Williamson River Delta Preserve vegetation monitoring: Tulana third-year post-breaching results

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I. Introduction

Establishing native wetland vegetation in restored wetlands is an integral component of the Williamson River Delta Preserve's restoration goals. In fall 2007, large sections of levee were breached on the Tulana portion of the property, and in fall 2008, additional sections of levee were breached on the Goose Bay portion of the property, resulting in the re-connection of the entire delta to the surrounding water bodies. On Tulana, where some wetland vegetation was already established via managed flooding, levee breaching resulted in a dramatic change in the hydrologic regime- most areas are now subject to deeper water and longer hydroperiods. Goose Bay, which was not previously managed as a wetland, was flooded and became colonized by wetland vegetation for the first time since being drained and converted from wetland to agricultural fields over 60 years ago.

A new monitoring program was developed in 2008 to track the response of vegetation to hydrologic restoration. The first year of post-breaching vegetation monitoring was completed on Tulana in 2008 (Elseroad et al. 2009), and in 2009, monitoring was initiated on Goose Bay (Elseroad et al. 2010). This report describes the third-year post-breaching results from Tulana.

II. Methods

Monitoring design

In 2010, we used the same monitoring methodology that was used in Tulana in 2008 (see Elseroad et al. 2009). As in 2008, vegetation was sampled in 40 1m^2 plots within each hydrologic zone (riparian/wet prairie, emergent wetland, and deep water wetland-1 and 2) that encompass the range of ground surface elevations where wetland vegetation is expected to establish (Table 1, Figure 1).

Plot locations were randomly selected prior to sampling using Hawth's tools in ArcMap. Plot locations are intended to be re-randomized each year that monitoring occurs, which will allow a larger percentage of the area to be sampled over time.

Data collection

In plots without standing water (i.e. all riparian/wet prairie plots and some emergent wetland plots), the aerial cover of each species and ground surface type (bare ground or litter) was estimated. Plant cover was estimated separately for each species; therefore plant cover totaled over 100% when species overlapped one another. In plots with standing water (i.e. some emergent wetland plots and all deep water wetland-1 and 2 plots), cover was estimated, as described above, if emergent plant species were present. For species submerged underwater, a double-headed garden rake was lowered to the ground surface, dragged along the ground for approximately 1 meter, twisted 180°, and then carefully raised vertically out of the water. The

presence of each species attached to the rake was recorded. Nomenclature followed Hitchcock and Cronquist's (1973) Flora of the Pacific Northwest, and species names were updated following USDA (2009).

Water depths were also measured in plots with standing water. Lake elevations during sampling (obtained from the U.S. Bureau of Reclamation website, http://www.usbr.gov/mp/kbao/operations/water) and measured water depths were used to estimate plot elevations. If the estimated plot elevation was more than 12 inches off from the intended plot elevation, a new plot location was chosen from a list of additional random plots. All data were collected by Adrien Elseroad from September 15-18, 2010.

Data analysis

For each hydrologic zone, average species richness, and the average cover of each ground surface type, all species, native species, exotic species, and three plant guilds were calculated. Plant guilds included perennial forbs, perennial graminoids, and annuals (combined with biennials). Species nativity and duration followed USDA (2010). For submerged aquatic species, only frequency values were calculated.

III. Results

Riparian/wet prairies

Total plant cover in riparian/wet prairies decreased from 100% in 2008 to 90% in 2010 (Table 2, Figure 2). Plant cover remained dominated by native species in 2010, although native species cover declined from 82% in 2008 to 61% in 2010, and exotic species cover increased from 16% in 2008 to 28% in 2010 (Table 2, Figure 2). Native species declines were largely driven by the annual *Rumex maritimus*, which decreased from 49% in 2008 to 4% in 2010. Increases in exotic cover were driven by small increases in *Rumex crispus*, *Cirsium arvense*, and *Tripleurospermum maritimum* (Table 4). *Elymus repens* was the dominant exotic species, and its cover remained stable at 13%-14% in 2008-2010.

Plant guild cover shifted from dominance by annuals to perennial forbs and graminoids (Table 2, Figure 2). Annual cover declined from 57% in 2008 to 18% in 2010, with declines driven by *Rumex maritimus*. Perennial forb cover increased from 21% in 2008 to 45% in 2010, and cover was dominated by the native species *Epilobium ciliatum* ssp. *watsonii* and *Potentilla norvegica*. Perennial graminoid cover also increased, from 20% to 26%, and cover was dominated by the exotic grass *Elymus repens*. While cover of native perennial graminoid species remained relatively low (<8%) in 2010, species including *Typha latifolia*, *Eleocharis palustris*, and *Schoenoplectus acutus* were frequently encountered (in 20%, 20% and 18% of plots, respectively) and all increased in cover between 2008 and 2010 (Table 4).

The total number of species found in riparian/wet prairie plots increased from 25 in 2008 to 44 in 2010, and species richness increased from 6 to 7 species/m^2 (Tables 3 and 4).

Emergent wetlands

Total plant cover in emergent wetlands increased from 36% in 2008 to 44% in 2010. Plot area not occupied by plants consisted of either bare ground or water, depending on the plot elevation. Plots located at 4139-4140 ft. had saturated soils but no standing water, and plots located at 4138 ft. had up to 11 inches of standing water.

Plant cover remained dominated by native species in 2010, although exotic species cover increased slightly, from 1% in 2008 to 7% in 2010 (Table 2, Figure 3). Increases in exotic cover were driven by *Phalaris arundinacea*, although cover of this species in 2010 averaged only 2% and it occurred in only 3% of plots. Exotic species that occurred in at least 10% of plots included *Chenopodium album* and *Rumex crispus*.

Plant guild cover shifted from dominance by annuals to perennial forbs and graminoids (Table 2, Figure 3). Annual cover declined from 18% in 2008 to 10% in 2010, with declines driven by *Rumex maritimus*. Perennial forb cover increased from 7% in 2008 to 11% in 2010, and cover was dominated by the native species *Hippuris vulgaris*. Perennial graminoid cover also increased, from 11% to 23%, and cover was dominated by the native species *Schoenoplectus acutus*. *Schoenoplectus acutus* was the dominant species in emergent wetlands overall, increasing from 10% cover in 2008 to 17% in 2010, and occurring in 25% of plots. Cover of other native perennials was low, but the native perennial species *Potentilla norvegica*, *Eleocharis palustris*, *Veronica anagallis-aquatica*, *Epilobium ciliatum* ssp. *watsonii*, *Lemna minor* var. *minima*, and *Typha latifolia* occurred in 10-20% of plots.

The total number of species found in emergent wetland plots increased from 21 in 2008 to 36 in 2010, and species richness increased from 2 to 3 species/m^2 (Tables 3 and 5).

Deep water wetlands

Submerged aquatic species were found in 15% of deep water wetland-1 plots, compared to 0% in 2008 (data not shown). *Potamogeton crispus*, an exotic, was the most common submerged aquatic species, occurring in 8% of plots (Table 5). The three other species found, *Stuckenia pectinatus*, *Najas guadalupensis*, and *Ceratophyllum dermersum*, are all native, and occurred in 3-5% of plots. No emergent or other plant species were found in plots in 2010. Water depths during sampling ranged from 20-48 inches.

No plants were found in deep water wetland-2 plots in 2010, where water depths during sampling ranged from 49-74 inches.

IV. Discussion

Short-term vegetation establishment

Vegetation in both the riparian/wet prairie and emergent wetland hydrologic zones shifted from annual-dominated in the first year following levee breaching (2008), to perennial-dominated by the third year (2010). In addition, many additional species colonized the wetlands between 2008 and 2010. Native perennials common in adjacent lake-fringe wetlands and in the delta's early action projects, such as *Eleocharis palustris*, *Typha latifolia*, *Schoenoplectus acutus*, and *Alisma triviale*, are now widely established, although cover of many of these species remain low. These and other native perennial species can be expected to increase in cover over time and eventually dominate the wetlands, as occurred in the delta's early action projects (see Elseroad et al. 2006 and Elseroad and Aldous 2008).

Submerged aquatic species established in the shallower portions of the deep water wetlands (i.e. deep water wetland-1 plots) by 2010. Submerged aquatics are not yet abundant, but spread from existing plants is likely to occur now that they are established. No emergent species were found in plots, but as in 2008, small,

widely scattered clumps of *Polygonum amphibium* were observed outside of plots in deep water wetlands, suggesting that this and other emergent species may slowly increase over time.

Exotic species

Exotic species increased in both riparian/wet prairies and emergent wetlands between 2008 and 2010. Most of the exotic species are annuals that are not considered invasive, and thus not a priority for management. However, both *Cirsium arvense* and *Phalaris arundinacea* are invasive and do occur in the wetlands. *Cirsium arvense* is a "B" listed noxious weed in Oregon, and it occurred on 38% of riparian/wet prairie plots in 2010, and cover increased slightly from 2008 to 2010. While cover remains low at 4%, management strategies for this species should be developed if increases continue. *Phalaris arundinacea*, the exotic species of most concern in the delta's wetlands because of its ability to form large monocultures, was observed in plots in 2010, although cover and frequency was low. Patches of this species are controlled with herbicide annually, which should maintain populations at low densities.

Other common perennial exotic species included *Elymus repens*, *Rumex crispus,* and *Potamogeton crispus*. *Elymus repens* was the most abundant exotic species in riparian/wet prairies. It has been present in portions of Tulana at least since the late 1990's (Elseroad et al. 2004), and although it will probably decrease in abundance as the native perennials increase, it is likely to remain a minor component of the vegetation in the long-term. *Rumex crispus* is widespread in riparian/wet prairies and forms dense patches in some areas. It is a deep-rooted species with high seed production and is often an early colonizer of disturbed wet soils (Halvorson and Guertin 2003). It was common on the delta prior to hydrologic restoration, but patches appeared larger and more abundant in 2010. It is unclear how well native perennials will compete with it or whether further increases can be expected to occur. *Potamogeton crispus* was the most common species in deep water wetlands. It is also common in Goose Bay (Elseroad et al. 2010) and the delta's early action projects (Elseroad and Aldous 2008) and often co-occurs with native submerged aquatic species.

V. Management recommendations

1) Continue scheduled monitoring frequency.

Vegetation monitoring plots on Tulana are scheduled to be re-sampled in 2013. Sampling once every three years should provide a long enough time period for detecting additional changes in vegetation that occur following hydrologic restoration.

2) Survey for *Phalaris arundinaceae* annually.

Phalaris occurs in isolated patches within the restored wetlands and can form large monocultures once established. Due to the aggressive nature of this invasive species, *Phalaris* surveys should be conducted in the riparian/wet prairie and the upper elevations of the emergent wetlands hydrologic zone every year and all patches found should be controlled.

VI. Literature cited

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Figure 1.

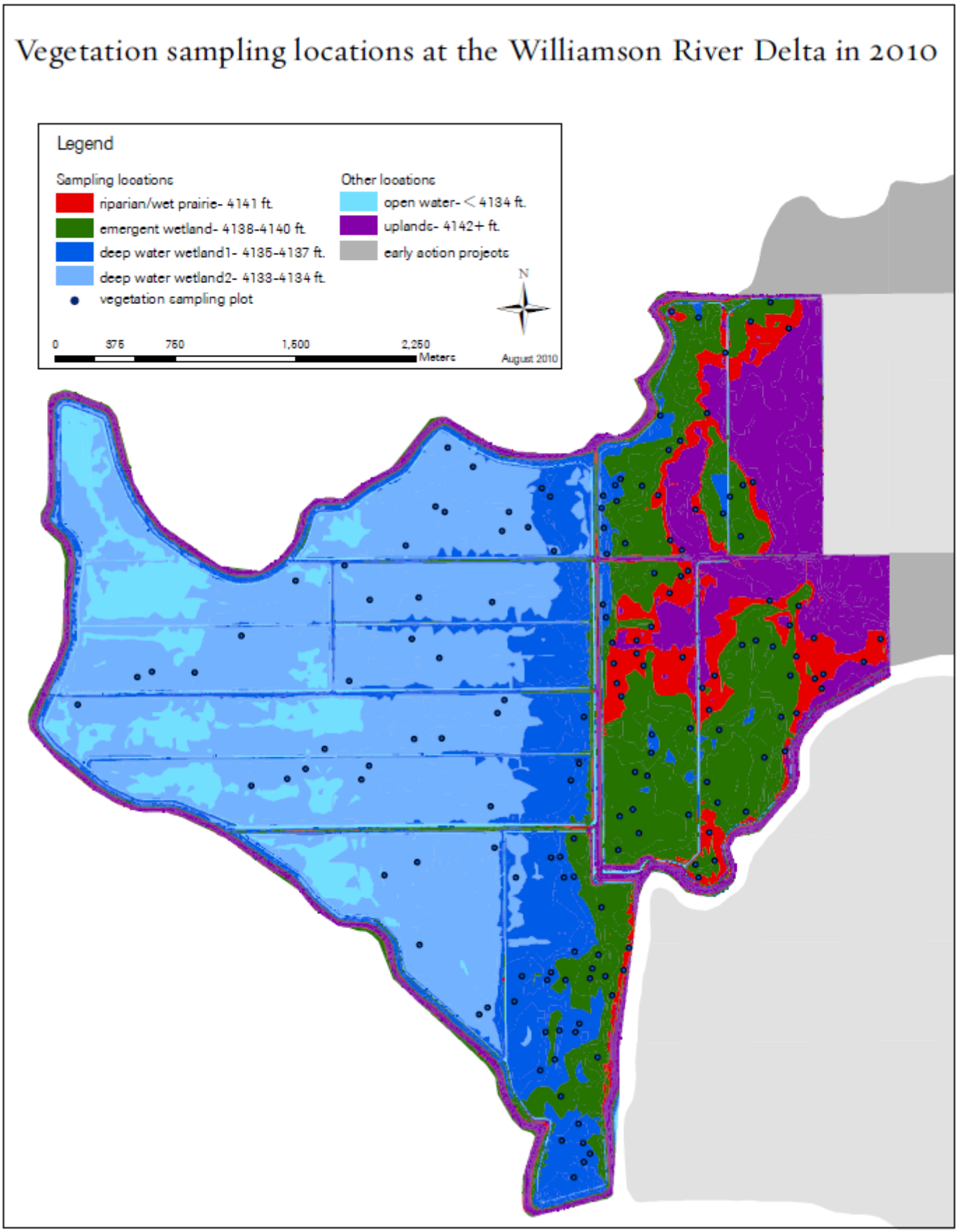
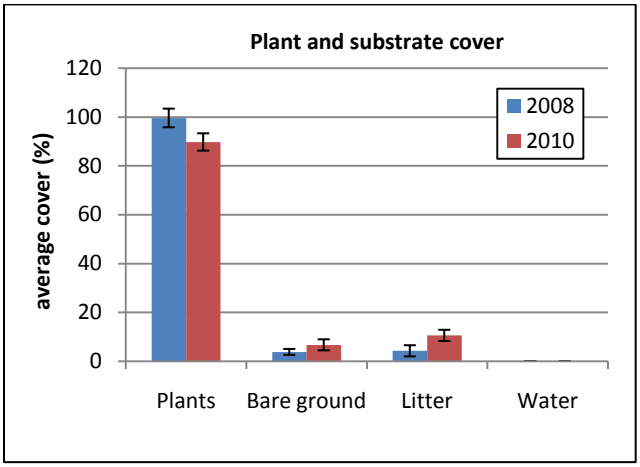
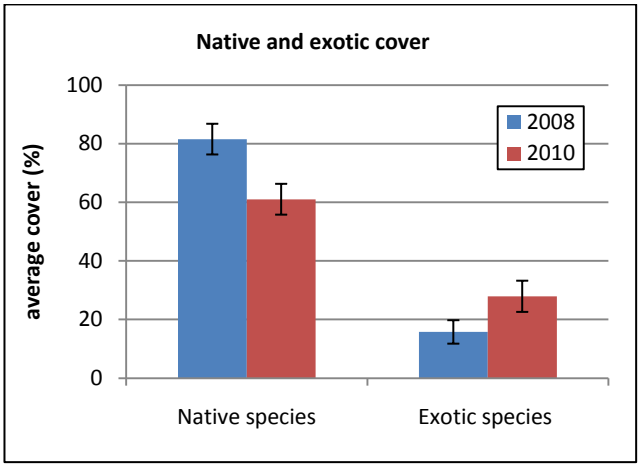

Vegetation sampling locations at the Williamson River Delta in 2010
Legend
Sampling locations
riparian/wet prairie- 4141 ft.
emergent wetland- 4138-4140 ft.
deep water wetland1- 4135-4137 ft.
deep water wetland2- 4133-4134 ft.
vegetation sampling plot
Other locations
open water- < 4134 ft.
uplands- 4142+ ft.
early action projects
N
0
375
750
1,500
2,250
Meters
August 2010

Figure 2. Plant and substrate cover in riparian/wet prairie monitoring plots on Tulana at the Williamson River Delta in 2008-2010. Values are means ± SE (n=40).





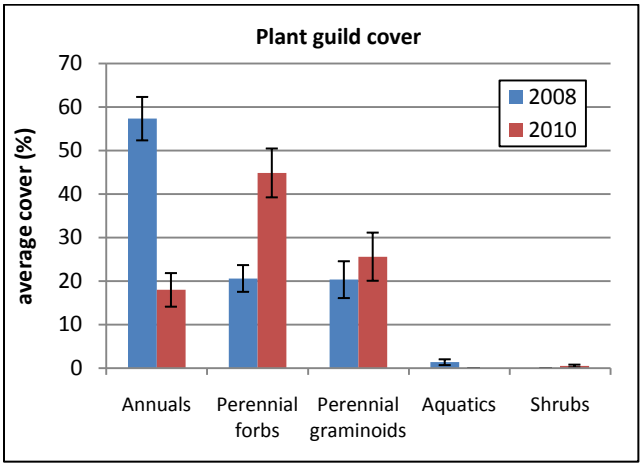


Figure 3. Plant and substrate cover in emergent wetland monitoring plots on Tulana at the Williamson River Delta in 2008-2010. Values are means ± SE (n=40).

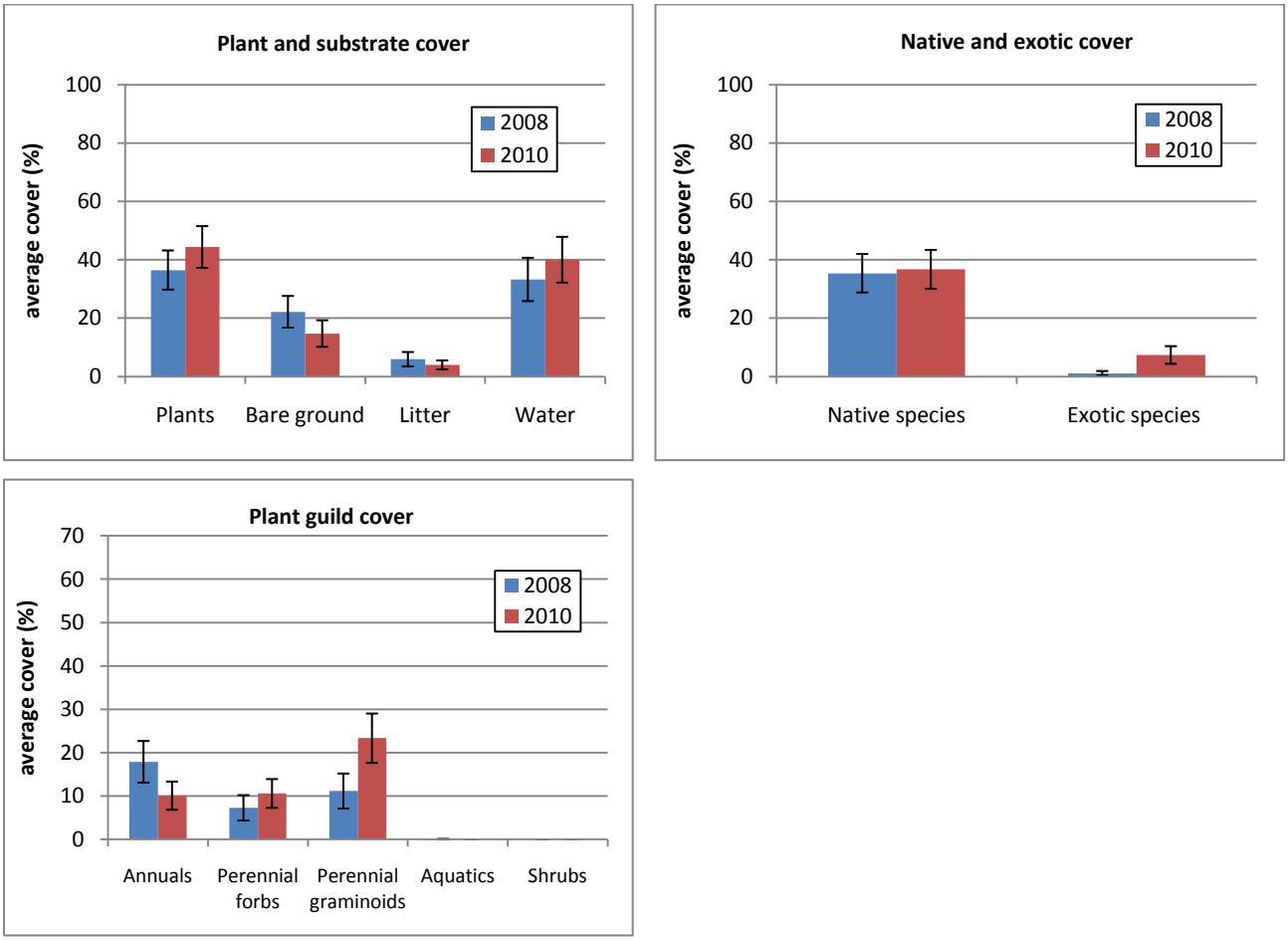


Table 1. Hydrologic zones where vegetation monitoring plots were sampled on Tulana at the Williamson River Delta in 2010.

Hydrologic zone	Elevation range (ft)	Minimum water depth (ft)*	Maximum water depth (ft)*
riparian/wet prairie	4141	0	1.8
emergent wetland	4138-4140	0-0.8	2.8-4.8
deep water wetland-1	4135-4137	1.8	5.8
deep water wetland-2	4133-4134	4.8-5.8	8.8-9.8

* water depths based on the Below Average water year type as stated in the U.S. Fish and Wildlife Service's Biological Opinion on the 10-year operation plan for the Klamath Project (U.S. Fish and Wildlife Service 2002).

Table 2. Average plant and substrate cover in Tulana vegetation monitoring plots at the Williamson River Delta in 2008-2010. Values are means ± SE (n=40).

	Riparian/wet prairie		Emergent wetland	
	2008	2010	2008	2010
total plant cover	99.61 ± 3.82	89.77 ± 3.54	36.47 ± 6.72	44.38 ± 7.15
bare ground	3.8 ± 1.21	6.7 ± 2.26	22.16 ± 5.42	14.7 ± 4.55
litter	4.25 ± 2.27	10.55 ± 2.3	5.93 ± 2.45	3.98 ± 1.54
water	0 ± 0	0 ± 0	33.25 ± 7.43	40 ± 7.84
native species	81.55 ± 5.24	61.02 ± 5.26	35.38 ± 6.61	36.72 ± 6.66
exotic species	15.74 ± 4.01	27.9 ± 5.32	1.08 ± 0.77	7.35 ± 3.03
annuals	57.34 ± 4.99	17.98 ± 3.86	17.91 ± 4.8	10.11 ± 3.25
perennial forbs	20.6 ± 3.08	44.86 ± 5.62	7.31 ± 2.92	10.62 ± 3.32
perennial graminoids	20.32 ± 4.23	25.61 ± 5.54	11.17 ± 4.04	23.35 ± 5.68
aquatics	1.35 ± 0.67	0 ± 0	0.08 ± 0.08	0 ± 0
shrubs	0 ± 0	0.48 ± 0.32	0 ± 0	0 ± 0

Table 3. Average plant species richness (# species/m^2) in Tulana vegetation monitoring plots at the Williamson River Delta in 2008-2010. Values are means ± SE (n=40).

	Riparian/wet prairie		Emergent wetland	
	2008	2010	2008	2010
All species	5.8 ± 0.33	6.9 ± 0.53	2.1 ± 0.35	2.98 ± 0.51
Native	4.35 ± 0.28	4.75 ± 0.44	1.75 ± 0.3	2.4 ± 0.39
Exotic	1.3 ± 0.14	2 ± 0.15	0.25 ± 0.08	0.53 ± 0.1

Table 4. Average plant species cover (average ± SE; n=60) and frequency for riparian/wet prairie monitoring plots in Tulana at the Williamson River Delta Preserve in 2008-2010 (n=40).

Scientific name	Cover 2008 (%)	Cover 2010 (%)	Frequency 2008 (%)	Frequency 2010 (%)
Agrostis exarata	0 ± 0	0.23 ± 0.2	0.00	5.00
Alisma triviale	0.18 ± 0.18	0.55 ± 0.24	2.50	12.50
Alopecurus aequalis	0 ± 0	0.5 ± 0.5	0.00	2.50
Amaranthus albus	0.06 ± 0.05	0 ± 0	5.00	0.00
Argentina anserina	0 ± 0	1.58 ± 1.38	0.00	10.00
Azolla mexicana	1.35 ± 0.67	0 ± 0	35.00	0.00
Bidens cernua	0.16 ± 0.07	1.31 ± 0.56	17.50	27.50
Bidens frondosa	0.15 ± 0.1	0.08 ± 0.06	7.50	5.00
Carex sp.	0.003 ± 0.003	0.03 ± 0.03	2.50	2.50
Chenopodium album	0.09 ± 0.03	0.68 ± 0.29	20.00	25.00
Chenopodium sp.	0 ± 0	0.85 ± 0.42	0.00	12.50
Cirsium arvense	0.44 ± 0.11	3.76 ± 2.04	35.00	37.50
Eleocharis acicularis	0 ± 0	0.58 ± 0.42	0.00	5.00
Eleocharis palustris	0.89 ± 0.75	3.53 ± 2.01	20.00	20.00
Elymus repens	13.6 ± 4.01	13.05 ± 4.74	50.00	32.50
Epilobium ciliatum ssp. watsonii	0.2 ± 0.08	21.21 ± 5.19	30.00	60.00
Equisetum arvense	0 ± 0	0.05 ± 0.05	0.00	2.50
Erysimum cheiranthoides	0 ± 0	0.8 ± 0.45	0.00	15.00
Gnaphalium palustre	2.82 ± 1.74	1.91 ± 0.98	20.00	20.00
Hippuris vulgaris	0.003 ± 0.003	0.05 ± 0.05	2.50	2.50
Hordeum jubatum	0 ± 0	0.48 ± 0.32	0.00	7.50
Lemna minor var. minima	0 ± 0	0.3 ± 0.19	0.00	7.50
Limosella aquatica	0 ± 0	0.003 ± 0.003	0.00	2.50
Muhlenbergia filiformis	0.08 ± 0.08	0 ± 0	2.50	0.00
Panicum capillare	2.17 ± 1.25	1.16 ± 0.58	15.00	30.00
Perennial grass	2.33 ± 1.54	0.003 ± 0.003	15.00	2.50
Phalaris arundinacea	0 ± 0	0.08 ± 0.08	0.00	2.50
Polygonum amphibium	0 ± 0	0.43 ± 0.34	0.00	5.00
Polygonum aviculare	0.09 ± 0.08	1.85 ± 1.75	5.00	7.50
Polygonum lapathifolium	0 ± 0	0.01 ± 0.01	0.00	2.50
Polygonum persicaria	1.51 ± 1.06	0.49 ± 0.2	20.00	17.50
Polypogon monspeliensis	0 ± 0	0.4 ± 0.38	0.00	5.00
Potentilla norvegica	18.5 ± 3.19	4.9 ± 1.55	87.50	70.00
Ranunculus cymbalaria	0 ± 0	2.29 ± 2.25	0.00	7.50
Rorippa curvisiliqua	0.21 ± 0.08	0.42 ± 0.22	32.50	17.50
Rumex crispus	0 ± 0	4.28 ± 0.88	0.00	50.00
Rumex maritimus	49.36 ± 4.87	4.13 ± 1.47	97.50	37.50
Salix geyeriana	0 ± 0	0.05 ± 0.05	0.00	2.50
Salix lucida ssp. lasiandra	0 ± 0	0.43 ± 0.31	0.00	7.50
Schoenoplectus acutus	3.5 ± 2	6.55 ± 3.28	7.50	17.50
Schoenoplectus maritimus	0 ± 0	0.6 ± 0.39	0.00	7.50
Symphyotrichum frondosum	0.64 ± 0.29	2.24 ± 1.02	25.00	22.50
Tripleurospermum maritimum	0 ± 0	2.48 ± 2.04	0.00	5.00
Typha latifolia	0.95 ± 0.46	1.58 ± 1.02	15.00	20.00
Urtica dioica	0.33 ± 0.22	0.55 ± 0.32	10.00	7.50
Verbascum thapsus	0 ± 0	0.05 ± 0.05	0.00	2.50
Veronica anagallis-aquatica	0 ± 0	3.36 ± 1.53	0.00	27.50

Table 5. Average plant species cover (average ± SE; n=60) and frequency for emergent wetland monitoring plots in Tulana at the Williamson River Delta Preserve in 2008-2010 (n=40). *cover not estimated for submerged species

Scientific name	Cover* 2008 (%)	Cover* 2010 (%)	Frequency 2008 (%)	Frequency 2010 (%)
Alisma triviale	0 ± 0	0.13 ± 0.13	0.00	2.50
Alopecurus aequalis	0 ± 0	1.93 ± 1.87	0.00	7.50
Annual forb	0 ± 0	0 ± 0	2.50	0.00
Annual grass	0 ± 0	0 ± 0	0.00	2.50
Azolla mexicana	0.08 ± 0.08	0 ± 0	2.50	0.00
Bidens cernua	0.09 ± 0.05	1.71 ± 1.5	17.50	15.00
Bidens frondosa	0 ± 0	0.05 ± 0.05	0.00	2.50
Ceratophyllum dermersum	-	-	0.00	2.50
Chenopodium album	0.02 ± 0.01	0.32 ± 0.21	5.00	12.50
Chenopodium sp.	0 ± 0	0.3 ± 0.3	0.00	2.50
Cirsium arvense	0 ± 0	0.5 ± 0.5	0.00	2.50
Eleocharis acicularis	0 ± 0	0.85 ± 0.71	2.50	5.00
Eleocharis palustris	0.43 ± 0.27	0.52 ± 0.39	12.50	15.00
Elodea canadensis	0 ± 0	0 ± 0	0.00	2.50
Elymus repens	1.06 ± 0.77	0.43 ± 0.38	12.50	7.50
Epilobium ciliatum ssp. watsonii	0.1 ± 0.1	0.62 ± 0.4	2.50	12.50
Gnaphalium palustre	0.75 ± 0.75	0.2 ± 0.17	5.00	12.50
Gratiola neglecta	0 ± 0	0.01 ± 0.01	0.00	2.50
Hippuris vulgaris	0.03 ± 0.03	4.15 ± 2.89	2.50	7.50
Lemna minor var. minima	0.94 ± 0.46	0.85 ± 0.75	25.00	10.00
Ludwigia palustris	0 ± 0	0.08 ± 0.08	0.00	2.50
Panicum capillare	0.01 ± 0	0.05 ± 0.03	5.00	7.50
Perennial grass	0 ± 0	0 ± 0	2.50	0.00
Phalaris arundinacea	0 ± 0	2.38 ± 2.38	0.00	2.50
Polygonum amphibium	1.98 ± 1.75	0.03 ± 0.03	12.50	2.50
Polygonum aviculare	0 ± 0	1.05 ± 1.05	0.00	2.50
Polygonum lapathifolium	0 ± 0	0.02 ± 0.01	0.00	5.00
Polygonum persicaria	0 ± 0	0.43 ± 0.28	2.50	7.50
Potamogeton crispus	-	-	0.00	2.50
Potentilla norvegica	2.63 ± 1.76	0.64 ± 0.33	20.00	20.00
Ranunculus cymbalaria	0 ± 0	0.03 ± 0.03	0.00	2.50
Rorippa curvisiliqua	0 ± 0	1.45 ± 0.84	0.00	15.00
Rumex crispus	0 ± 0	1.98 ± 1.24	0.00	10.00
Rumex maritimus	17.04 ± 4.73	4.45 ± 1.79	37.50	22.50
Sagittaria cuneata	0 ± 0	0.03 ± 0.03	0.00	2.50
Schoenoplectus acutus	9.68 ± 3.89	17.23 ± 5.26	22.50	25.00
Schoenoplectus maritimus	0 ± 0	0.03 ± 0.03	0.00	2.50
Stuckenia pectinatus	-	-	5.00	5.00
Symphyotrichum frondosum	0 ± 0	0.09 ± 0.08	0.00	5.00
Tripleurospermum maritimum	0.01 ± 0	0.29 ± 0.27	5.00	5.00
Typha latifolia	1.63 ± 1.62	0.5 ± 0.3	5.00	10.00
Urtica dioica	0 ± 0	0.03 ± 0.03	0.00	2.50
Veronica anagallis-aquatica	0 ± 0	1.08 ± 0.65	2.50	12.50

Table 5. Plant species frequency for deep water-1 monitoring plots in Tulana at the Williamson River Delta Preserve in 2008-2010 (n=40).

Scientific name	Frequency 2008 (%)	Frequency 2010 (%)
Ceratophyllum dermersum	0.00	5.00
Najas guadalupensis	0.00	2.50
Potamogeton crispus	0.00	7.50
Stuckenia pectinatus	0.00	5.00

Appendix. Plant species list for Tulana at the Williamson River Delta Preserve in 2008-2010. N=native, I=introduced, U=unknown, P=perennial, A=annual, B=biennial. Wetland status and species nomenclature follow USDA (2010).

Scientific name	Common name	Family	Origin	Duration	Wetland status	Growth habit	Plant guild	Old name
Agrostis exarata	spike bentgrass	Poaceae	N	P	FACW	graminoid	perennial graminoid	
Alisma triviale	American water-plantain	Alistmataceae	N	P	OBL	forb	perennial forb	Alisma plantago-aquatica
Alopecurus aequalis	shortawn foxtail	Poaceae	N	P	OBL	graminoid	perennial graminoid	
Amaranthus albus	prostrate pigweed	Amaranthaceae	N	A	FACU	forb	annual	
Argentina anserina	silverweed cinquefoil	Roseaceae	N	P	OBL	forb	perennial forb	Potentilla anserina
Azolla mexicana	Mexican mosquitofern	Azollaceae	N	P	OBL	forb	aquatic	
Bidens cernua	nodding beggarticks	Asteraceae	N	A	FACW+	forb	annual	
Bidens frondosa	devil beggarticks	Asteraceae	N	A	FACW+	forb	annual	
Carex sp.		Cyperaceae	N	P	FACW	graminoid	perennial graminoid	
Ceratophyllum dermersum	coontail	Ceratophyllaceae	N	P	OBL	forb	aquatic	
Chenopodium album	lambsquarters	Chenopodiaceae	I	A	FAC	forb	annual	
Chenopodium sp.		Chenopodiaceae	U	U		forb	U	
Cirsium arvense	Canada thistle	Asteraceae	I	P	FACU+	forb	perennial forb	
Eleocharis acicularis	needle spike-rush	Cyperaceae	N	A/P	OBL	graminoid	perennial graminoid	
Eleocharis palustris	creeping spike-rush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid	
Elodea canadensis	Canadian waterweed	Hydrocharitaceae	N	P	OBL	forb	aquatic	
Elyums repens	quackgrass	Poaceae	I	P	FACU	graminoid	perennial graminoid	Elytrigia repens
Epilobium ciliatum ssp. watsonii	fringed willowherb	Onagraceae	N	P	FACW-	forb	perennial forb	
Equisetum arvense	common horsetail	Equisetaceae	N	P	FAC	forb	perennial forb	
Erysimum cheiranthoides	wormseed wallflower	Brassicaceae	I	A/B	FACU	forb	annual	
Gnaphalium palustre	western marsh cudweed	Asteraceae	N	A	FAC+	forb	annual	
Hippuris vulgaris	common mare's tail	Hippuridaceae	N	P	OBL	forb	perennial forb	
Hordeum jubatum	foxtail barley	Poaceae	N	P	FAC+	graminoid	perennial graminoid	
Lemna minor var. minima	common duckweed	Lemnaceae	N	P	OBL	forb	perennial forb	
Limosella aquatica	water mudwort	Scrophulariaceae	N	A	OBL	forb	annual	
Ludwigia palustris	marsh seedbox	Onagraceae	N	P	OBL	forb	perennial forb	
Muhlenbergia filiformis	pullup muhly	Poaceae	N	A	FACW	graminoid	annual	
Najas guadalupensis	southern waternymph	Najadaceae	N	A	OBL	forb	aquatic	
Panicum capillare	witchgrass	Poaceae	N	A	FAC	graminoid	annual	
Phalaris arundinacea	reed canary-grass	Poaceae	I	P	FACW	graminoid	perennial graminoid	
Polygonum amphibium	water smartweed	Polygonaceae	N	P	OBL	forb	perennial forb	
Polygonum aviculare	prostrate knotweed	Polygonaceae	I	A/P	FACW-	forb	annual	
Polygonum lapathifolium	curlytop knotweed	Polygonaceae	N	A	FACW+	forb	annual	
Polygonum persicaria	spotted ladysthumb	Polygonaceae	I	A/P	FACW	forb	annual	

Scientific name	Common name	Family	Or-igin	Dur-ation	Wetland status	Growth habit	Plant guild	Old name
Polypogon monspeliensis	annual rabbitsfoot grass	Poaceae	I	A	FACW+	graminoid	annual	
Potamogeton crispus	curly pondweed	Potamogetonaceae	I	P	OBL	forb	aquatic	
Potentilla norvegica	Norwegian cinquefoil	Rosaceae	N	A/B/P	FAC	forb	perennial forb	
Ranunculus cymbalaria	alkali buttercup	Ranunculaceae	N	P	OBL	forb	perennial forb	
Rorippa curvisiliqua	curvepod yellowcress	Brassicaceae	N	A/B	FACW+	forb	annual	
Rumex crispus	curly dock	Polygonaceae	I	P	FACW	forb	perennial forb	
Rumex maritimus	golden dock	Polygonaceae	N	A/B	FACW+	forb	annual	
Sagittaria cuneata	arumleaf arrowhead	Alistmataceae	N	P	OBL	forb	perennial forb	
Salix geyeriana	Geyer's willow	Salicaceae	N	P	FACW+	tree/shrub	shrub/tree	
Salix lucida ssp. lasiandra	Pacific willow	Salicaceae	N	P	FACW+	tree/shrub	shrub/tree	
Schoenoplectus acutus	hardstem bulrush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid	Scirpus acutus
Schoenoplectus maritimus	cosmopolitan bulrush	Cyperaceae	N	P	OBL	graminoid	perennial graminoid	Scirpus maritimus
Stuckenia pectinatus	leafy pondweed	Potamogetonaceae	N	P	OBL	forb	aquatic	Potamogeton pectinatus
Symphyotrichum frondosum	short-rayed alkalai aster	Asteraceae	N	A	FACW+	forb	annual	Aster frondosus
Tripleurospermum maritimum	false mayweed	Asteraceae	I	A/B/P	FACU	forb	annual	Matricaria maritima
Typha latifolia	broadleaf cattail	Typhaceae	N	P	OBL	forb	perennial forb	
Urtica dioica	stinging nettle	Urticaceae	N	P	FAC+	forb	perennial forb	
Verbascum thapsus	mullein	Scrophulariaceae	I	B	UPL	forb	annual	
Veronica anagallis-aquatica	water speedwell	Scrophulariaceae	N	P/B	OBL	forb	perennial forb	