

Williamson River Delta Preserve wetland vegetation monitoring: Goose Bay fifth-year and Tulana sixth-year post-breaching results



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Introduction

The 7,440 acre Williamson River Delta Preserve is located on the mouth of the Williamson River, along Upper Klamath and Agency Lakes, near Chiloquin, Oregon. The area was once dominated by emergent wetlands. Beginning in the 1940s, levee construction and subsequent wetland drainage allowed the area to be used for farming and cattle pasture. Since 1999, The Nature Conservancy has worked to hydrologically reconnect the Delta to adjacent waterbodies and establish native wetland vegetation. Large portions of levee were breached in Tulana in 2007 and Goose Bay in 2008. Flooding in Tulana has resulted in open water and deep water habitat in the western half of the project area, with dense emergent wetlands in the middle of the project area (figure 1). Flooding in Goose Bay has resulted in a mosaic of emergent wetlands, wet prairies and riparian areas throughout the project area, with small areas of deep water habitat. Vegetation transition zones have been driven by water depth and flooding duration, which are a result of Bureau of Reclamation controlled Upper Klamath Lake elevations. Since restoration, in a typical water year, the lake level has been highest in April, with an elevation of approximately 4,143 feet (Bureau of Reclamation vertical datum) and lowest in October, with an elevation of approximately 4,139 feet (Elseroad et al., 2008; USFWS 2002). A vegetation monitoring program was initiated in 2008 to evaluate the response of vegetation to hydrologic restoration. Tulana was monitored in 2008 and 2010 (Elseroad et al., 2011), while Goose Bay was monitored in 2009 (Elseroad et al., 2010). In 2013, both Goose Bay and Tulana were monitored.

One of the fundamental questions pertaining to wetland restoration on lands adjacent to Upper Klamath Lake is how vegetation responds to hydrologic reconnection at different ground surface elevations. Therefore, the Delta monitoring methodology was designed to focus on elevation gradients and associated hydrologic zones. The purpose of monitoring is to assess vegetation changes following alteration of the hydrologic regime within the Preserve.

Methods

Sampling Design

This sampling design pertains to both the Tulana and Goose Bay project areas of the Delta, but excludes the early action projects in Camp Field, Riverbend and South Marsh. Monitoring was stratified by hydrologic zone using ground surface elevation data (table 1 and figure 1). Hydrologic zones were based on elevation ranges where wetland vegetation is expected to establish (Elseroad 2004). The open water zone was excluded from monitoring because vegetation is not expected to establish in areas with maximum water depths greater than 10 feet. Deep water areas were divided into 2 zones to reflect differences in potential species water depth preferences. In previous years vegetation monitoring included the deep water wetland-2 hydrologic zone (elevation range 4,133-4,134 feet, water depth 4.8-9.8 feet). However, no species were observed within that zone. Therefore, the deep water wetland-2 hydrologic zone was removed from current monitoring efforts. A few deep water species may establish within this zone in the future, for example wocus (*Nuphar lutea* ssp. *polysepala*). If it appears that the deep water wetland-2 zone is becoming vegetated, monitoring would be reinstated in that zone. Riparian and wet prairie habitats were combined into one stratum.

Table 1. Hydrologic zones monitored in 2013 at the Williamson River Delta Preserve.

Hydrologic zone	Elevation (ft)*	Minimum water depth (ft)**	Maximum water depth (ft)**	Area of stratification (ac)
riparian/wet prairie	4,141	0	1.8	507
emergent wetland	4,138-4,140	0-0.8	2.8-4.8	1,998
deep water wetland-1	4,135-4,137	1.8-3.8	5.8-7.8	490

* Bureau of Reclamation vertical datum.

**Water depths are based on below average water year lake elevations (USFWS 2002).

Plots are randomly located each year in order to increase the area sampled over time. In 2013, plot locations were generated using the Geospatial Modeling Environment (Beyer 2012). In previous years, 40 plots per hydrologic zone were sampled in Tulana, while in Goose Bay 40 plots were sampled in the riparian/wet prairie zone, 60 plots were sampled in the emergent wetland zone and 20 plots were sampled in the deep water wetland-1 zone. In 2013, the number of plots was

reduced from previous years. Thirty plots each were sampled within the riparian/wet prairie and emergent wetland hydrologic zones, while 27 plots were sampled in the Tulana deep water-1 zone and 14 plots were sampled in the Goose Bay deep water-1 zone.

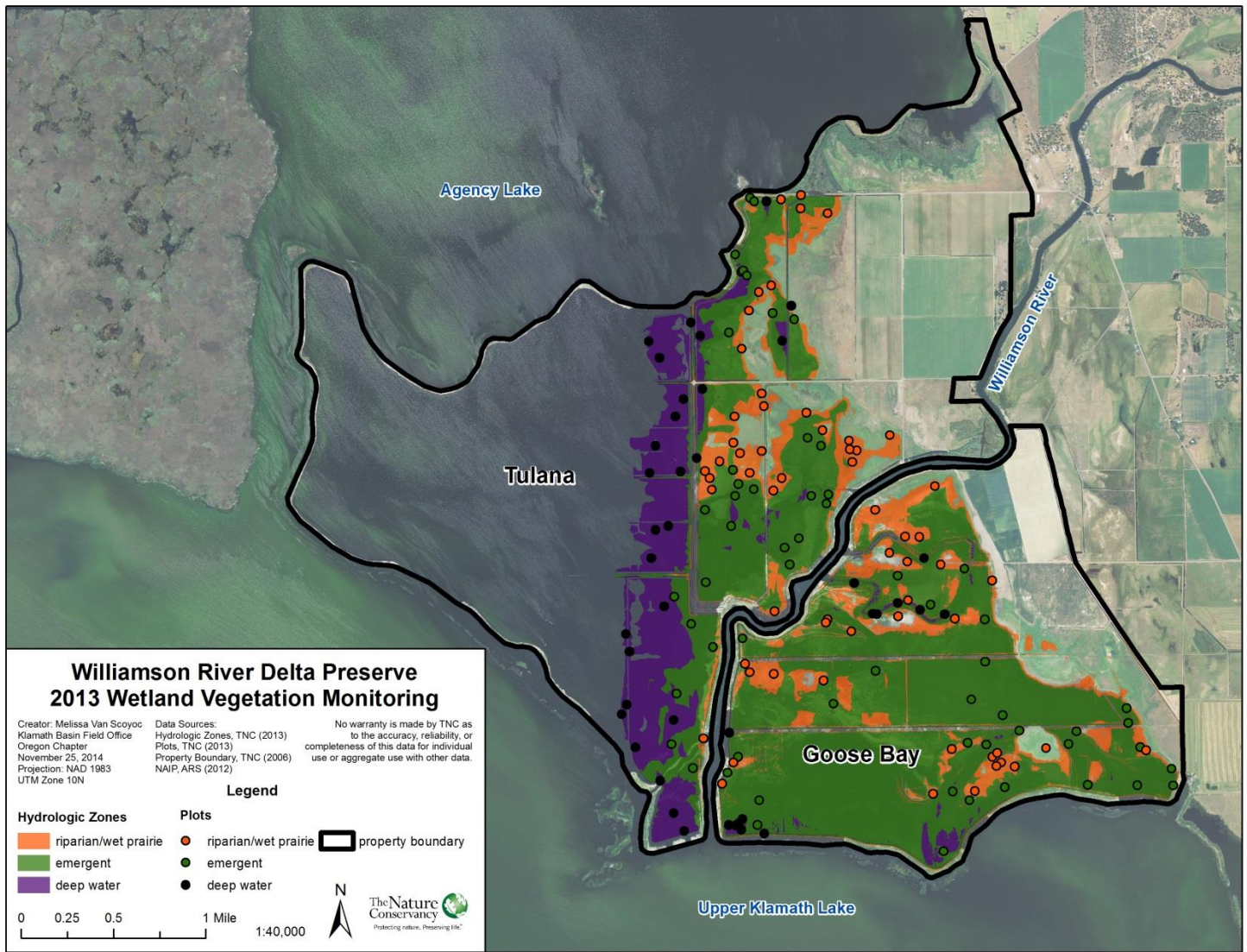


Figure 1. 2013 Williamson River Delta Preserve wetland vegetation monitoring locations.

Data Collection and Analysis

Monitoring was conducted from mid-August through early-October using 1 m² plots. Within the riparian/wet prairie hydrologic zones, percent cover of species and ground surface type (bare ground and litter) were collected. In plots with standing water (i.e., some emergent wetland plots and all deep water wetland plots) submerged species frequency and water depth were also collected. For submerged species, a double-headed garden rake was lowered to the bottom of the waterbody, dragged along the bottom for approximately 1 meter, twisted 180° and then raised vertically out of the water. The presence of each species attached to the rake was recorded. In plots with standing water, daily lake elevation data (USGS 2013) and water depth were used to estimate plot elevations. If the elevation of the plot was more than 12 inches from the intended elevation, the plot was relocated or another backup plot was used.

Calculations for each hydrologic zone included: average percent cover per species and origin type (native or exotic); average overall richness and richness by origin type; average percent bare ground and litter; and frequency and richness of submerged species. Species were considered dominant in riparian/wet prairies if their average cover was greater than 10% and/or they occurred in at least 80% of plots (i.e., 80% frequency). Species were considered dominant in emergent wetlands if their average cover was greater than 5% and/or frequency was greater than 80%. Species were considered

dominant in deep water wetlands if frequency was greater than 50%. Species nomenclature and origin were identified using the PLANTS database (2014; see Appendix A for species list). Trends in vegetation are summarized as relative percent change.

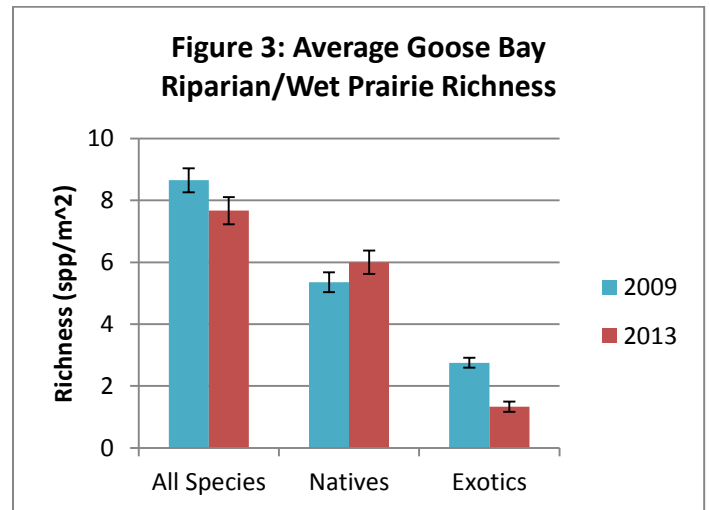
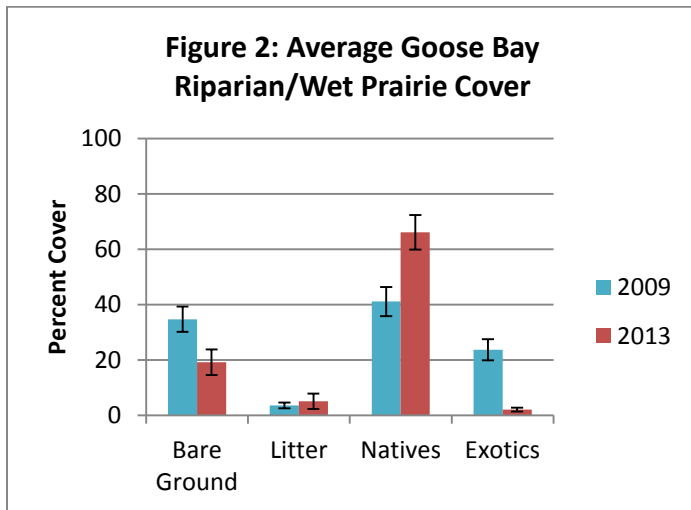
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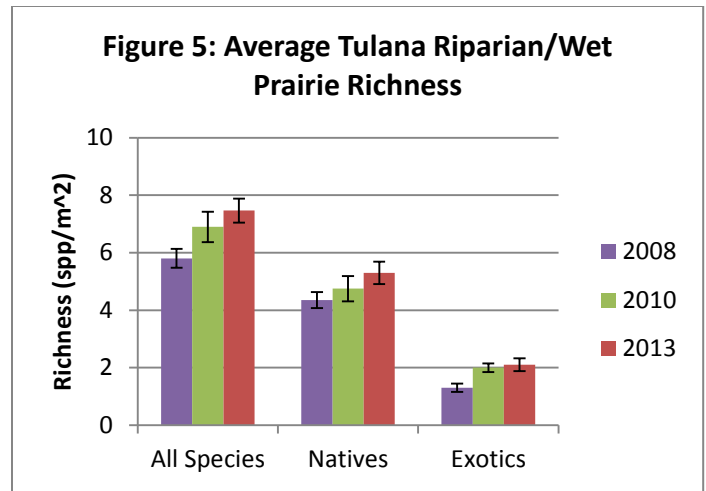
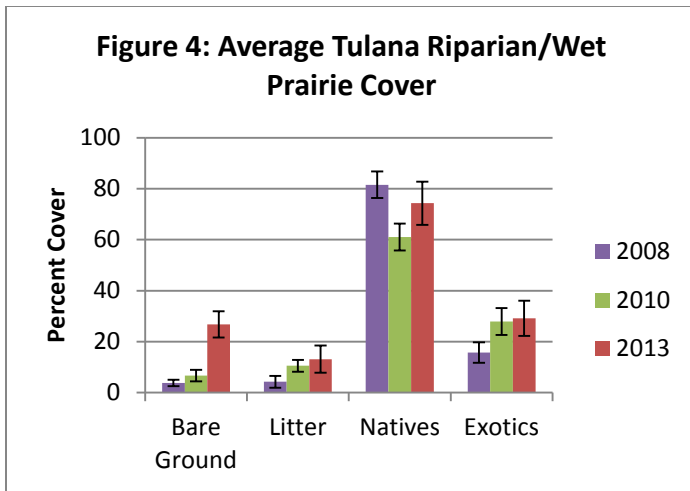
Goose Bay Riparian/Wet Prairies

Goose Bay riparian/wet prairie areas were dominated by native species and their average cover increased by 61% since 2009 (figure 2). Dominant species were needle spike-rush (*Eleocharis acicularis*), shortawn foxtail (*Alopecurus aequalis*) and western marsh cudweed (*Gnaphalium palustre*). Total richness was 48 species, an increase of 17 species since 2009. Average richness was 7.7 spp/m² (± 0.4 spp/m²), which was similar in 2009 (figure 3). Of the exotic species observed, spotted ladythumb (*Polygonum persicaria*) occurred the most; however it only averaged 1% cover ($\pm 0.2\%$). Exotic species average cover declined by 91% since 2009. Bare ground declined by 45% since 2009. Dominant plants were primarily native perennial graminoids, a shift from annual forbs (exotic and native) in 2009.

Tulana Riparian/Wet Prairies

Tulana riparian/wet prairie areas were dominated by native species, increasing by 22% since 2010 (figure 4). Dominant native species were witchgrass (*Panicum capillare*), shortawn foxtail and Norwegian cinquefoil (*Potentilla norvegica*). Total richness was 49 species, an increase of 5 species since 2010. Average richness was 7.5 spp/m² (± 0.4 spp/m²), which was similar in 2010 (figure 5). Golden dock (*Rumex maritimus*), a native annual, initially had high average cover in 2008 (82% average cover, $\pm 5\%$), but has since declined (0.2% average cover, $\pm 0\%$ in 2013) and been replaced with native perennial species. The exotic species curly dock (*Rumex crispus*) was a dominant species in 2013, with 17% average cover ($\pm 2\%$). Bare ground increased from 7% ($\pm 2\%$) average cover in 2010 to 27% ($\pm 5\%$) average cover in 2013. Dominant plants did not have a prevailing plant guild, but were comprised of the native annual graminoid, perennial forb and perennial graminoid guilds, as well as the exotic perennial forb guild. In 2010 dominant plant guilds were the native perennial forb and the exotic perennial graminoid guilds.





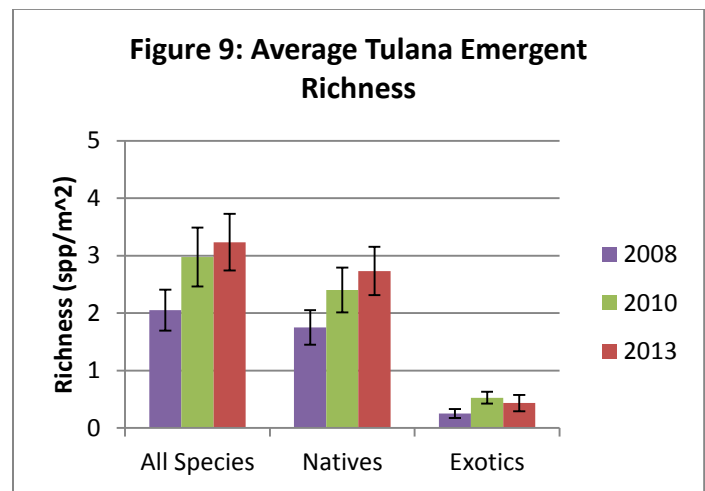
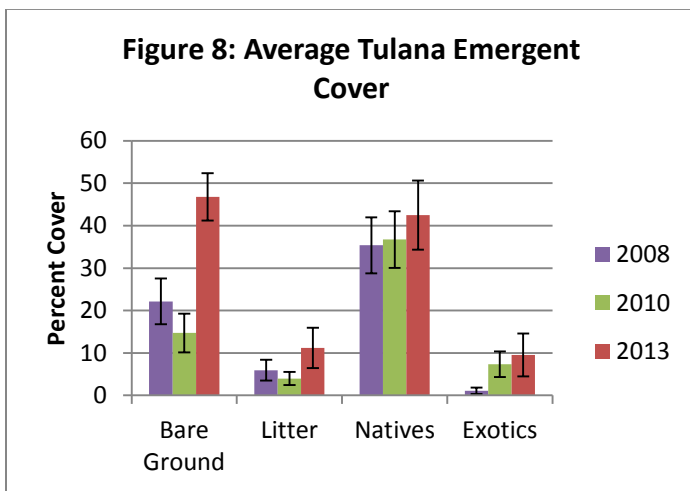
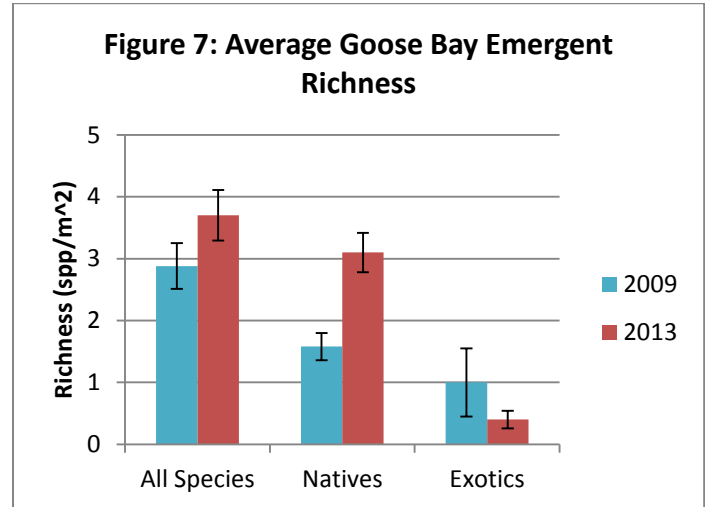
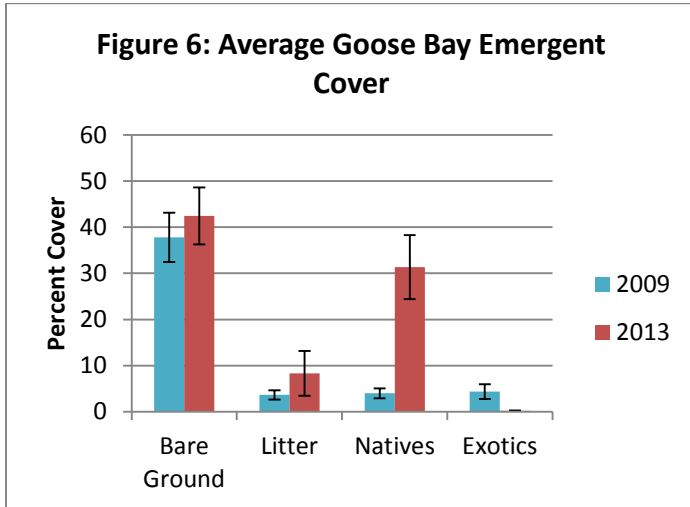
Figures 2-5: Riparian/wet prairie hydrologic zone average (\pm SE) cover and richness for Goose Bay and Tulana.

Goose Bay Emergent Wetlands

Goose Bay emergent wetlands were dominated by native species; 31% average cover (\pm 7%) as compared to 4% average cover (\pm 1%) in 2009 (figure 6). Dominant native species were needle spike-rush and hardstem bulrush (*Schoenoplectus acutus*). Total richness was 37 species, an increase of 4 species since 2009. Average richness was 3.7 spp/m² (0.4 spp/m²), which was similar in 2009 (figure 7). Of the exotic species observed, prostrate knotweed (*Polygonum aviculare*) occurred the most; however it only averaged 0.1% cover (\pm 0%). Sixty percent of all plots had standing water; of those plots, 17 contained native aquatic species. In plots with standing water, needle spike-rush, shortspike watermilfoil (*Myriophyllum sibiricum*) and common duckweed (*Lemna minor*) were common species; all of which are native perennial forbs. In plots with standing water, water depths during sampling averaged 0.83 feet, with a range of 0.07-1.64 feet. Bare ground increased by 12% since 2009. Dominant plants were primarily native perennial graminoids, a shift from the exotic annual forb and exotic perennial graminoid guilds in 2009.

Tulana Emergent Wetlands

Tulana emergent wetlands were dominated by native species; 43% average cover (\pm 8%), which was similar in 2010 (figure 8). Dominant native species were hardstem bulrush and water smartweed (*Polygonum amphibium*). Total richness was 35 species, a decrease of 1 species since 2010. Average richness was 3.2 spp/m² (\pm 0.5 spp/m²), which was similar in 2010 (figure 9). The exotic species spotted ladysthumb was a dominant species, with 7% average cover (\pm 1%). 40% of all plots had standing water, however only 6 plots contained aquatic species; all of which were native. Canadian waterweed (*Elodea Canadensis*) and shortspike watermilfoil were common species in plots with standing water, both are native perennial forbs. In plots with standing water, water depths during sampling averaged 0.89 feet and ranged from 0.05-2.13 feet. Bare ground increased from 15% average cover (\pm 5%) in 2010 to 47% average cover (\pm 6%) in 2013. Dominant plants did not have a prevailing plant guild, but were comprised of the native perennial graminoid and forb guilds, as well as the exotic annual guild. In 2010 the dominant plant guilds were the native perennial forb and native perennial graminoid guilds.



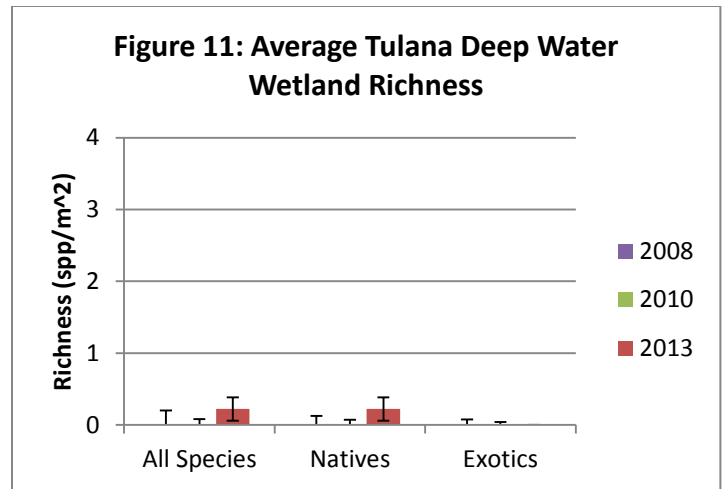
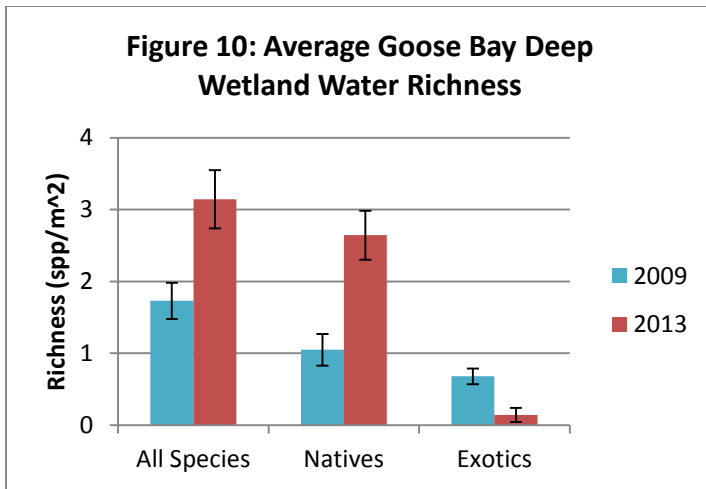
Figures 6-9: Emergent wetland hydrologic zone average (\pm SE) cover and richness for Goose Bay and Tulana.

Goose Bay Deep Water Wetlands

Goose Bay deep water wetlands were dominated by native perennial species, occurring in 93% of the plots. Dominant species were shortspike watermilfoil and coon's tail (*Ceratophyllum demersum*). All plots contained plants, up from 84% of plots in 2009. Total richness was 9 species, just as in 2009. Average richness increased by 1.4 species/m² since 2009 (figure 10). Curly pondweed (*Potamogeton crispus*), the only exotic species, had a frequency of 14%. Water depths during sampling averaged 2.46 feet and ranged from 0.69-4.86 feet. Aquatic perennials (native and exotic) were the only plant guild present.

Tulana Deep Water Wetlands

Tulana deep water wetlands contained only native perennial species. However, only 2 of the 27 plots contained plants in 2013. Total richness was 5 species, an increase of 1 species since 2010. Average richness was 0.2 species/m² (\pm 0.2 spp/m²), which was similar in 2010 (figure 11). None of the species observed were dominant, but included sago pondweed (*Stuckenia pectinata*), coon's tail, shortspike watermilfoil, white water crowfoot (*Ranunculus aquatilis*) and water speedwell (*Veronica anagallis-aquatic*). Curly pondweed, an exotic, was a common species observed in 2010, but was not observed in 2013. Water depths during sampling averaged 3.12 feet and ranged from 0.49-4.76 feet. The aquatic native perennial guild was the only plant guild present.



Figures 10-11: Deep water wetland hydrologic zone average (\pm SE) richness for Goose Bay and Tulana.

Discussion

Succession

Restored wetland habitats within the Williamson River Delta Preserve have naturally revegetated and are dominated by perennial native species, with the exception of Tulana deep water wetland habitats which are generally unvegetated. This shows a shift in succession, as expected (Elseroad et al., 2009 and 2010), from pioneering annual and exotic species to early/mid-seral native species. Though previous monitoring suggested Goose Bay was slower to recolonize as compared to Tulana, richness and vegetative cover are similar to Tulana now.

Richness was similar to previous years, with the exception of Goose Bay riparian/wet prairie areas which had a 55% increase in total richness. Dominant species across the entire Delta included needle spike-rush, shortawn foxtail, hardstem bulrush and shortspike watermilfoil, all perennial native species. In previous years, needle spike-rush and hardstem bulrush were also common natives, along with broadleaf cattail (*Typha latifolia*), northern water plantain (*Alisma triviale*), Salix species and water smartweed. Two native species were observed for the first time during monitoring efforts. Teal lovegrass (*Eragrostis hypnoides*), an annual graminoid, was observed in both Goose Bay and Tulana riparian/wet prairie habitat as well as Tulana emergent habitat. Pacific waterclover (*Marsilea oligospora*), a rare perennial forb, was observed in Goose Bay riparian/wet prairie habitat. Twelve species observed in previous monitoring efforts were not observed in 2013 (see Appendix B for species list). In Goose Bay riparian/wet prairie areas vegetative cover increased greatly. However, in all other areas of the Delta bare ground increased, ranging from 27-47%. The increase in bare ground is likely due to the inherent variability within the sampling design. Anecdotally, it appeared that an inordinate number of plots were located in areas of recent drawdown. Such areas would have a high percentage of bare ground because vegetation had not recovered from inundation yet. In Goose Bay, native perennial graminoids were the dominant plant guild, a shift from annual and exotic species, while in Tulana, dominant plant guilds were various.

In Tulana the number of deep water wetland plots was reduced because the majority of the plots were unvegetated. In Goose Bay, the number of plots was reduced because the areas of deep water wetlands have become limited. Goose Bay aquatic habitats were all populated with native perennial aquatic species. These results reflect previous monitoring efforts, which were thought to have resulted from Tulana water depths being largely deeper than Goose Bay habitats. However, in 2013 monitoring efforts, Goose Bay and Tulana average water depths and ranges during sampling were relatively similar. The difference in revegetation is likely because Tulana deep water habitats are much more exposed to wave action as compared to Goose Bay and therefore the environment is may be too harsh for plants to establish. Along with this, prevailing winds push Williamson River water through Goose Bay, resulting in better clarity and less algae as compared to Tulana. The resulting improved water quality in Goose Bay is more conducive for vegetation establishment.

Exotic Species

Though exotic species occur throughout Delta wetlands, they are not the primary species revegetating restored areas. Curly dock continues to be a dominant species within Tulana riparian/wet prairie areas. It is known to have occurred throughout the Delta prior to restoration and has formed dense patches in some areas. It is a deep-rooted species with high

seed production and is an early colonizer of disturbed wet soils (Halvorson and Guertin 2003). However, anecdotal observations and photopoint monitoring suggest that it is declining and being replaced with native perennial species (figures 12 and 13). The exotic annual species common in previous years were false mayweed and wormseed wallflower (*Erysimum cheiranthoides*), which are not invasive species and have decreased over the years as expected (Elseroad et al., 2010), giving way to perennial native species. Three other non-native annual species, annual rabbitsfoot grass (*Polypogon monspeliensis*), shepherd's purse (*Capsella bursa-pastoris*) and tall tumblemustard (*Sisymbrium altissimum*) were observed in previous monitoring efforts, but not in 2013. Of those three species, tall tumblemustard has formed dense patches in higher elevation zones in the Delta. Because tall tumblemustard prefers higher elevation habitat it is unlikely that it would become a dominant species in wetland habitat. Quackgrass was a common species in Tulana riparian/wet prairie areas in past years, but has declined to 3% average cover ($\pm 0.5\%$) in 2013. Curly pondweed has declined greatly, but still occurs in aquatic habitats; it is not a dominant species and is not considered noxious in Oregon. Black medick (*Medicago lupulina*) was observed for the first time during monitoring efforts in Tulana riparian/wet prairie habitat; however it is not expected to become a dominant species. Reed canary-grass (*Phalaris arundinacea*) and Canada thistle (*Cirsium arvense*), the exotic species of greatest concern in the Delta, were observed, but rarely; one occurrence per species in Tulana and Goose Bay respectively. These species prefer slightly higher elevation zones in the Delta, and are dominant species in those locations.



Figure 12: Curly dock patches in September 2009 (© TNC).

Figure 13: Curly dock being replaced with native wetland species by October 2011 (© TNC).

Management Recommendations

Continue scheduled monitoring frequency.

Vegetation monitoring plots in Goose Bay and Tulana are scheduled to be re-sampled in 2016. Sampling once every 3 years should provide an appropriate time-frame for further successional changes to be detected. In Goose Bay many areas previously identified as deep water wetland zones have sedimented in and are now considered emergent wetland habitat. In Tulana the majority of the deep water areas are unvegetated. Therefore, the number of deep water wetland-1 hydrologic zone plots should be further reduced or eliminated. If it appears the deep water wetland-1 and -2 hydrologic zones are becoming vegetated, monitoring of such areas should be reinstated.

Survey for noxious weed species.

Noxious weed surveys should be conducted annually throughout wetland habitats. Reed canarygrass and Canada thistle are known to occur in the upper elevations of riparian habitats. Annual monitoring and treatment of noxious weed species is essential to supporting native wetland vegetation establishment.

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Appendix A: 2013 species list for Goose Bay and Tulana.

Species nomenclature, origin and wetland status were identified using the PLANTS database (2014).

Origin: N = native, I = Introduced, U=Unknown

Wetland Status for the Arid West Region: OBL (obligate) = almost always occurring in wetlands, FACW (facultative wetland) = usually occurring in wetlands, FAC (facultative) = occurring in wetlands and uplands, FACU (facultative upland) = usually occurring in uplands, UPL (obligate upland) = almost always occurring in uplands.

Scientific Name	Common Name	Family	Origin	Guild	Wetland Status	Synonym
<i>Alisma triviale</i>	northern water plantain	Alistmataceae	N	perennial forb	OBL	<i>Alisma plantago-aquatica</i>
<i>Alopecurus aequalis</i>	shortawn foxtail	Poaceae	N	perennial graminoid	OBL	
<i>Alopecurus pratensis</i>	meadow foxtail	Poaceae	I	perennial graminoid	FACW	
<i>Amaranthus powellii</i>	Powell's amaranth	Amaranthaceae	N	perennial forb	UPL	
<i>Argentina anserina</i>	silverweed cinquefoil	Roseaceae	N	perennial forb	OBL	<i>Potentilla anserina</i>
<i>Artemisia biennis</i>	biennial wormwood	Asteraceae	N	annual forb	FACW	
<i>Bidens cernua</i>	nodding beggarticks	Asteraceae	N	annual forb	OBL	
<i>Bidens frondosa</i>	devil's beggarticks	Asteraceae	N	annual forb	FACW	
<i>Ceratophyllum demersum</i>	coon's tail	Ceratophyllaceae	N	annual forb	OBL	
<i>Chamaesyce serpyllifolia</i>	thymeleaf sandmat	Euphorbiaceae	N	annual forb	FACW	<i>Euphorbia serpyllifolia</i>
<i>Chenopodium album</i>	lambsquarters	Chenopodiaceae	I	annual forb	FACU	
<i>Cirsium arvense</i>	Canada thistle	Asteraceae	I	perennial forb	FACU	
<i>Cyperus squarrosus</i>	bearded flatsedge	Cyperaceae	N	annual forb	OBL	<i>Cyperus aristatus</i>
<i>Echinochloa crus-galli</i>	barnyard grass	Poaceae	I	annual graminoid	FACW	
<i>Elatine</i> sp.	waterwort	Elatinaceae	U	annual forb	OBL	
<i>Eleocharis acicularis</i>	needle spike-rush	Cyperaceae	N	perennial graminoid	OBL	
<i>Eleocharis palustris</i>	common spikerush	Cyperaceae	N	perennial graminoid	OBL	creeping spikerush
<i>Elodea bifoliata</i>	twoleaf waterweed	Hydrocharitaceae	N	aquatic forb	OBL	
<i>Elodea canadensis</i>	Canadian waterweed	Hydrocharitaceae	N	aquatic forb	OBL	
<i>Elymus repens</i>	quackgrass	Poaceae	I	perennial graminoid	FAC	<i>Elytrigia repens</i>
<i>Epilobium ciliatum</i> ssp. <i>watsonii</i>	fringed willowherb	Onagraceae	N	perennial forb	FACW	
<i>Eragrostis hypnoides</i>	teal lovegrass	Poaceae	N	annual graminoid	OBL	
<i>Erysimum cheiranthoides</i>	wormseed wallflower	Brassicaceae	I	annual forb	FACU	

Scientific Name	Common Name	Family	Origin	Guild	Wetland Status	Synonym
<i>Gnaphalium palustre</i>	western marsh cudweed	Asteraceae	N	annual forb	FACW	
<i>Gratiola neglecta</i>	clammy hedgehyssop	Scrophulariaceae	N	annual forb	OBL	
<i>Hippuris vulgaris</i>	common mare's-tail	Hippuridaceae	N	perennial forb	OBL	
<i>Hordeum jubatum</i>	foxtail barley	Poaceae	N	perennial graminoid	FAC	
<i>Lactuca serriola</i>	prickly lettuce	Asteraceae	I	annual forb	FACU	
<i>Lemna minor</i>	common duckweed	Lemnaceae	N	aquatic forb	OBL	
<i>Limosella aquatica</i>	water mudwort	Scrophulariaceae	N	annual forb	OBL	
<i>Malva neglecta</i>	common mallow	Malvaceae	I	annual forb	UPL	
<i>Marsilea oligospora</i>	Pacific waterclover	Marsileaceae	N	perennial forb	OBL	
<i>Matricaria discoidea</i>	disc mayweed	Asteraceae	I	annual forb	FACU	Chamomilla suaveolens
<i>Medicago lupulina</i>	black medick	Fabaceae	I	annual	FAC	
<i>Medicago sativa</i>	alfalfa	Fabaceae	I	perennial forb	UPL	
<i>Mentha arvensis</i>	wild mint	Lamiaceae	N	perennial forb	FACW	
<i>Muhlenbergia filiformis</i>	pullup muhly	Poaceae	N	annual graminoid	FACW	
<i>Myriophyllum sibiricum</i>	shortspike watermilfoil	Haloragaceae	N	aquatic forb	OBL	
<i>Nemophila</i> sp.	nemophila	Hydrophyllaceae	U	forb	NA	
<i>Panicum capillare</i>	witchgrass	Poaceae	N	annual graminoid	FACU	
<i>Phalaris arundinacea</i>	reed canary-grass	Poaceae	I	perennial graminoid	FACW	
<i>Phragmites australis</i> ssp. <i>americanus</i>	common reed	Poaceae	N	perennial graminoid	FACW	
<i>Plagiobothrys scouleri</i>	Scouler's popcornflower	Plantaginaceae	N	perennial forb	FAC	
<i>Plantago major</i>	common plantain	Boraginaceae	N	annual forb	FACW	
<i>Polygonum amphibium</i>	water smartweed	Polygonaceae	N	perennial forb	OBL	
<i>Polygonum aviculare</i>	prostrate knotweed	Polygonaceae	I	annual forb	FACW	
<i>Polygonum persicaria</i>	spotted ladythumb	Polygonaceae	I	annual forb	FACW	
<i>Potamogeton crispus</i>	curly pondweed	Potamogetonaceae	I	aquatic forb	OBL	
<i>Potamogeton epihydrus</i>	ribbonleaf pondweed	Potamogetonaceae	N	aquatic forb	OBL	
<i>Potamogeton natans</i>	floating pondweed	Potamogetonaceae	N	aquatic forb	OBL	
<i>Potamogeton praelongus</i>	whitestem pondweed	Potamogetonaceae	N	aquatic forb	OBL	
<i>Potentilla norvegica</i>	Norwegian cinquefoil	Rosaceae	N	perennial forb	FAC	
<i>Ranunculus cymbalaria</i>	alkali buttercup	Ranunculaceae	N	perennial forb	OBL	

Scientific Name	Common Name	Family	Origin	Guild	Wetland Status	Synonym
<i>Ranunculus aquatilis</i>	white water crowfoot	Ranunculaceae	N	aquatic forb	OBL	
<i>Rorippa curvisiliqua</i>	curvepod yellowcress	Brassicaceae	N	annual forb	OBL	
<i>Rorippa sphaerocarpa</i>	roundfruit yellowcress	Brassicaceae	N	annual forb	FACW	
<i>Rumex crispus</i>	curly dock	Polygonaceae	I	perennial forb	FAC	
<i>Rumex maritimus</i>	golden dock	Polygonaceae	N	annual forb	FACW	
<i>Sagittaria cuneata</i>	arumleaf arrowhead	Alistmataceae	N	perennial forb	OBL	
<i>Salix exigua</i>	narrowleaf willow	Salicaceae	N	shrub/tree	FACW	
<i>Salix lucida</i> ssp. <i>lasiandra</i>	Pacific willow	Salicaceae	N	shrub/tree	FACW	
<i>Schoenoplectus acutus</i>	hardstem bulrush	Cyperaceae	N	perennial graminoid	OBL	<i>Scirpus acutus</i>
<i>Solanum dulcamara</i>	climbing nightshade	Solonaceae	I	perennial forb	FAC	
<i>Sparganium eurycarpum</i>	giant bur-reed	Sparganiaceae	N	perennial forb	OBL	
<i>Stuckenia pectinata</i>	sago pondweed	Potamogetonaceae	N	aquatic forb	OBL	<i>Potamogeton pectinatus</i> ; leafy pondweed
<i>Symphotrichum frondosum</i>	short-rayed alkalai aster	Asteraceae	N	annual forb	FACW	<i>Aster frondosus</i>
<i>Thlaspi arvense</i>	field pennycress	Brassicaceae	I	annual forb	UPL	
<i>Tripleurospermum maritimum</i>	false mayweed	Asteraceae	I	annual forb	FACU	<i>Matricaria maritima</i>
<i>Typha latifolia</i>	broadleaf cattail	Typhaceae	N	perennial forb	OBL	
<i>Urtica dioica</i>	stinging nettle	Urticaceae	N	perennial forb	FAC	
<i>Verbascum thapsus</i>	common mullein	Scrophulariaceae	I	annual forb	FACU	
<i>Veronica anagallis-aquatic</i>	water speedwell	Scrophulariaceae	N	perennial forb	OBL	

Appendix B: Species observed in previous monitoring efforts, but not observed in 2013.

Species nomenclature, origin and wetland status were identified using the PLANTS database (2014).

Origin: N = native, I = Introduced, U=Unknown

Wetland Status for the Arid West Region: OBL (obligate) = almost always occurring in wetlands, FACW (facultative wetland) = usually occurring in wetlands, FAC (facultative) = occurring in wetlands and uplands, FACU (facultative upland) = usually occurring in uplands, UPL (obligate upland) = almost always occurring in uplands.

Scientific Name	Common Name	Family	Origin	Guild	Wetland Status	Synonym
<i>Agrostis exarata</i>	spike bentgrass	Poaceae	N	perennial graminoid	FACW	
<i>Amaranthus albus</i>	prostrate pigweed	Amaranthaceae	N	annual	FACU	
<i>Azolla mexicana</i>	Mexican Mosquito Fern	Azollaceae	N	aquatic	OBL	
<i>Capsella bursa-pastoris</i>	shepherd's purse	Brassicaceae	I	annual	FACU	
<i>Equisetum arvense</i>	field horsetail	Equisetaceae	N	perennial forb	FAC	common horsetail
<i>Ludwigia palustris</i>	marsh seedbox	Onagraceae	N	perennial forb	OBL	
<i>Najas guadalupensis</i>	southern waternymph	Najadaceae	N	aquatic	OBL	
<i>Polygonum lapathifolium</i>	curlytop knotweed	Polygonaceae	N	annual	FACW	
<i>Polypogon monspeliensis</i>	annual rabbitsfoot grass	Poaceae	I	annual	FACW	
<i>Salix geyeriana</i>	Geyer willow	Salicaceae	N	shrub/tree	OBL	
<i>Schoenoplectus maritimus</i>	cosmopolitan bulrush	Cyperaceae	N	perennial graminoid	OBL	<i>Scirpus maritimus</i>
<i>Sisymbrium altissimum</i>	tall tumbled mustard	Brassicaceae	I	annual	FACU	