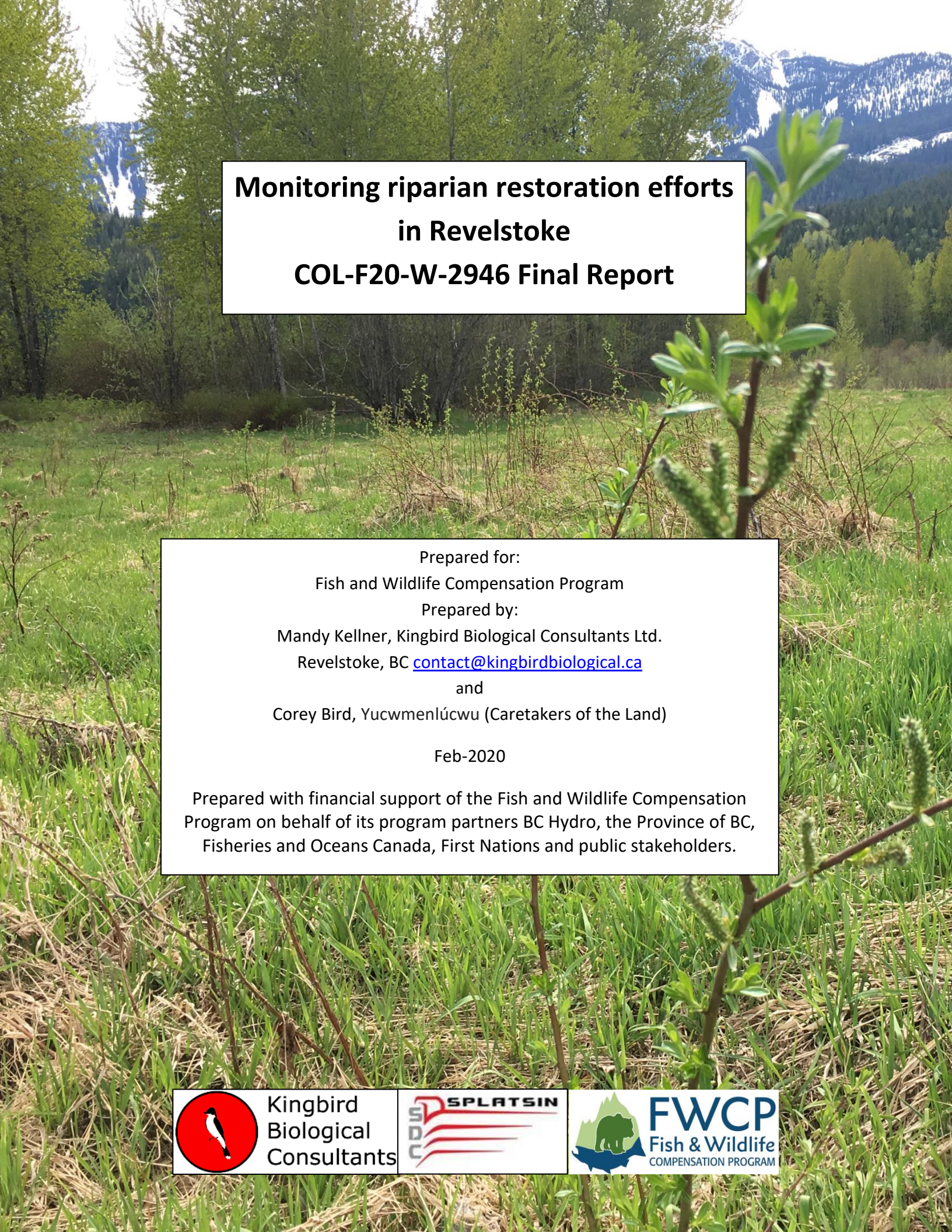

Monitoring riparian restoration efforts in Revelstoke
COL-F20-W-2946 Final Report

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SPLATSIN SDC

FWCP Fish & Wildlife COMPENSATION PROGRAM

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 we planted live stakes and small shrubs to initiate new habitat patches, or expand on existing patches, of native shrubs through increased competition and eventual shading of reed canarygrass. In 2014, we worked with volunteers to plant 550 live stakes and 250 small shrubs in the Downie Marsh area of the Arrow Lakes drawdown zone at Revelstoke. A second project grew from this experience, and in 2017 we expanded the project area and employed committed technicians in an attempt to ensure quality of plantings, and planted over 1300 live stakes at four sites. Species planted included red-osier dogwood (*Cornus stolonifera*), willow (*Salix* spp.), and cottonwood (*Populus balsamifera* ssp. *trichocarpa*).

Monitoring the success of restoration efforts allows lessons to be learned to guide future work. This monitoring project directly contributed to the Priority Action: Monitoring and Evaluation 11.1 : Compile, assess, and document the effectiveness of completed wetland and riparian restoration projects Columbia Basin Riparian and Wetlands Action Plan, FWCP 2014).

Survival of live stakes was low, at an average of 18 % survival after two growing seasons and 16 % after five growing seasons. However, it appears that mortality of stakes was high in the two years after planting, and then stakes that had survived became established and continued to flourish. After 5 years, these stakes provided patches of native habitat in the reed canarygrass. Survival of containerized shrubs was 100%; however, these were only planted in one site.

Survival rates of live stakes ranged widely across sites. Two sites supported robust plant growth of surviving stakes. Two other sites had poor soil and mortality neared 100 %. Investigation of dead stakes identified poor root development, likely from drought and lack of nutrition, as the likely cause. Vole damage was seemingly reduced to an insignificant amount with the application of vole guards in 2017. The drought in the summer 2017, plus planting in sites that were not very fertile or were frequented by humans, likely negatively impacted stake survival.

Our results highlighted that even with an emphasis on quality planting efforts and protection from predation, issues such as human or livestock interference and extended drought will continue to negatively influence plant survival. We recommend increased outreach and education, careful site selection, and physical protection of staked areas if possible, to increase stake survival.

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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 terrestrial and avian 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).

In 2017 revegetation efforts were continued with the aim of restoring areas 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 has proven effective in this floodplain habitat (KES 2011, KBC 2015). Further, 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. 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).

Monitoring the success of restoration efforts allows lessons to be learned and guides future work. In spring 2019 we conducted a final monitoring session to document from the results of the 2014 and 2017 restoration efforts (the 'Project'). This monitoring project directly contributed to the Priority Action: Monitoring and Evaluation 11.1 : Compile, assess, and document the effectiveness of completed wetland and riparian restoration projects Columbia Basin Riparian and Wetlands Action Plan, FWCP 2014).

Our objectives for the monitoring project were to:

1. Determine survival rates of live stakes after 2 years (2017 plantings) and 5 years (2014 plantings)
2. Assess utility of vole guards in reducing mortality from voles
3. Identify other causes of mortality, including human impacts,
4. Remove vole guards from dead stakes to improve the appearance of sites.
5. Summarize results and survival rates by project and communicate the findings to project supporters and interested groups

Methods

Study area

The Project sites 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 were 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*). 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).

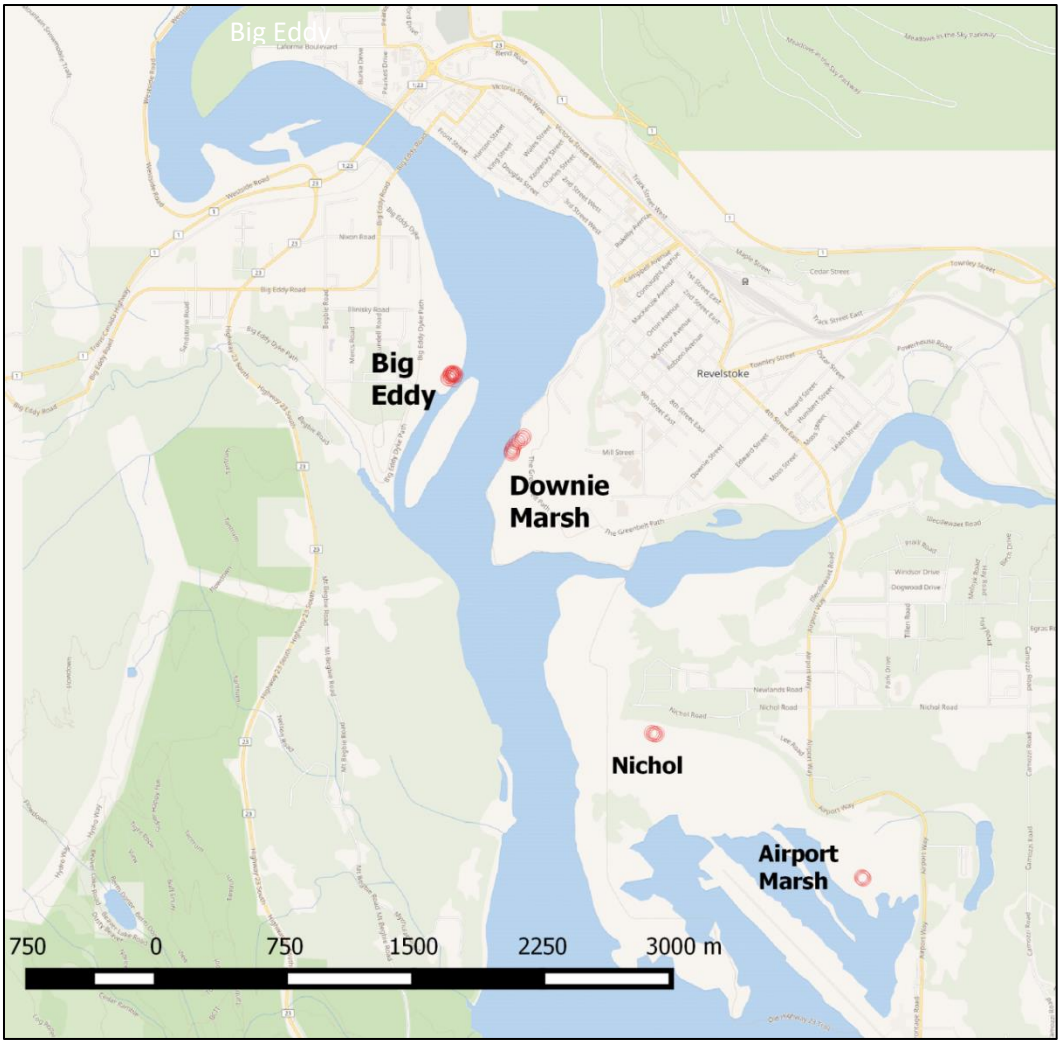

Figure 1. Site and monitoring plot locations for restoration sites established in 2016/17. All 2014 restoration works were completed at the Downie Marsh site.

Monitoring

For the 2017 project, monitoring plots were set up during planting in spring 2017, with multiple plots randomly situated within each site. Plots were circular 2.82 m radius plots (25 m^2), identified by 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.

The 28 plots contained 495 stakes (150 dogwood, 332 willow/cottonwood, and 13 mixed bundles) that had been harvested and planted in 2017 (Kellner and Bird 2017). In 2019, four of these plots were not included in the analyses – Plots 1,5,6, and 7 (Big Eddy) suffered from human interference, with all stakes pulled up and thrown into nearby brush, or stacked on the ground. We therefore monitored 403 stakes in 24 plots (8- 36 stakes per plot).

For the 2014 planting, survival of small shrubs was monitored at three plots, containing 24 dogwood and snowberry shrubs. There were 625 stakes of willow and dogwood, monitored at 27 plots.

Survival of stakes was assessed in May 2019 with a total count of live stakes in each plot, as per Kellner 2016. For the 2017 plantings, this was after two growing seasons and two winters. For live stakes and shrubs planted in 2014 (Kellner 2015, Kellner 2016), this was after five growing seasons.

Results and outcomes

Survival of 2017 plantings

All species

Overall survival after two growing seasons was down to an average of 18 % (Table 1). Survival varied across sites and plots (Figure 2).

The Big Eddy and Downie Marsh had survival of 33 and 17 percent, respectively. These two sites had rich soil, and although survival was low, the stakes that survived were often healthy and strong (Figure 3). Some sites were affected by human or domestic animal interference – at three of the Big Eddy sites, all of the stakes had been removed from the ground and piled nearby, and trampling was evident (Figure 4, left). Vole damage was observed on two stakes - the vole guard had been displaced on one stake (Figure 4, right), whereas the other stake was chewed above the vole guard.

Table 1. The number of plots, number of stakes, and survival rate of stakes at each of four sites planted in spring 2017.

Site	N (# plots)	# stakes total	% survival (Fall 2017 - after 1 growing season)				% survival (Spring 2019 - after 2 growing seasons)			
			mean	sd	min	max	mean	sd	min	max
Airport Marsh	3	94	**33**	5	28	36	**5**	8	0	14
Big Eddy	8	125	**42**	32	0	90	**33**	25	0	67
Downie	9	114	**51**	19	21	80	**17**	12	0	36
Nichol	4	70	**16**	19	0	33	**0**	0	0	0
All sites	24	403	**40**	26	0	90	**18**	20	0	67

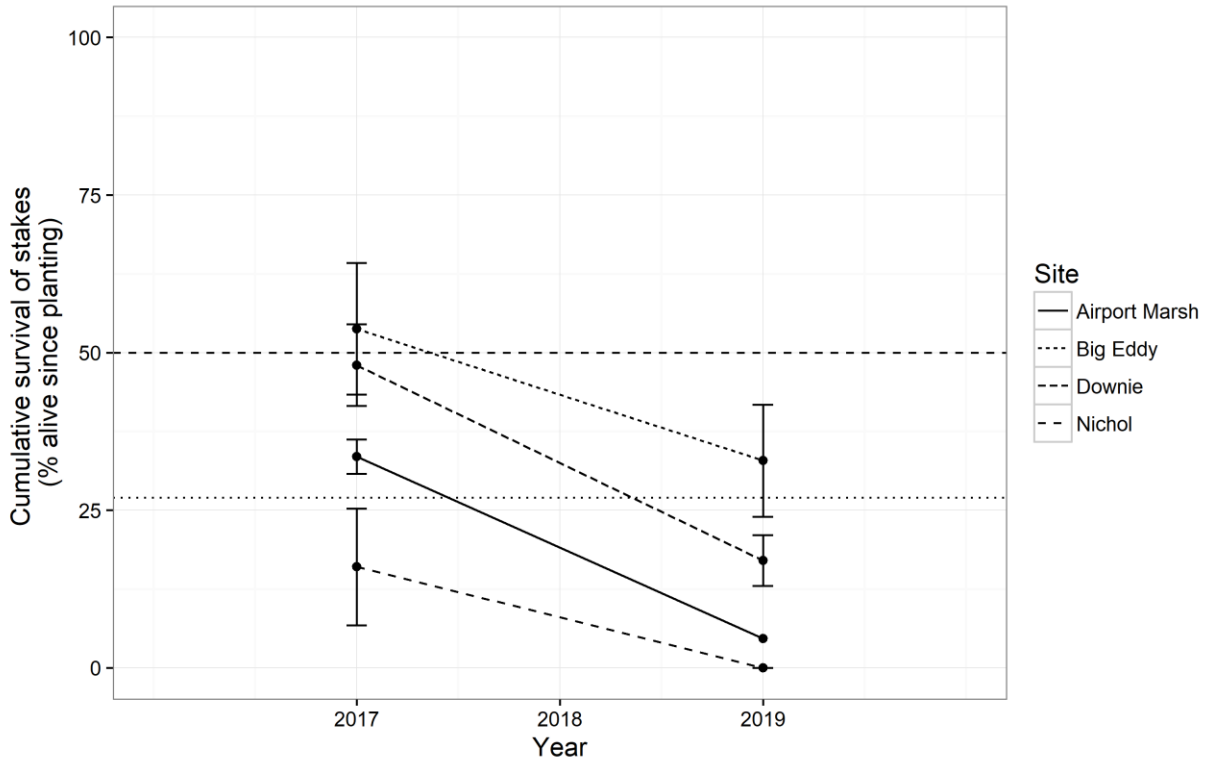

Figure 2. The average survival (% alive ± s.d.) of stakes at the four planting sites, showing variability between sites and plots. N=3, 8, 8, and 4 plots per site.

Figure 3. Leaf-out at the Big Eddy (left) and Downie Marsh (right).

Figure 4. Mortality in the Big Eddy was due primarily to human interference (left). Vole damage was present at two unprotected stakes in the Big Eddy where vole guards were displaced (right).

At Nichol and Airport Marsh, stake survival was zero and five percent, respectively. Examination of dead stakes revealed very little root growth (Figure 3). Both sites are composed of sandy soil and are very well-drained. It appeared that all the stakes in these sites suffered from insufficient water and nutrition to support developing roots. No vole damage was observed.

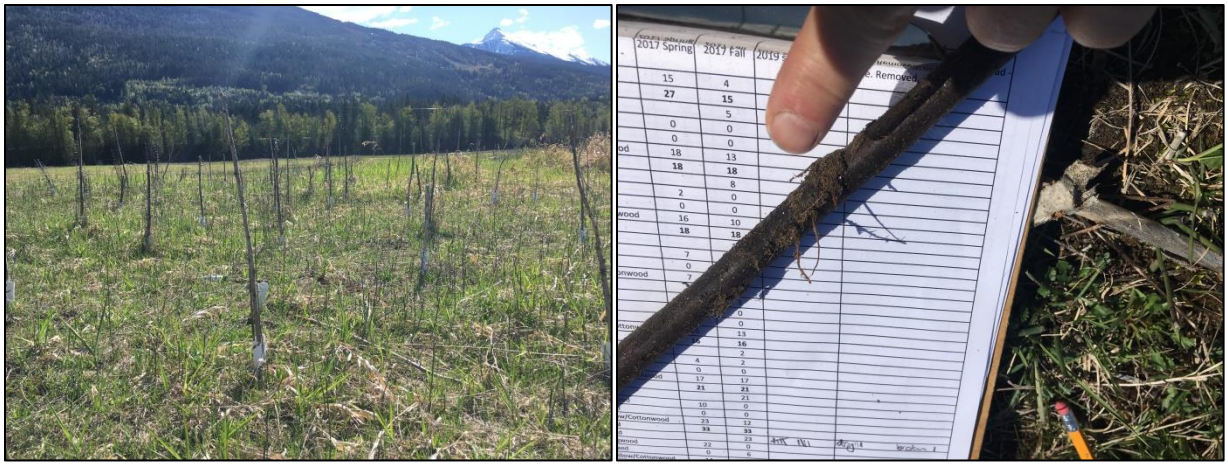

Figure 5. The Nichol site showing failed staking (left). Dry sandy soil was probably to be the main problem at this site. This led to poor root development (right).

Survival by species group

We monitored a total of 136 red-osier dogwood stakes in 20 plots. Dogwood survival was poor. After one growing season, surviving dogwood stakes were found in 5 of 23 monitored plots (1 in Downie Marsh and 4 in Big Eddy), with an overall survival rate of 8.4 % . After two seasons, live dogwood was only found in 3 of 23 plots, for an overall survival rate of 3.3 % (Table 2, Figures 6,7).

By 2019, there were only three plots where dogwood survived (2 in Big Eddy, and 1 in Airport Marsh that did not appear alive in 2017). Looking only at survival rates in these three plots, dogwood survival averaged 19 %.

Table 2. The survival of Red-osier dogwood planted in April 2017. Survival was assessed in September 2017 after one growing season and May 2019 after two growing seasons and two winters.

Site	N (# plots)	Red-osier dogwood % survival 2017				2019			
		mean	sd	min	max	Mean	sd	min	max
Airport Marsh	3	**0**	0	0	0	**4.5**	8	0	14
Big Eddy	7	**15**	21	0	50	**7.5**	12	0	25
Downie	4	**7.5**	15	0	30	**0**	0	0	0
Nichol	4	**0**	0	0	0	**0**	0	0	0
All sites	18	**8.4**	16	0	50	**3.3**	7.7	0	25

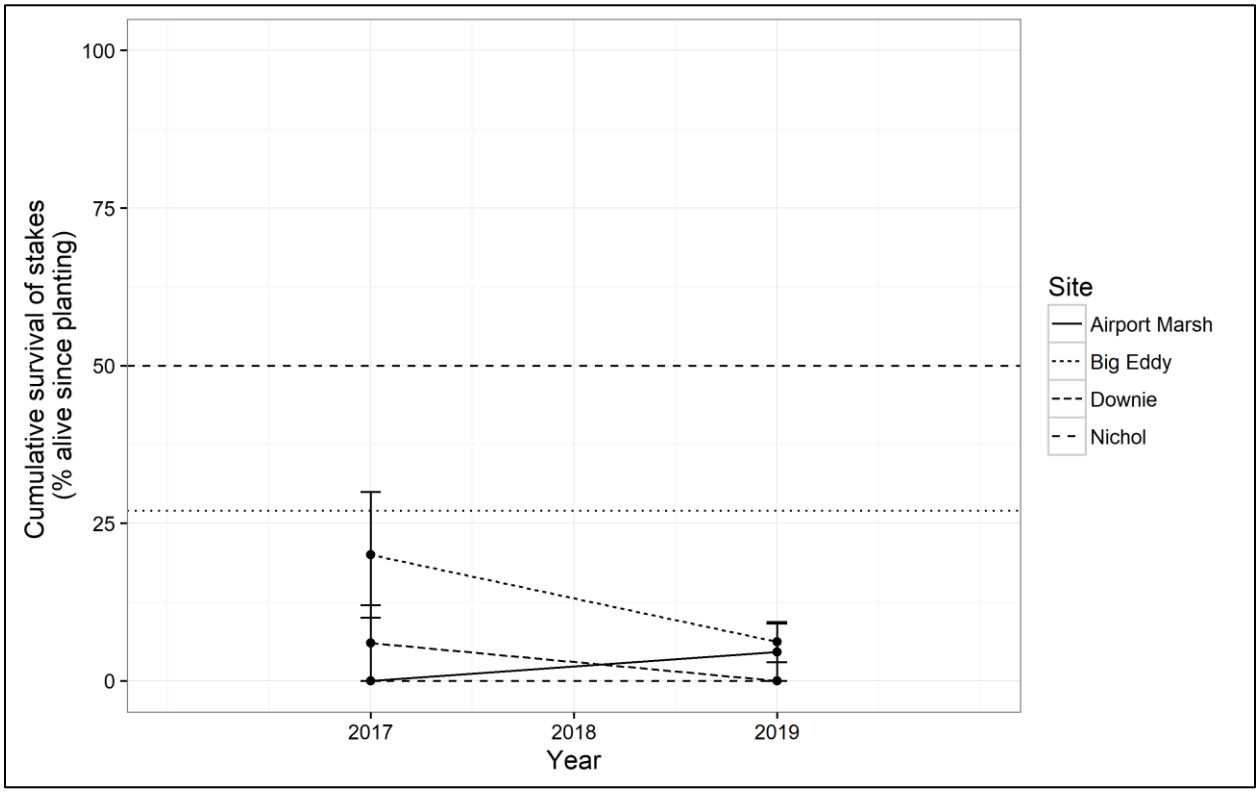

Figure 6. Survival (mean ± se) of dogwood stakes planted in spring 2017, assessed in fall 2017 and spring 2019.

All 26 monitoring plots contained cottonwood/willow stakes, with stakes surviving in 23 of these plots. In total, 70 of 314 stakes survived for a 22 % survival rate (Table 3, Figure 7).

Table 3. The survival of cottonwood/willow stakes planted in April 2017. Survival was assessed in September 2017 and May 2019.

Site	N (# plots)	Cottonwood/ willow % survival 2017 - (after 1 growing season)				2019 – 2 growing seasons, 2 winters			
		mean	sd	min	max	mean	sd	min	max
Airport Marsh	3	48	05	43	52	5	8	0	14
Big Eddy	8	58	31	0	100	23	28	0	76
Downie	8	69	30	27	100	28	18	0	67
Nichol	4	20	23	0	42	0	0	0	0
All sites	23	49	32	0	100	22	24	0	76

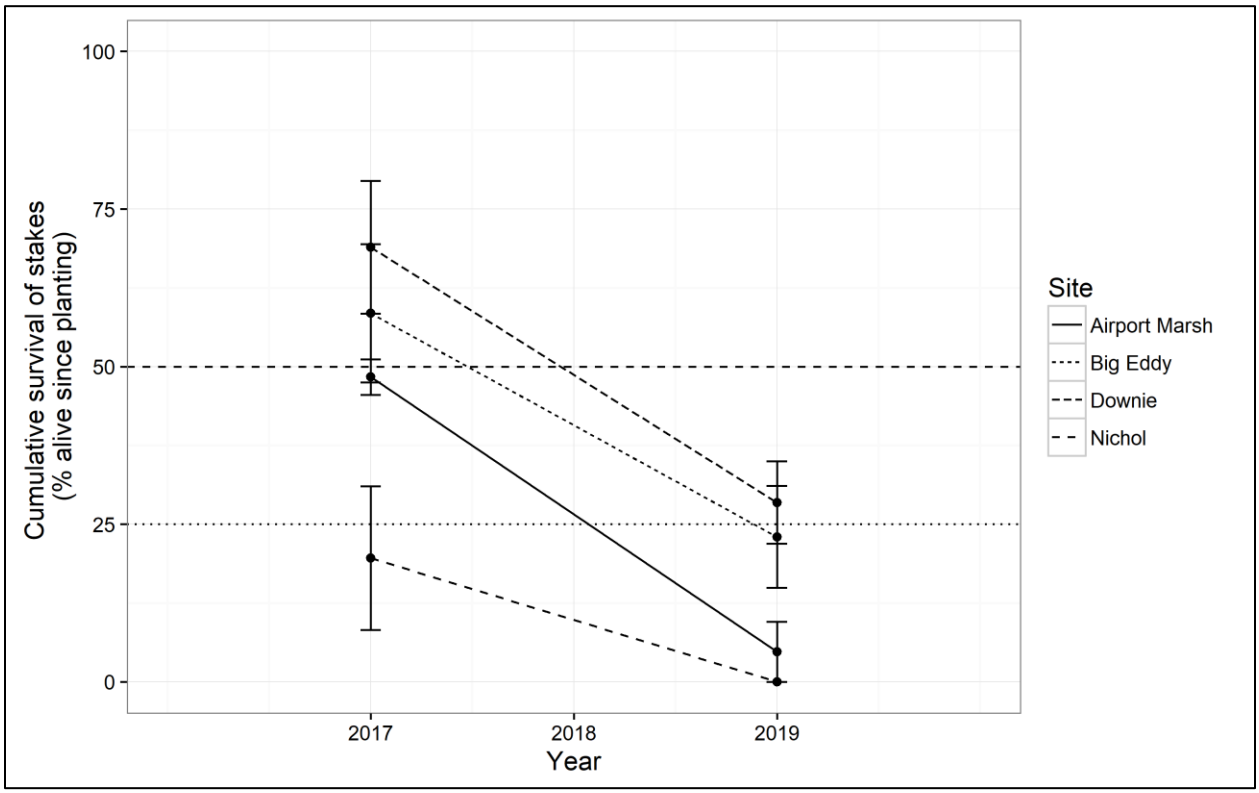

Figure 7. Survival (mean ± se) of cottonwood and willow stakes planted in spring 2017, assessed in fall 2017 and spring 2019.

Survival of 2014 plantings

The live stakes and shrubs planted in 2014 were located and assessed for survivorship. Detailed analysis of this dataset is outside the scope of the current project; the data was gathered opportunistically for future analyses. Cumulative survival at the 'Community Plots' (Kellner 2015, 2016) was 16 % after 5 years (Table 4, Figure 9). Although survival was low, many of the surviving stakes are now over 2 m in height and robust (Figure 10).

Survival small shrubs was 100 % (24/24).

Table 4. 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
2019-spring	81	16.1	13.6	3.6	46.7

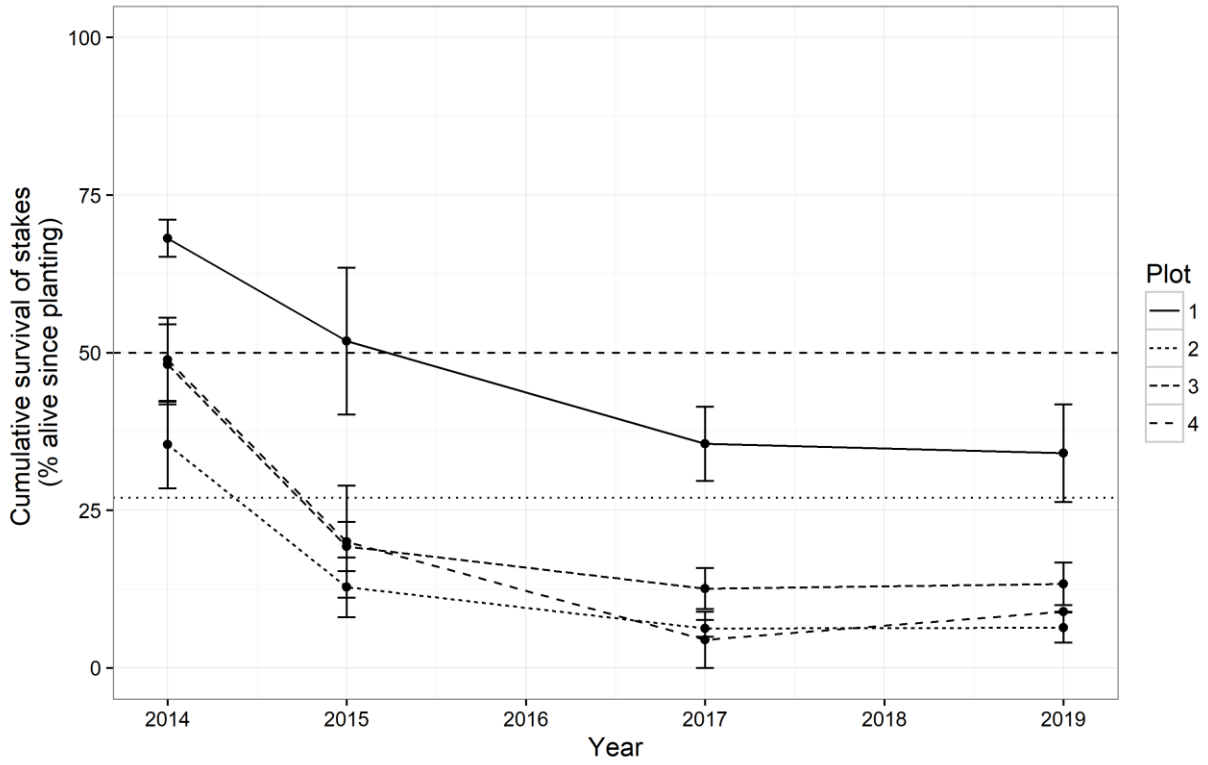

Figure 8. The average survival (% alive ± s.d.) of all stakes in the four Community Plots planted in 2014 at Downie Marsh. N=3 sublots for each plot, except for plot 4 where n=2 subplots.

Figure 9. A thicket of dogwood and willow planted in 2014 has reached ~ 2m height in 2019 and may provide nesting or other wildlife habitat.

Community involvement and partnerships

We worked with Begbie View Elementary Grade 5/6 students to learn about native tree and shrub species and their importance for wildlife, including a walk and plant identification session during the Take Me Outside Winter Challenge Week in February 2020 (https://takemeoutside.ca/winterchallenge/). Topics covered included identification of common native trees, use by wildlife and historic distribution of species in the Revelstoke drawdown zone.

The final report will be shared with project partners and supporters including Columbia Shuswap Invasive Species Society, BC Ministry of Environment, BC Hydro, and BC Ministry if Forests, Lands, Resource Operations and Rural Development.

Discussion

This project directly contributes to the Priority Action: Monitoring and Evaluation 11.1 - Compile, assess, and document the effectiveness of completed wetland and riparian restoration projects.

Survival of the stakes planted in 2017 dropped from an average of 40 % after one growing season to 18 % after two growing seasons. Survival of the 2014 plantings averaged 16 % after five growing seasons. The longer-term monitoring suggests that after an initial period of high mortality, existing stakes are well-established and likely to survive.

In comparison with other projects, first-season survival was 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). In a live-staking program in Ontario, multi-year survival of 20 % was considered a success in restoring an area formerly covered by an invasive plant (Williams 2015).

Stake survival varied across sites, likely due to difference in soil type and moisture. The better survival in Big Eddy and Downie plots likely reflect the richer, finer textured soils at these sites. The Nichol site and Airport Marsh sites had sandy/gravelly soil, and planting was considered a trial in these areas (Kellner and Bird 2018). These poor sites should not be targets for future restoration work.

The Big Eddy site, despite exhibiting favourable soil conditions, continued to suffer from what appeared to be human disturbance, first observed in 2017. Increased public education and involvement to encourage stewardship, and perhaps livestock fencing, would be necessary if this site is considered for future restoration.

The application of vole- guards at all sites was effective at reducing vole damage. Vole damage was rarely observed in 2019, unlike when monitoring previous plantings in the Revelstoke Reach drawdown zone (Kellner 2016, KES 2011).

We expect that planting of poorer sites and sites subject to disturbance, plus two summers of drought, led to the poor initial survival for the 2017 plantings. Surviving stakes will hopefully continue to thrive and contribute to the biodiversity in the sites.

Recommendations

The project and the challenges associated with it have emphasized the need, to commit adequate resources to planning, permitting, and outreach activities when doing restoration projects. This should help ensure that survival of plants depends primarily on natural conditions. These recommendations were made in Kellner and Bird 2018.

Recommendations arising specifically from the monitoring project include:

- conduct test plots and soil analysis prior to committing to planting sites
- install vole guards during planting, when working in reed-canary grass/drawdown zone environments
- ensure local public is engaged and supportive of restoration efforts, 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

The two planting efforts and the monitoring work described in this report benefitted from the support of the FWCP staff, Splatsin staff, Cory Legebokow (FLNRO), and Robyn Hooper and Laura Gaster of the Columbia Shuswap Invasive Species Society. BC Hydro provided access to sites at Airport Marsh and Nichol. The Fish and Wildlife Compensation Program on behalf of its program partners – BC Hydro, the Province of British Columbia, the Department of Fisheries and Oceans Canada, First Nations, and Public Stakeholders - provided financial support.

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Appendix 1. Location and number of stakes in monitoring plots

Site	Plot	X	Y	Type	Spring17	Fall17	Spring19	Comments
Big Eddy	1	414768	5649780	Dead	0	17	0	All stakes pulled out by horses
Big Eddy	1	414768	5649780	Dogwood	3	0	0	
Big Eddy	1	414768	5649780	Mixed	1	0	0	
Big Eddy	1	414768	5649780	Willow/Cottonwood	15	1	0	
Big Eddy	2	414769	5649792	Dead	0	9	2	
Big Eddy	2	414769	5649792	Dogwood	1	0	0	
Big Eddy	2	414769	5649792	Mixed	0	0	0	
Big Eddy	2	414769	5649792	Willow/Cottonwood	14	6	5	
Big Eddy	3	414776	5649795	Dead	0	4	2	
Big Eddy	3	414776	5649795	Dogwood	2	1	0	
Big Eddy	3	414776	5649795	Mixed	1	0	0	
Big Eddy	3	414776	5649795	Willow/Cottonwood	7	5	1	vole damage - guard was off
Big Eddy	4	414774	5649787	Dead	0	9	0	
Big Eddy	4	414774	5649787	Dogwood	5	1	1	vole chewing above guard - survival uncertain
Big Eddy	4	414774	5649787	Mixed	0	0	0	
Big Eddy	4	414774	5649787	Willow/Cottonwood	8	0	0	
Big Eddy	5	414782	5649784	Dead	0	0	0	horses pulled plot marker out
Big Eddy	5	414782	5649784	Dogwood	3	0	0	
Big Eddy	5	414782	5649784	Mixed	1	0	0	
Big Eddy	5	414782	5649784	Willow/Cottonwood	18	0	0	
Big Eddy	6	414786	5649792	Dead	0	0	0	All stakes pulled out by horses
Big Eddy	6	414786	5649792	Dogwood	11	0	0	
Big Eddy	6	414786	5649792	Mixed	3	0	0	
Big Eddy	6	414786	5649792	Willow/Cottonwood	10	0	0	
Big Eddy	7	414788	5649794	Dead	0	0	0	All stakes pulled out by horses
Big Eddy	7	414788	5649794	Dogwood	12	0	2	
Big Eddy	7	414788	5649794	Mixed	0	0	0	
Big Eddy	7	414788	5649794	Willow/Cottonwood	15	0	0	
Big Eddy	8	414793	5649780	Dead	0	0	0	
Big Eddy	8	414793	5649780	Dogwood	0	0	0	
Big Eddy	8	414793	5649780	Mixed	0	0	0	
Big Eddy	8	414793	5649780	Willow/Cottonwood	18	0	10	
Big Eddy	9	414798	5649787	Dead	0	0	0	
Big Eddy	9	414798	5649787	Dogwood	2	0	0	
Big Eddy	9	414798	5649787	Mixed	0	0	0	
Big Eddy	9	414798	5649787	Willow/Cottonwood	16	0	6	
Big Eddy	10	414785	5649758	Dead	0	0	0	
Big Eddy	10	414785	5649758	Dogwood	7	0	0	
Big Eddy	10	414785	5649758	Mixed	0	0	0	
Big Eddy	10	414785	5649758	Willow/Cottonwood	7	0	0	

Site	Plot	X	Y	Type	Spring17	Fall17	Spring19	Comments
Big Eddy	11	414758	5649764	Dead	0	0	0	
Big Eddy	11	414758	5649764	Dogwood	0	0	0	
Big Eddy	11	414758	5649764	Mixed	0	0	0	
Big Eddy	11	414758	5649764	Willow/Cottonwood	16	0	9	
Big Eddy	12	414755	5649767	Dead	0	0	0	
Big Eddy	12	414755	5649767	Dogwood	4	0	1	
Big Eddy	12	414755	5649767	Mixed	0	0	0	
Big Eddy	12	414755	5649767	Willow/Cottonwood	17	0	13	
Airport Marsh	13	417117	5646831	Dead	0	0	33	all dead - very little root development
Airport Marsh	13	417117	5646831	Dogwood	10	0	0	too dry and sandy - droughty 2 summers were bad
Airport Marsh	13	417117	5646831	Mixed	0	0	0	
Airport Marsh	13	417117	5646831	Willow/Cottonwood	23	0	0	
Airport Marsh	14	417121	5646826	Dead	0	0	31	
Airport Marsh	14	417121	5646826	Dogwood	22	0	3	
Airport Marsh	14	417121	5646826	Mixed	0	0	0	
Airport Marsh	14	417121	5646826	Willow/Cottonwood	14	0	2	
Airport Marsh	15	417126	5646822	Dead	0	0	25	
Airport Marsh	15	417126	5646822	Dogwood	11	0	0	
Airport Marsh	15	417126	5646822	Mixed	0	0	0	
Airport Marsh	15	417126	5646822	Willow/Cottonwood	14	0	0	
Nichol	16	415935	5647681	Dead	0	0	13	
Nichol	16	415935	5647681	Dogwood	2	0	0	
Nichol	16	415935	5647681	Mixed	0	0	0	
Nichol	16	415935	5647681	Willow/Cottonwood	11	0	0	
Nichol	17	415926	5647678	Dead	0	0	24	all dead - very little root development
Nichol	17	415926	5647678	Dogwood	4	0	0	too dry and sandy - droughty 2 summers were bad
Nichol	17	415926	5647678	Mixed	1	0	0	
Nichol	17	415926	5647678	Willow/Cottonwood	19	0	0	
Nichol	18	415917	5647683	Dead	0	0	21	
Nichol	18	415917	5647683	Dogwood	12	0	0	
Nichol	18	415917	5647683	Mixed	4	0	0	
Nichol	18	415917	5647683	Willow/Cottonwood	5	0	0	
Nichol	19	415906	5647687	Dead	0	0	12	
Nichol	19	415906	5647687	Dogwood	3	0	0	
Nichol	19	415906	5647687	Mixed	2	0	0	
Nichol	19	415906	5647687	Willow/Cottonwood	7	0	0	
Downie	20	415182	5649411	Dead	0	0	0	

Site	Plot	X	Y	Type	Spring17	Fall17	Spring19	Comments
Downie	20	415182	5649411	Dogwood	0	0	0	
Downie	20	415182	5649411	Mixed	0	0	0	
Downie	20	415182	5649411	Willow/Cottonwood	13	0	4	1 willow, 3 cottonwood
Downie	21	415166	5649397	Dead	0	0	0	not found
Downie	21	415166	5649397	Dogwood	11	0	0	not found
Downie	21	415166	5649397	Mixed	0	0	0	not found
Downie	21	415166	5649397	Willow/Cottonwood	0	0	0	1 cottonwood, 3 willow
Downie	22	415189	5649421	Dead	0	0	0	
Downie	22	415189	5649421	Dogwood	1	0	0	
Downie	22	415189	5649421	Mixed	0	0	0	
Downie	22	415189	5649421	Willow/Cottonwood	12	0	3	3 willow
Downie	23	415148	5649388	Dead	0	0	0	
Downie	23	415148	5649388	Dogwood	10	0	0	
Downie	23	415148	5649388	Mixed	0	0	0	
Downie	23	415148	5649388	Willow/Cottonwood	5	0	1	1 willow
Downie	24	415129	5649363	Dead	0	0	0	
Downie	24	415129	5649363	Dogwood	3	0	0	
Downie	24	415129	5649363	Mixed	0	0	0	
Downie	24	415129	5649363	Willow/Cottonwood	12	0	4	willow; 1 natural cottonwood
Downie	25	415118	5649340	Dead	0	0	0	
Downie	25	415118	5649340	Dogwood	11	0	0	
Downie	25	415118	5649340	Mixed	0	0	0	
Downie	25	415118	5649340	Willow/Cottonwood	3	0	2	also +2 natural cottonwood
Downie	26	415119	5649332	Dead	0	0	0	
Downie	26	415119	5649332	Dogwood	0	0	0	
Downie	26	415119	5649332	Mixed	0	0	0	
Downie	26	415119	5649332	Willow/Cottonwood	10	0	0	
Downie	27	415118	5649323	Dead	0	0	0	
Downie	27	415118	5649323	Dogwood	0	0	0	
Downie	27	415118	5649323	Mixed	0	0	0	
Downie	27	415118	5649323	Willow/Cottonwood	8	0	2	
Downie	28	415125	5649352	Dead	0	0	0	
Downie	28	415125	5649352	Dogwood	0	0	0	
Downie	28	415125	5649352	Mixed	0	0	0	
Downie	28	415125	5649352	Willow/Cottonwood	15	0	4	2 willow, 2 cottonwood