet pedestrian bridge (J. Vickers, pers. comm.). On a larger scale, BC Hydro has funded cottonwood, dogwood, and willow staking, along with planting of deciduous seedling and sedge plugs, in the drawdown zone south of Revelstoke (CLBWORKS-2, KES 2011).

Our project aimed to continue this effort by contributing to the restoration of riparian forest and shrub habitats at select sites in the highest elevations of the drawdown zone in Revelstoke Reach. To establish patches, or expand on existing patches, of native plants at these sites, we planted locally- harvested live stakes. Establishment of cottonwood, willow, and red-osier dogwood (*Cornus stolonifera*) by live-staking is effective in this floodplain habitat (KES 2011, KBC 2015), and use of these fast-growing species will encourage shading-out of reed canarygrass (Kim et al 2006) and should eventually allow establishment of other native species. Cottonwood in particular may benefit from live-staking as natural recruitment is usually reduced in reservoir systems, although specific details on recruitment in Revelstoke Reach are lacking (FWCP 2014). Restored areas should soon provide habitat for a wide variety of the focal and inventory wildlife species listed in the FWCP Species of Interest Action Plan (FWCP 2012).

Our project also addressed public interest in the restoration work. Downie Marsh in particular is heavily used for recreation by the people of Revelstoke, and provides an accessible site to continue to raise awareness about restoration and native plants. We strived to increase public interest and knowledge by hosting a public open house/ workshop, providing an opportunity for outreach, two-way communication, and potentially volunteer recruitment.

Our objectives were to:

1. create patches of native cottonwood riparian habitat, by planting live stakes of willow, dogwood, and cottonwood that will eventually shade out the competing reed canarygrass and become functional riparian ecosystems, and
2. increase community engagement and knowledge by providing an opportunity to discuss visions for Downie Marsh, opportunities to be involved in restoration work, and education about local native and non-native species and the benefits of habitat enhancement.

Methods

Study area

The sites for this project occur within the Revelstoke Reach drawdown zone near Revelstoke, BC, and include approximately 3 ha in the Big Eddy, Downie Marsh, and Airport Marsh (Fig. 1). These sites are all accessible for hand-planting and are dominated by reed canarygrass but retain elements of a functioning ecosystem, including some small stands of maturing black cottonwood trees (*Populus balsamifera*), scattered willow (*Salix* sp.) and paper birch (*Betula papyrifera*), and some red-osier dogwood (*Cornus stolonifera*). Baseline conditions were documented with pre-planting photos, and all planting occurred in areas dominated by reed canarygrass, although plantings were often adjacent to existing native tree or shrub patches. Importantly, the sites are all relatively high-elevation (> 439 m ASL). The higher elevation means that sites usually have little or no inundation period when the Arrow Lakes Reservoir fills in early summer, which will avoid creating an ecological trap for shrub-nesting birds, which might otherwise experience nest flooding at lower elevations (van Oort et al 2011).

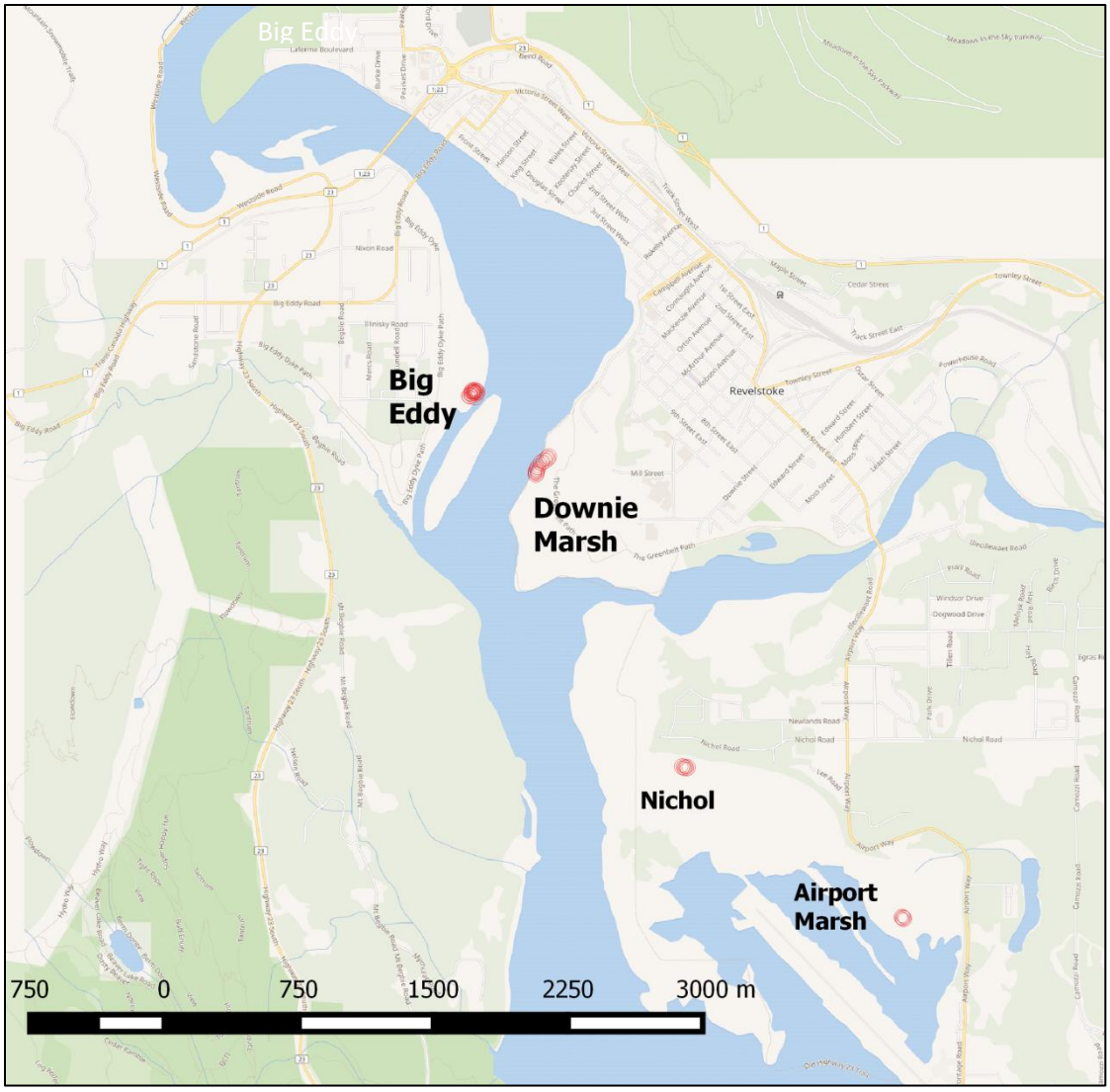

Figure 1. Sites chosen for restoration work in 2016/17 include suitable portions of the Big Eddy, Downie Marsh, Nichol area, and Airport Marsh. Plots at each site are indicated with red circles.

Harvesting of live stakes

Live black cottonwood, red osier dogwood, and willow stakes were harvested from local, low-impact donor sites (e.g., power-lines, airport properties, BC Hydro properties). Harvesting was done with the use of hand-tools (e.g., hand-saws, pruners, etc.) in early spring when plants were still dormant (i.e. March 1-3, 2017). During harvesting, we utilized recommendations from previous projects, and harvested long (up to 2 m), large-diameter (1.5 cm +) stakes, cutting the bottom of stakes on an angle (DesCamp 2004, Darris 2006, KES 2011, Kellner 2015, 2016). Once harvested, stakes were stored under snow at appropriate temperatures (0˚ - 4˚C) until planting areas were snow-free.

Planting

Planting occurred soon after snow-melt made the sites accessible, from April 24-28, 2017 and was done according to existing recommendations (e.g. Darris 2006, Kellner 2016) with the exception that not all stakes were soaked prior to planting. Photos were taken of all sites prior to planting. The existing

groundcover vegetation before planting was primarily reed canarygrass, although part of both the Nichol Bench and Airport Marsh sites were sandy and covered in sparse short grass.

Stakes were removed from snow the day they were planted; any stakes left at the end of the day were stored in water and were planted the following day. The base of each stake was trimmed by 10 -15 cm to remove any dry or damaged ends; long stakes were cut to size as needed on-site. Large-diameter stakes were planted individually; thinner stakes were sometimes bundled into group plantings of 2-5 stakes of the same species.

Planting microsites were selected based on topography and proximity to existing native vegetation, and stakes were planted in natural-looking clusters, with stakes 0.5 – 1.0 m apart (Kim et al 2006). Holes for planting were made by pounding in rebar (smaller diameter stakes) or a large prybar (for larger stakes) to create deep planting sites. Stakes were planted with 60 - 80 % of their length in the ground. Care was taken that stakes were planted the correct way up and that planting holes were snugged up around the base of each stake to prevent air from reaching the in-ground portion. Once planted, the base of each stake or group was wrapped with a 20 cm tall expandable plastic tree guard to protect against vole damage. Stakes at Airport Marsh were also wrapped in wire mesh to protect them from beaver damage.

Monitoring

The survival of a subset the stakes planted in April 2017 was monitored after the 2017 growing season and summer reservoir inundation using permanent plots, with multiple plots randomly situated within each site. Monitoring plots were circular 2.82 m radius plots (25 m^2), identified by permanent wooden centre stakes marked with metal tags, with locations recorded by GPS. Sites had from 3 – 13 plots based on the size of the area planted, with plots containing an average of 17 stakes per plot. While on-site, the survival of the live stakes and shrubs planted in 2014 (Kellner 2015, Kellner 2016) was also monitored by locating each plot and counting visible surviving stems as per Kellner 2016.

Results

Stake harvesting

Approximately 1000 large dormant red-osier dogwood, willow, and cottonwood stakes were harvested around Revelstoke in March, from disturbed sites near the drawdown zone (Figure 2). Stakes ranged from 1 – 2.5 m in length and approximately 1.5 – 7 cm in diameter. Larger sections were stored intact, to be pruned to size before planting. Stakes were bundled into groups of approximately 30 – 50 stakes, then stored under deep snow until needed. Willow and cottonwood were identified during harvest, but subsequent handling and storage resulted in mixing of stakes and these species could no longer confidently be differentiated.

Figure 2. Dormant stakes were harvested from under powerlines and along road edges, then bundled and stored under snow.

Planting

Our team of four people hand-planted around 250 stakes per day, and a total of 1318 stakes and stake bundles were planted in April 2017 (Table 1, Figure 3).

Table 1. The number and species of live stakes or stake bundles planted at each site in 2017.

Site	Dogwood	Willow / Cottonwood	Total
Airport Marsh	65	153	218
Big Eddy	108	381	489
Downie	80	405	485
Nichol	61	65	126
Total	314	1004	1318

Survival of stakes

We established plots to monitor the survival of 495 stakes (150 dogwood, 332 willow/cottonwood, and 13 mixed bundles) at 28 permanent plots. Two of these plots were not included in the analyses – Plot 5 (Big Eddy) had the plot marker removed (found on ground), and the plot marker for plot 21 (Downie Marsh) was not located. We therefore monitored 462 stakes in 26 plots (8- 36 stakes per plot).

Figure 3. Nichol before, during, and after being planted with live stakes April 2017. Each stake or stake bundle was wrapped in an expandable plastic vole guard to prevent vole damage in winter.

All species

Overall survival averaged 40 % (Table 2). Survival varied across sites and plots (Figure 4). Some sites were affected by human or domestic animal interference – at three of the Big Eddy sites, 85- 95 % of the stakes had been removed from the ground and trampling was evident (Figure 5). These sites were included in the survival analysis.

Table 2. The number of plots, number of stakes, and survival rate of stakes at each of four sites planted in spring 2017.

Site	N (# plots)	% survival (after 1 growing season)			
		mean	sd	min	max
Airport Marsh	3	**33**	5	28	36
Big Eddy	11	**42**	32	0	90
Downie	8	**51**	19	21	80
Nichol	4	**16**	19	0	33
All sites	26	**40**	26	0	90

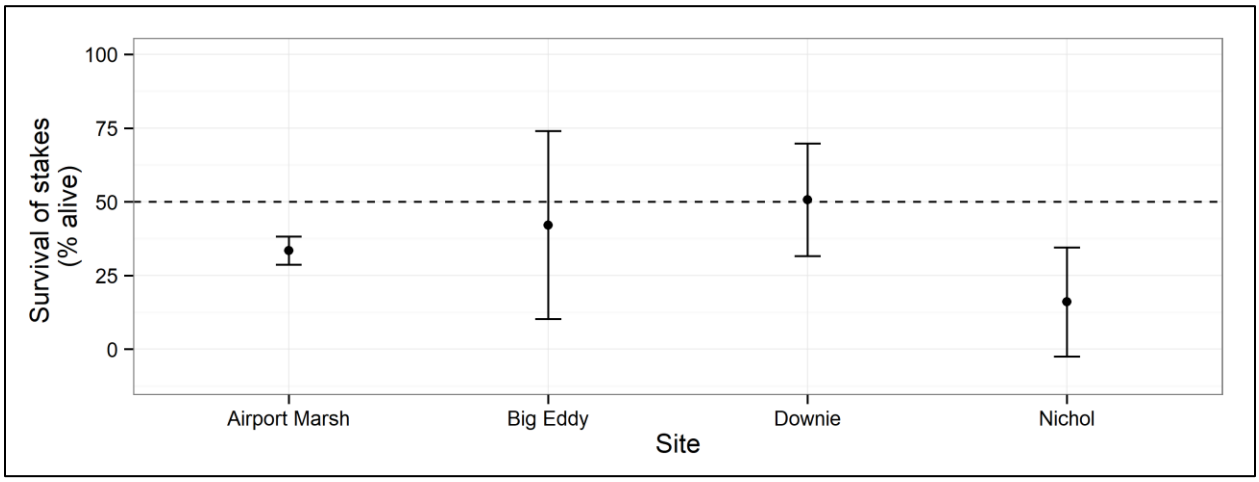

Figure 4. The average survival (% alive ± s.d.) of stakes at the four planting sites, showing variability between sites and plots. N=3, 8. 11, and 4 plots per site.

Figure 5. Several plots in the Big Eddy site suffered from trampling and removal of stakes.

Survival by species group

We monitored a total of 136 red-osier dogwood stakes in 20 plots. Dogwood survival was poor. Surviving dogwood stakes were found in 5 of 20 monitored plots (1 in Downie Marsh and 4 in Big Eddy), with an overall survival rate of 8.4 ± 16 % (Table 3, Figures 6,7). Looking only at the 5 plots where dogwood survived, survival averaged 34 %.

Table 3. The survival of Red-osier dogwood planted in April 2017. Survival was assessed in September 2017 after one growing season.

Site	N (# plots)	Red-osier dogwood % survival (after 1 growing season)			
		mean	sd	min	max
Airport Marsh	3	0	0	0	0
Big Eddy	9	15	21	0	50
Downie	4	7.5	15	0	30
Nichol	4	0	0	0	0
All sites	20	8.4	16	0	50

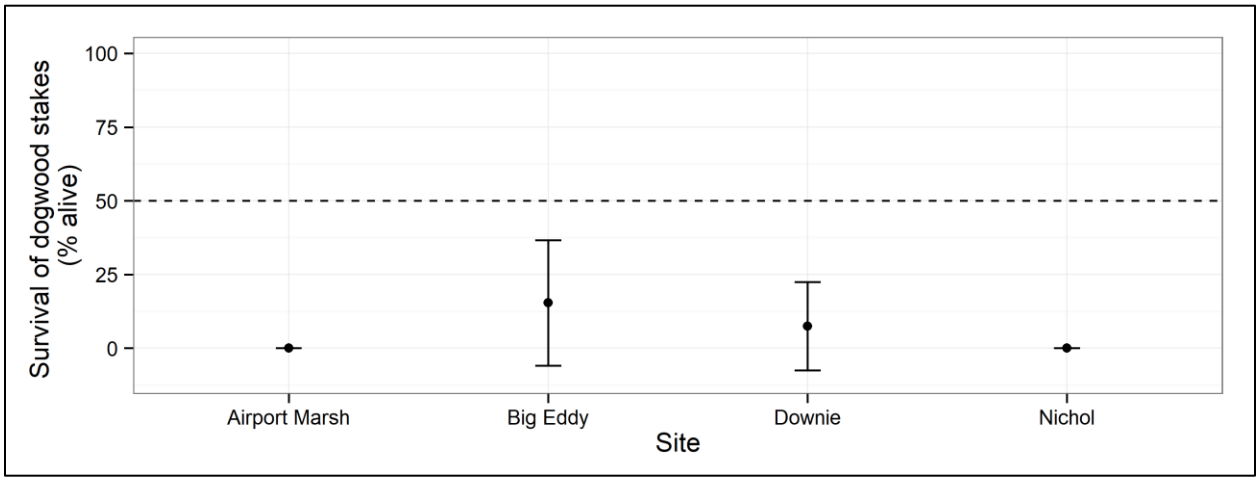

Figure 6. The average survival (% alive ± s.d.) of red-osier dogwood stakes at the four planting sites, showing variability between sites and plots. N=3, 9, 4, and 4 plots per site.

Figure 7. Red-osier dogwood leafing out mid-stake at Downie Marsh (left); a willow at Airport Marsh struggling on the edge of a patch of poor soil, where even reed canary grass is not growing well (right).

All 26 monitoring plots contained cottonwood/willow stakes, with stakes surviving in 23 of these plots. In total 156 of 314 stakes survived for a 49 % survival rate (Table 4, Figure 8). The number of surviving cottonwoods and willows were tallied across plots in fall 2017. There were 18 cottonwoods and 138 willows in the 26 monitored plots; survival could not be calculated because the initial numbers planted were not known.

Table 4. The survival of cottonwood/willow stakes planted in April 2017. Survival was assessed in September 2017 after one growing season.

Site	N (# plots)	Cottonwood/ willow % survival (after 1 growing season)			
		Mean	sd	min	max
Airport Marsh	3	48	05	43	52
Big Eddy	11	46	33	0	100
Downie	8	69	30	27	100
Nichol	4	20	23	0	42
All sites	26	49	32	0	100

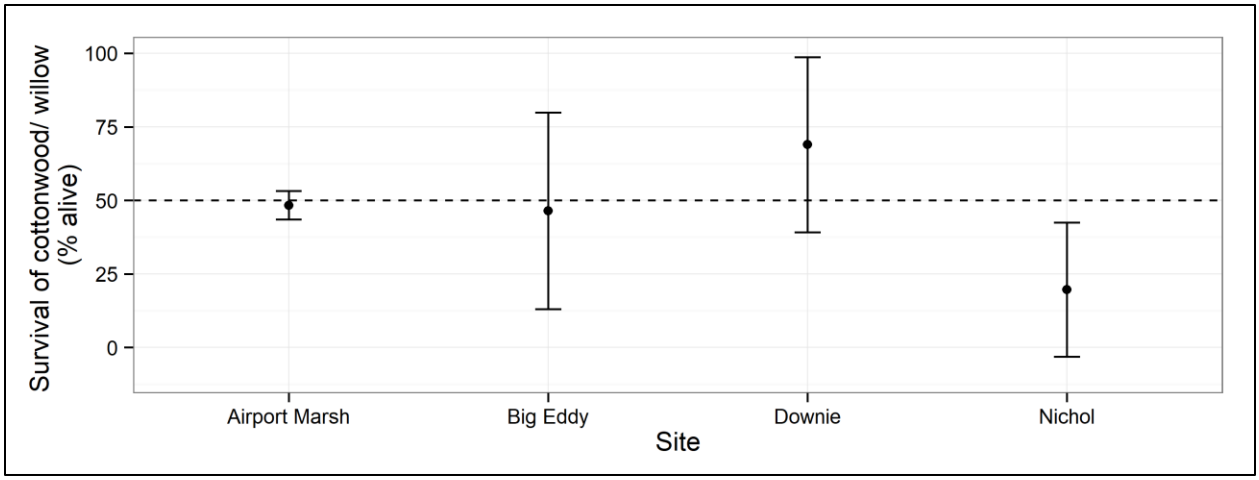

Figure 8. The average survival (% alive ± s.d.) of cottonwood and willow stakes at the four planting sites, showing variability between sites and plots. N=3, 11, 8, and 4 plots per site.

Remeasuring of 2014 stakes and plots

The live stakes and shrubs planted in 2014 were relocated and survival of the stakes was assessed. Detailed analysis of this growing longer-term dataset is outside the scope of the current project; the data was gathered opportunistically for future analyses. A brief calculation of cumulative survival at the 'Community Plots' (Kellner 2015, 2016) showed a survival rate of 15.5 % after 3 years (Table 5, Figure 9). Some of the surviving stakes are now approximately 2 m in height and robust (Figure 10).

Table 5. Multi-year survival rates of Community Plots, planted with willow and dogwood in 2014 at Downie Marsh.

Season	Surviving stakes (#)	Cumulative % survival (% alive since planting)			
		Mean	sd	min	max
2014-spring	502	-	-	-	-
2014-summer	251	50.3	15.2	21.8	71.1
2015-spring	180	36.2	19.3	9.1	75.6
2015-summer	132	26.5	19.8	7.3	66.7
2017-summer	78	15.5	14.3	4.4	35.6

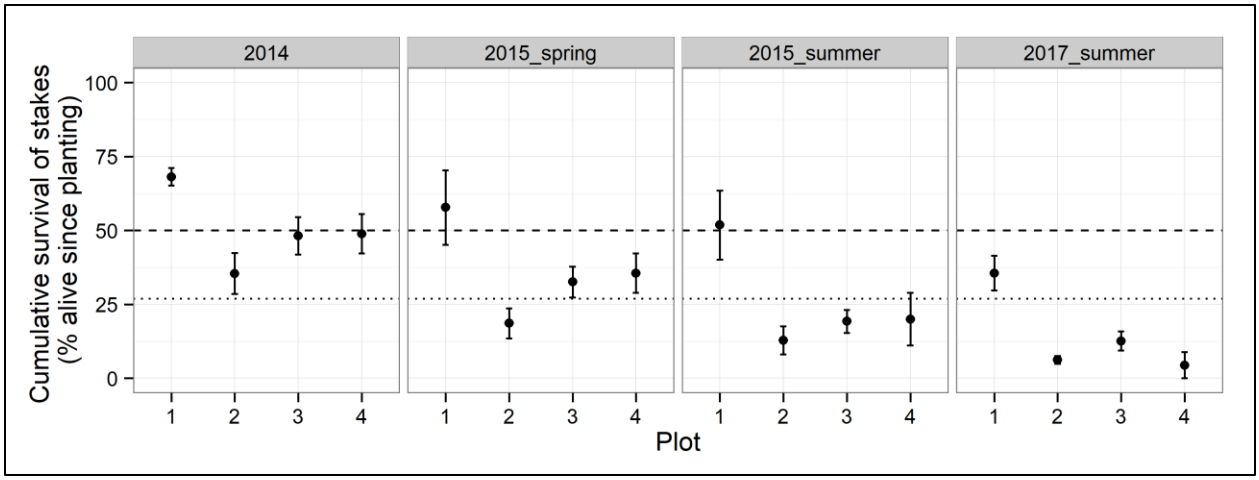

Figure 9. The average survival (% alive ± s.d.) of all stakes in the four Community Plots planted in 2014 at Downie Marsh. N=3 sublots for each plot, except for plot 4 where n=2 subplots.

Figure 10. Downie Marsh 2017 – in the foreground, the surviving dogwood and willow stakes planted in 2014 now make a significant contribution to the area (see person for scale).

Community involvement and partnerships

We partnered with the Columbia Shuswap Invasive Species Society (CSISS) to host an 'open-air open-house on-site at Downie Marsh in Revelstoke in May 2016 (Figure 11). The open house provided information about riparian restoration, specific details about the proposed planting efforts, and about invasive species in general. A poster about the proposed restoration project was developed and displayed (Appendix 1).

Figure 11. An open-air open house with Columbia Shuswap Invasive Species Society at the Illicillewaet Greenbelt / Downie Marsh provided information on the project and invasive species, and offered an opportunity to discuss restoration plans with users of the area.

Discussion

Survival of the stakes planted in 2017 in this project was fairly low (average 40 %) after one growing season. This was lower than that achieved in 2014 with hand-plantings at Downie Marsh (50 %, Kellner 2015) and similar to the first-season survival rates reported for stakes planted from 2009-2011 in other areas of the Upper Arrow Lakes (Project CLBWORKS-2, KES 2011). The CLBWORKS-2 survival rates were estimated by a less-conservative technique, counting only dead stakes that were located, whereas we used the total number planted even if they were not relocated.

Stake survival varied across sites, likely due to difference in soil type and moisture. The better survival in Big Eddy and Downie plots likely reflected richer, finer textured soils at these sites. The Nichol site had sandy/gravelly soil, with poor growth of existing herbs in some areas. The soil type was identified as a potential problem during planting, although we chose to continue planting as a trial; however, the sandy well-drained soil likely contributed to poor performance of plants in this site, particularly during times of drought.

Although a fertile site, the Big Eddy site suffered from fairly significant disturbance, either from humans or livestock. While we believe the latter contributed the majority of the damage, if human disturbance was a factor, further education about the project in the local neighbourhood may have reduced this damage. The workshop and surrounding publicity, plus all on-site discussions, occurred on the other side

of town near the Downie site, which also has a history of planting projects. Regardless, if this fertile site is considered for future restoration, livestock management techniques such as fencing may be required.

We expect that planting of poorer sites and sites subject to disturbance, plus a summer drought, led to the poor initial survival in this project. The growth of surviving stakes in 2017 will ideally ensure they have advantage needed to remain above reed canary-grass and continue to grow in 2018. The application of vole guards to every stake when planted should greatly reduce loss of stakes to vole damage overwinter, which had been observed in previous plantings (Kellner 2016, KES 2011).

Our survival rate for dogwood (8.4 %) was well below that reported by Kellner (70 %, Kellner 2016) and Keefer (31 %, KES 2011), while the survival of cottonwood/willow stakes (49 %) was similar to Keefer's willow results (45 %, KES 2011) and above those from Downie Marsh in 2014 (33 %, Kellner 2016). The low success of dogwood in 2017 was very surprising, given its success in 2014, and could be due to the very hot dry summer in 2017.

Our community engagement efforts aimed to educate users of Revelstoke Reach about invasive species and the value of native habitats, as well as increase knowledge and interest in our planting project. Increasing outreach to a broader audience and users of all sites, instead of focussing on users of Downie Marsh, may have benefitted the project, with increased knowledge and stewardship across all sites and potentially a resulting increase in plant survival.

Project challenges

A persistent valley-bottom snowpack in 2017 delayed planting until the end of April. We nearly had further delays in planting because of confusion about the permitting process. Any restoration work below the full-pool level of the reservoir requires a Change or Notification under the Water Act, with an application and review through FrontCounterBC. The length of time required to secure a Change Approval can be up to 6 months; this delay plus a $750 application fee must be considered in future restoration works. Alternatively, if the project is a partnership with a local, regional, or provincial government, the Change Approval can be made a Notification - this should be indicated early on in the permitting process and fees can be waived and the permitting process expedited.

Environmental conditions created several other challenges for the project besides the deep snow in spring 2017. First funded in April 2016, the early leaf-out that year meant that buds were already bursting on local shrubs by the time funding confirmation was received. We delayed stake harvesting, the first phase of fieldwork, until the following winter 20116/2017 to ensure that only dormant stakes were harvested, and planting finally occurred in spring 2017. However, the deep snow and late melt in 2017 meant that when planting began at the end of April, Canada Geese (*Branta canadensis*) were already nesting at several areas of Airport Marsh, restricting our planting activities to one small site. The summer of 2017 brought other challenges for plants and for monitoring – the weather was record-breaking, with persistent hot, dry conditions, and this likely contributed to high stake mortality. At the same time, water levels in Arrow Lakes Reservoir were near peak from July through mid-September (due to high snowpack in winter 2016/17). Some plots may have been submerged, and access to the monitoring plots was restricted until mid-September.

Recommendations

The project and the challenges associated with it have emphasized the need, when doing restoration projects, to commit adequate resources to planning, permitting, and outreach activities. This should help ensure that survival of plants depends primarily on natural conditions. Recommendations arising from this project include:

- Ensure permitting is in place - discuss all requirements with FLNRO / FrontCounter BC,
- Ensure quality-control when planting:
    - avoid planting trimmed 'tips' unless they are 'large enough' (> 1.5 cm diameter),
    - ensure holes around stakes are firmly closed,
- Accept lower survival, or avoid planting, on sites suspected to have low fertility or be overly well-drained,
- Consider other potential users of the site and their possible impacts. In our case, we did not know prior to planting that horses ranged or were ridden over the proposed area in the Big Eddy. We had considered conflicting school activities (games, class trips), but recommend more research into all potential conflicting uses of sites,
- Increase community outreach and engagement so conflicting users of a site can take care to avoid impacts,
- Flag, sign, or fence the restoration area to alert the public and alleviate concerns about possible injuries to pets and reduce accidental trampling or destruction,
- Utilize a more accurate GPS or investigate alternate permanent plot markers for marking of plot centres, and
- Develop a broader-scale, longer-term restoration plan for Revelstoke Reach (e.g. Masse 2014 in southeastern BC), and consider a phased approach, fencing, and machine planting as options.

Acknowledgements

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Appendix 1. Poster developed for display at the open air open house.

Restoring native habitats around Revelstoke

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Background

- Forested riparian habitats support diverse plant and animal communities
- These habitat are rare in the mid- and lower- Columbia basin, due to the history of agricultural clearing and reservoir creation
- At present, reed canary-grass prevents native plants from becoming established in areas that could support riparian forests

The goal

- Diverse riparian ecosystems, including mature cottonwood forests and associated plants and animals

Kingbird Biological Consultants

COOPER BEAUCHESNE & associates ltd.

Our approach

- Planting native species + time
- Plant fast-growing native species including live cottonwood, red-osier dogwood, and willow stakes
- These will eventually shade-out the reed canary grass and allow other native species to become established
- Target highest areas in drawdown zone to reduce flooding when reservoir fills
- Partner with interested groups / individuals and encourage learning and stewardship

Progress to-date

- 2014 – plating of 600 live stakes and 250 small shrubs in the Downie Pond area
- Planting was done by school and community volunteers.

2016/17

- Plant high-density cottonwood, willow, and dogwood stakes in appropriate areas
- Increased scale of effort
- Focus on Big Eddy, Downie Marsh, and Airport Marsh sites

Acknowledgements and partnerships

- This project is supported by the Columbia Shuswap Invasive Species Society and the North Columbia Environmental Society
- It is a joint project by Kingbird Biological Consultants, Cooper Beauschesne, and Splatsin Development Corp.
- Funding is from the Fish and Wildlife Compensation program.

Appendix 2. Location and number of stakes in monitoring plots

Site	Plot	Zone	UTM_E	UTM_N	Type	Spring Count	Fall Count	Cotton wood	Comments
Big Eddy	1	11	414768	5649780	Dead		17		All stakes pulled out by horses
Big Eddy	1	11	414768	5649780	Dogwood	3	0		
Big Eddy	1	11	414768	5649780	Mixed	1	0		
Big Eddy	1	11	414768	5649780	Willow/Cottonwood	15	1	0	
Big Eddy	2	11	414769	5649792	Dead		9		
Big Eddy	2	11	414769	5649792	Dogwood	1	0		
Big Eddy	2	11	414769	5649792	Mixed	0	0		
Big Eddy	2	11	414769	5649792	Willow/Cottonwood	14	6	0	
Big Eddy	3	11	414776	5649795	Dead		4		
Big Eddy	3	11	414776	5649795	Dogwood	2	1		
Big Eddy	3	11	414776	5649795	Mixed	1	0		
Big Eddy	3	11	414776	5649795	Willow/Cottonwood	7	5	0	
Big Eddy	4	11	414774	5649787	Dead		9		
Big Eddy	4	11	414774	5649787	Dogwood	5	1		
Big Eddy	4	11	414774	5649787	Mixed	0	0		
Big Eddy	4	11	414774	5649787	Willow/Cottonwood	8	3	3	
Big Eddy	5	11	414782	5649784	Dead		plot marker pulled		horses pulled plot marker out
Big Eddy	5	11	414782	5649784	Dogwood	3	plot marker pulled		
Big Eddy	5	11	414782	5649784	Mixed	1	plot marker pulled		
Big Eddy	5	11	414782	5649784	Willow/Cottonwood	18	plot marker pulled		
Big Eddy	6	11	414786	5649792	Dead		18		All stakes pulled out by horses
Big Eddy	6	11	414786	5649792	Dogwood	11	2		
Big Eddy	6	11	414786	5649792	Mixed	3	0		
Big Eddy	6	11	414786	5649792	Willow/Cottonwood	10	1	0	
Big Eddy	7	11	414788	5649794	Dead		11		All stakes pulled out by horses
Big Eddy	7	11	414788	5649794	Dogwood	12	0		
Big Eddy	7	11	414788	5649794	Mixed	0	0		
Big Eddy	7	11	414788	5649794	Willow/Cottonwood	15	4	0	
Big Eddy	8	11	414793	5649780	Dead		5		
Big Eddy	8	11	414793	5649780	Dogwood	0	0		
Big Eddy	8	11	414793	5649780	Mixed	0	0		
Big Eddy	8	11	414793	5649780	Willow/Cottonwood	18	13	0	
Big Eddy	9	11	414798	5649787	Dead		8		
Big Eddy	9	11	414798	5649787	Dogwood	2	0		
Big Eddy	9	11	414798	5649787	Mixed	0	0		
Big Eddy	9	11	414798	5649787	Willow/Cottonwood	16	10	0	
Big Eddy	10	11	414785	5649758	Dead		14		
Big Eddy	10	11	414785	5649758	Dogwood	7	0		
Big Eddy	10	11	414785	5649758	Mixed	0	0		
Big Eddy	10	11	414785	5649758	Willow/Cottonwood	7	0	0	
Big Eddy	11	11	414758	5649764	Dead		3		
Big Eddy	11	11	414758	5649764	Dogwood	0	0		
Big Eddy	11	11	414758	5649764	Mixed	0	0		
Big Eddy	11	11	414758	5649764	Willow/Cottonwood	16	13	0	
Big Eddy	12	11	414755	5649767	Dead		2		
Big Eddy	12	11	414755	5649767	Dogwood	4	2		

Big Eddy	12	11	414755	5649767	Mixed	0	0		
Big Eddy	12	11	414755	5649767	Willow/Cottonwood	17	17	0	
Big Eddy	13	11	417117	5646831	Dead		21		
Airport Marsh	13	11	417117	5646831	Dogwood	10	0		
Airport Marsh	13	11	417117	5646831	Mixed	0	0		
Airport Marsh	13	11	417117	5646831	Willow/Cottonwood	23	12	0	
Airport Marsh	14	11	417121	5646826	Dead		23		
Airport Marsh	14	11	417121	5646826	Dogwood	22	0		
Airport Marsh	14	11	417121	5646826	Mixed	0	6		
Airport Marsh	14	11	417121	5646826	Willow/Cottonwood	14	7	0	
Airport Marsh	15	11	417126	5646822	Dead		18		
Airport Marsh	15	11	417126	5646822	Dogwood	11	0		
Airport Marsh	15	11	417126	5646822	Mixed	0	1		
Airport Marsh	15	11	417126	5646822	Willow/Cottonwood	14	6	0	
Nichol	16	11	415935	5647681	Dead		9		
Nichol	16	11	415935	5647681	Dogwood	2	0		
Nichol	16	11	415935	5647681	Mixed	0	0		
Nichol	16	11	415935	5647681	Willow/Cottonwood	11	4	0	
Nichol	17	11	415926	5647678	Dead		16		
Nichol	17	11	415926	5647678	Dogwood	4	0		
Nichol	17	11	415926	5647678	Mixed	1	0		
Nichol	17	11	415926	5647678	Willow/Cottonwood	19	8	0	
Nichol	18	11	415917	5647683	Dead		21		
Nichol	18	11	415917	5647683	Dogwood	12	0		
Nichol	18	11	415917	5647683	Mixed	4	0		
Nichol	18	11	415917	5647683	Willow/Cottonwood	5	0	0	
Nichol	19	11	415906	5647687	Dead		12		
Nichol	19	11	415906	5647687	Dogwood	3	0		
Nichol	19	11	415906	5647687	Mixed	2	0		
Nichol	19	11	415906	5647687	Willow/Cottonwood	7	0	0	
Downie	20	11	415182	5649411	Dead		6		
Downie	20	11	415182	5649411	Dogwood	0	0		
Downie	20	11	415182	5649411	Mixed	0	0		
Downie	20	11	415182	5649411	Willow/Cottonwood	13	7	5	also +7 natural cottonwood saplings
Downie	21	11	415166	5649397	Dead		not found		
Downie	21	11	415166	5649397	Dogwood	11	not found		
Downie	21	11	415166	5649397	Mixed	0	not found		
Downie	21	11	415166	5649397	Willow/Cottonwood	0	not found	0	
Downie	22	11	415189	5649421	Dead		5		
Downie	22	11	415189	5649421	Dogwood	1	0		
Downie	22	11	415189	5649421	Mixed	0	0		
Downie	22	11	415189	5649421	Willow/Cottonwood	12	7	0	
Downie	23	11	415148	5649388	Dead		6		
Downie	23	11	415148	5649388	Dogwood	10	3		
Downie	23	11	415148	5649388	Mixed	0	0		
Downie	23	11	415148	5649388	Willow/Cottonwood	5	6	0	

Downie	24	11	415129	5649363	Dead		8		
Downie	24	11	415129	5649363	Dogwood	3	0		
Downie	24	11	415129	5649363	Mixed	0	1		
Downie	24	11	415129	5649363	Willow/Cottonwood	12	6	2	also 1 natural cottonwood
Downie	25	11	415118	5649340	Dead		11		
Downie	25	11	415118	5649340	Dogwood	11	0		
Downie	25	11	415118	5649340	Mixed	0	0		
Downie	25	11	415118	5649340	Willow/Cottonwood	3	3	3	also +2 natural cottonwood
Downie	26	11	415119	5649332	Dead		2		
Downie	26	11	415119	5649332	Dogwood	0	0		
Downie	26	11	415119	5649332	Mixed	0	0		
Downie	26	11	415119	5649332	Willow/Cottonwood	10	8	0	
Downie	27	11	415118	5649323	Dead		3		
Downie	27	11	415118	5649323	Dogwood	0	0		
Downie	27	11	415118	5649323	Mixed	0	0		
Downie	27	11	415118	5649323	Willow/Cottonwood	8	5	3	
Downie	28	11	415125	5649352	Dead		11		
Downie	28	11	415125	5649352	Dogwood	0			
Downie	28	11	415125	5649352	Mixed	0			
Downie	28	11	415125	5649352	Willow/Cottonwood	15	4	2	