OREGON DEPARTMENT OF AGRICULTURE

NATIVE PLANT CONSERVATION PROGRAM

Monitoring introduced populations of *Thelypodium howellii* ssp. *spectabilis* (Howell's spectacular thelypody) at Baldock Slough

2009 Report

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for U.S. Fish and Wildlife Service
(Section 6 Agreement # OR-EP-2, Segment 19 and Supplemental Agreement 1018-06-M588)

February 28, 2010

ACKNOWLEDGMENTS

We would like to acknowledge the U.S. Fish and Wildlife Service and Natural Resources Conservation Service for providing funding and logistical support for this project.

DOCUMENT CITATION

Currin, R., M. Groberg and R. Meinke. 2010. Creating new populations of *Thelypodium howellii* ssp. *spectabilis* (Howell's spectacular thelypody) at Baldock Slough 2009 Report. Report prepared for U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. Oregon Department of Agriculture, Salem, Oregon.

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INTRODUCTION

Howell's spectacular thelypody (*Thelypodium howellii* ssp. *spectabilis*; Figure 1) is a rare biennial in the mustard family (Brassicaceae). The U.S. Fish and Wildlife Service (USFWS) lists this species as threatened, and it is listed as endangered by the State of Oregon. *Thelypodium howellii* ssp. *spectabilis* favors the ephemerally moist alkaline soils of native grassland remnants in Baker and Union counties in northeastern Oregon (Figure 2).

Figure 1. Flowering *Thelypodium howellii* ssp. *spectabilis* plants and closeup of flowers (inset). Photos by M. Carr.

Currently there are only 11 known populations of this species remaining. As with many rare plant species, habitat loss and fragmentation due to agricultural and urban development is the primary threat to *T. howellii* ssp. *spectabilis*. Invasive weed competition, livestock grazing, and hydrological alteration of the habitat in which it occurs have also played a role in the

decline of this species. Recovery of the species is likely contingent upon augmentation and management of existing thelypody sites combined with the introduction of new populations into suitable, secure locations (U.S. Fish and Wildlife Service 2002).

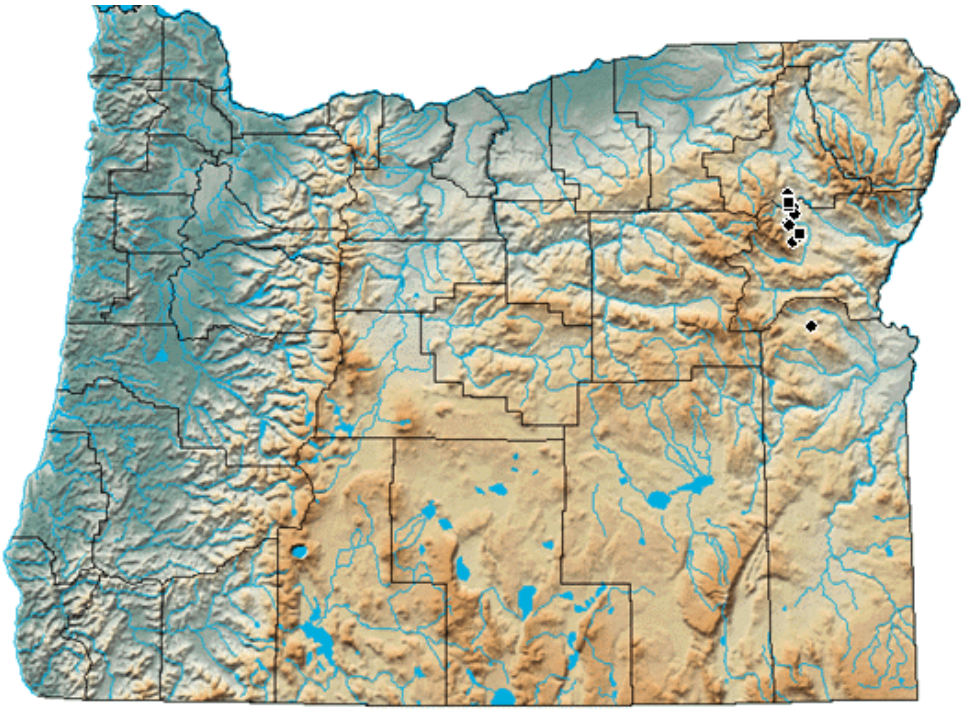

Figure 2. Map of *Thelypodium howellii* ssp. *spectabilis* populations. Map courtesy of the Oregon Flora Project.

Past conservation work by the Oregon Department of Agriculture (ODA) addressed several of the recovery tasks detailed for Howell's spectacular thelypody by USFWS. In 2001 and 2002, the first known introductions of Howell's spectacular thelypody seeds and cultivated plugs into new and existing thelypody sites were completed through joint efforts by ODA, USFWS, and the Natural Resources Conservation Service (NRCS). These sites were monitored annually from 2002-2009 (with the exception of 2005); the early findings indicate promise for both the outplanting and direct seeding introduction methods. In 2002 and 2003, grow-out and seed increase programs were initiated by ODA in Corvallis, Oregon and by two plant nurseries in Connell, Washington and Boise, Idaho. However, these attempts to field sow the species outside its natural range were unsuccessful. In 2003, photoplots and vegetation monitoring transects were installed at the Haines Rodeo thelypody mitigation site

as a means to evaluate changes in the plant community over time and identify potential non-native plant species invasions, promoting pro-active control of invasive weeds in thelypody habitat.

Building on these past thelypody recovery efforts, ODA entered into a cooperative agreement with USFWS to introduce Howell's spectacular thelypody into additional sites at Baldock Slough, monitor those new sites, and continue to monitor the original introduction sites as well. This report summarizes the 2009 monitoring results. For a detailed description of seed collection, seed germination, and seedling cultivation methodology, please refer to *Creating new populations of* Thelypodium howellii *ssp.* spectabilis *(Howell's spectacular thelypody): Baldock Slough introductions* (Currin et al. 2008).

METHODS

Site selection

Botanists from ODA, NRCS, and Baldock Slough management surveyed potential thelypody habitat at the Slough. Four new sites were selected for the 2007 introductions in areas where the group thought the thelypody transplants would be most likely to survive and reproduce (Appedix 1). The first two new sites (Areas 4 and 5) were located in areas that had been recently restored by clearing non-native species and reseeding the area with native grasses (Figure 3). The second two sites (Areas 6 and 7) were located in relatively undisturbed greasewood/saltgrass habitat at the northern edge of the property (Figure 3).

Figure 3. Habitat at each of the four 2007 *Thelypodium howellii* ssp. *spectabilis* experimental introduction sites at Baldock Slough.

Experimental outplanting: transplants

In April 2002, the first three experimental populations of *Thelypodium howellii* ssp. *spectabilis* were established at Baldock Slough. (For a detailed description of these initial Baldock Slough introductions, see Gisler 2002). In 2007, four additional subpopulations of *Thelypodium howellii* ssp. *spectabilis* were established at Baldock Slough. A total of 740 seedlings were transported by truck in a plywood frame and outplanted on April 23-24. Seed plots were also installed on those dates, with a total of 29,500 seeds directly sown at the site. Table 1 gives a summary of the thelypody introductions to date at the Baldock Slough site. For a map of experimental population locations, see Appendix 1.

Table 1. Summary of *Thelypodium howellii* ssp. *spectabilis* introductions at Baldock Slough.

Area	Date introduced	# Seedlings planted	# Seeds directly sown
1	4/23/02	160	6,000
2	4/23/02	160	6,000
3	4/23/02	200	6,000
Total 2002		**520**	**18,000**
4	4/23/07	184	7,000
5	4/23/07	172	7,500
6	4/23/07	200	8,000
7	4/23/07	184	7,000
Total 2007		**740**	**29,500**

Following the 2002 protocol, transplants introduced in 2007 were installed in one-meter^2 plots, with eight transplants in each plot. Seedlings were placed around a center 2-foot wooden stake marked with the plot number (Figure 4). At the time of transplanting, the root systems of the potted seedlings had reached the edges of the potting soil (Figure 5). Transplants were watered in using water either pumped or transported in buckets from nearby sources (Figures 6 and 7).

Figure 4. ODA botanist Brian Basor outplanting *Thelypodium howellii* ssp. *spectabilis* seedlings at Baldock Slough. Eight seedlings were installed around a center stake at each plot. Photo by R. Thomas.

Figure 5. Root system of *Thelypodium howellii* ssp. *spectabilis* transplant at the time of outplanting. Photo by B. Basor.

Figure 6. ODA botanist Brian Basor checking equipment. Water was pumped from a nearby pond and used to water in the newly transplanted *Thelypodium howellii* ssp. *spectabilis* seedlings. Photo by R. Thomas.

Figure 7. ODA botanist Rhiannon Thomas waters new *Thelypodium howellii* ssp. *spectabilis* transplants. Photo by B. Basor.

Experimental outplanting: seed plots

Seed plots were also installed at each of the four new experimental populations in 2007. A total of 30 one-meter^2 plots were installed: seven plots each in Areas 4 and 7, and eight plots each in Areas 5 and 6. Each seed plot was designated with a 2-foot wooden stake placed in the center of the plot. Each stake was marked with the plot number preceded by an "S" to indicate that the plot contained seeds, rather than transplants. Aside from the installation of the plot marker, no pre-sowing plot preparation occurred. ODA botanists scattered approximately 1,000 seeds within each plot (Figure 8). Due to a misplaced seed envelope, one plot in Area 5 received only 500 seeds.

Figure 8. One thousand *Thelypodium howellii* ssp. *spectabilis* seeds were scattered within each of the newly installed seed plots at Baldock Slough. Photo by B. Basor.

Experimental population monitoring (Areas 1-3)

Monitoring of the experimental thelypody populations at Baldock Slough was conducted annually from 2002–2009 (with the exception of 2005). During the first year of monitoring, data on both plug and seed plots were collected several times throughout the growing season, and transplant survival and the presence of seedlings in the seed plots were recorded. Second-year monitoring of these plots was completed June 19, 2003, during which time the numbers of surviving flowering plants in each of the seed and transplant plots were counted.

By 2004, all of the original transplanted plugs of this biennial species had senesced. Third-year monitoring was completed June 15, 2004 to assess seedling recruitment from introduced plants. All of the seeding and transplant plots were relocated and the number of seedlings associated with each plot was estimated. In the seeding plots, seedlings were looked for both within and in the immediate vicinity of the plots. At the transplant stakes, a one-meter-squared frame was centered on the stake, and a count of the number of seedlings within the frame was estimated. There was some difficulty encountered when trying to correctly identify and count the numerous and densely distributed seedlings. Most of the seedlings

were very small (1 cm tall) and other species' similar-looking seedlings were also present (Figure 9). Because of this, all plots were assigned one of the following classifications: actual count (for plots with <20 seedlings), <50 seedlings present, 51-100 seedlings present, and >100 seedlings present.

Figure 9. *Thelypodium howellii* ssp. *spectabilis* seedlings at Baldock Slough observed in June 2004. Photo by M. Carr.

By 2006, the boundaries of the introduced thelypody populations had expanded far beyond the original plots. Due to the large area of the population and the difficulty in locating and correctly identifying thelypody seedlings, only reproductive individuals were counted during the 2006-2009 monitoring visits (visits were made on June 20, June 21, June 19, and June 16 respectively). In all four years, flowering individuals located in Areas 1-3 (those recruited from plants or seeds originally outplanted in 2002) were flagged and counted (Figures 10 and 11). When possible, the plots with which the thelypody recruits were most likely associated were recorded. However, by 2008 most of the plot stakes were either missing or unreadable, and no such associations were possible. Therefore, in 2008 and 2009 no attempt was made to associate individual plants with the original plots.

Figure 10. Oregon Department of Agriculture botanist Bob Meinke searches for *Thelypodium howellii* ssp. *spectabilis* plants at Baldock Slough. Photo by R. Currin.

Figure 11. Reproductive Howell's spectacular thelypody plants at Baldock Slough. Each flag represents one flowering individual. Photo by R. Currin.

Experimental population monitoring (Areas 4-7)

Newly established transplant plots in Areas 4-7 were relocated and searched for surviving thelypody plants in the 2007-2009 monitoring trips (Figures 12 and 13). Observers recorded the presence or absence of all original transplants, as well as the reproductive status of survivors. Any thelypody plants found in the immediate vicinity of the seed plots were also recorded during the first two years.

By 2009, all of the original transplanted plugs planted in 2007 had senesced. Third-year monitoring in Areas 4-7 was completed June 16, 2009 to assess seedling recruitment from introduced plants. As has been previously noted, correctly identifying and counting numerous and densely distributed seedlings was challenging. Both seeding and transplant plots were relocated and the number of seedlings associated with each plot was estimated, using the same method used when monitoring Areas 1-3 in 2004 (see Experimental population monitoring [Areas 1-3] section above).

Figure 12. Relocated *Thelypodium howellii* ssp. *spectabilis* seed plot in one of the newly outplanted areas at Baldock Slough. Photo by R. Currin.

Figure 13. *Thelypodium howellii* ssp. *spectabilis* recruit in one of the newly outplanted areas at Baldock Slough. Photo by R. Currin.

RESULTS

Experimental population monitoring (Areas 1-3)

Table 2 summarizes the numbers of plants observed within Areas 1-3 over the last seven years. In 2002 (the year that these populations were installed), a total of 88 plants were present in July. It was assumed that many of the original transplants had died back by the time monitoring occurred, since in 2003 the number of plants present had increased to 253. The plant counts in 2003 included flowering plants, rosettes (transplanted plugs that did not reproduce during the second growing season), and seedlings (located exclusively within the seed plots). In 2004, the large number of plants reported (2,055-3,500) reflected the high levels of seedling recruitment observed that year. A total of 1,028 plants were present in 2006. This number declined over the next two years, with 637 plants observed in 2007 and

415 plants observed in 2008, but increased in 2009 to 543. Only flowering plants were counted in 2006-2009 (Figure 14).

Table 2. Number of *Thelypodium howellii* ssp. *spectabilis* individuals present in Areas 1-3 at Baldock Slough from 2002-2009 (plants/seeds originally introduced in April of 2002).

Area	# plugs installed/ seeds directly sown in 2002	Monitoring date						
		7/8/02 (all plants)	6/19/03 (all plants)	6/15/04 (estimated # seedlings only*)	6/20/06	6/21/07	6/19/08	6/16/ 09
1	160/ 6,000	13	58	530-1,000	299	116	50	?**
2	160/ 6,000	18	71	375-600	84	273	55	335
3	200/ 6,000	57	124	1,150-1,900	645	248	310	208
Total	520/ 18,000	88	253	2,055-3,500	1,028	637	415	543+**

**The estimated number of seedlings present in 2004 was calculated in the following manner: Where less than 20 seedlings were present in a plot, all seedlings were counted in that plot. Otherwise, the number of seedlings/plot was classified as <50, 51-100, or >100. To get the ranges listed in the table above, a maximum and minimum number of seedlings were established for each plot. For plots classified as <50 seedlings, the minimum was 20 and the maximum was 50. For plots classified as 51-100 seedlings, the minimum was 51 and the maximum was 100. For plots classified as >100 seedlings, the minimum was 100 and the maximum was conservatively (and arbitrarily) selected to be 150.*
***Difficult to identify seedlings in Area 1 in 2009. Recommend further monitoring to confirm species.*

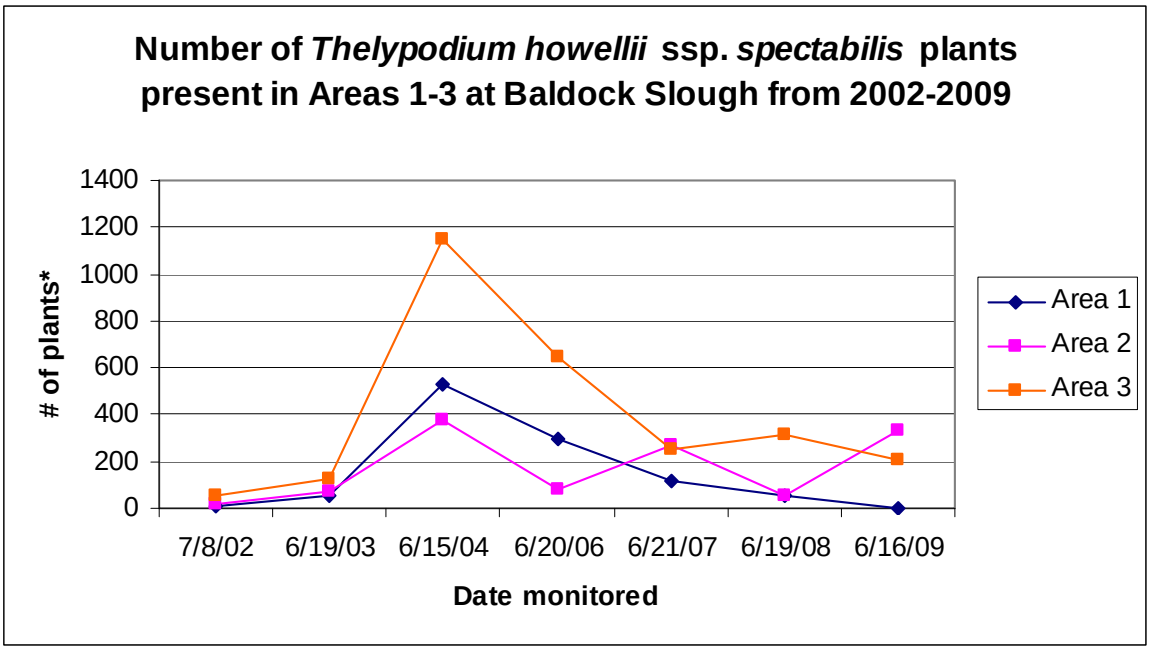

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Figure 14. Number of *Thelypodium howellii* ssp. *spectabilis* plants present at Baldock Slough in Areas 1-3 from 2002 – 2009. All plants (seedlings, rosettes, and reproductive plants) were counted in 2002 and 2003. The large plant counts in 2004 reflect the fact that many seedlings were present (this graph shows the minimum estimates of seedling numbers for that year). In 2006-2009 only reproductive plants were counted.

Experimental population monitoring (Areas 4-7)

Transplant and seed plots were installed in Areas 4-7 in April of 2007. First-year monitoring occurred in June of that same year. At that time, 67 (36%) of the original transplants were visible and appeared to be alive in Area 4, 72 (42%) transplants were present in Area 5, 28 (14%) transplants were present in Area 6, and 51 (28%) transplants were present in Area 7 (Table 3; Figure 15). All surviving transplants were still vegetative in 2007. No seedlings were observed in any of the seed plots during the first growing season after direct sowing.

In June of 2008, all Area 4-7 transplant and seed plots were monitored again. Monitoring results for this year are summarized in Table 3. In Area 4 there were 108 reproductive individuals (59% of the original transplants) in the transplant plots. No thelypody plants were observed in the seed plots. Area 5 transplant plots contained 85 surviving plants (84 reproductive and one vegetative; 49% of the original transplants; Figure 15). Eighteen seedlings were observed in Area 5's seed plots. In Area 6, only two (1%) of the transplants

survived to reproduce in 2008. However, many seedlings were observed in several of this area's seed plots. In Area 7, 11 transplants (6% of those originally planted) reproduced in 2008, and one seedling was present in this area's seed plots.

The new populations were last monitored in 2009. In Area 4 there were 31 vegetative plants, presumably recruits from seeds produced by the original transplants. There were no plants found in the seed plots. Area 5 had the most successful recruitment in 2009; there were an estimated minimum of 542 vegetative plants in vicinity of the transplant plots. Most of these were seedlings, although there were some rosettes present as well. The Area 5 seed plots contained four plants, three vegetative and one reproductive. In Area 6, there were no plants present in the transplant plots. However, there were 53 plants present in the seed plots, with all but six vegetative. No thelypody plants were located in Area 7 in either the transplant or seed plots in 2009.

Table 3. Number of *Thelypodium howellii* ssp. *spectabilis* individuals present at Baldock Slough in Areas 4-7 (established in April of 2007) in 2007, 2008 and 2009.

Area	Plot type	# Installed in 2007	Monitoring date		
			6/21/07	6/19/08	6/16/09
4	Transplant	184	67	108	31
	Seed	7,000	0	0	0
	Total		67	108	31
5	Transplant	172	72	85	542*
	Seed	7,500	0	18	4
	Total		72	103	546*
6	Transplant	200	28	2	0
	Seed	8,000	0	many seedlings**	53
	Total		28	2 + many seedlings	53
7	Transplant	184	51	11	0
	Seed	7,000	0	1	0
	Total		51	12	0
Total	Transplant	740	218	206	573
	Seed	29,500	0	19 + many seedlings	57
	Total		218	225 + many seedlings	630

**Area 5 2009 counts are estimates of the minimum number of seedlings present.*
*** Difficult to correctly identify and count the numerous and densely distributed seedlings in some seed plots. Most of the seedlings were very small (1 cm tall) and other species' similar-looking seedlings were also present.*

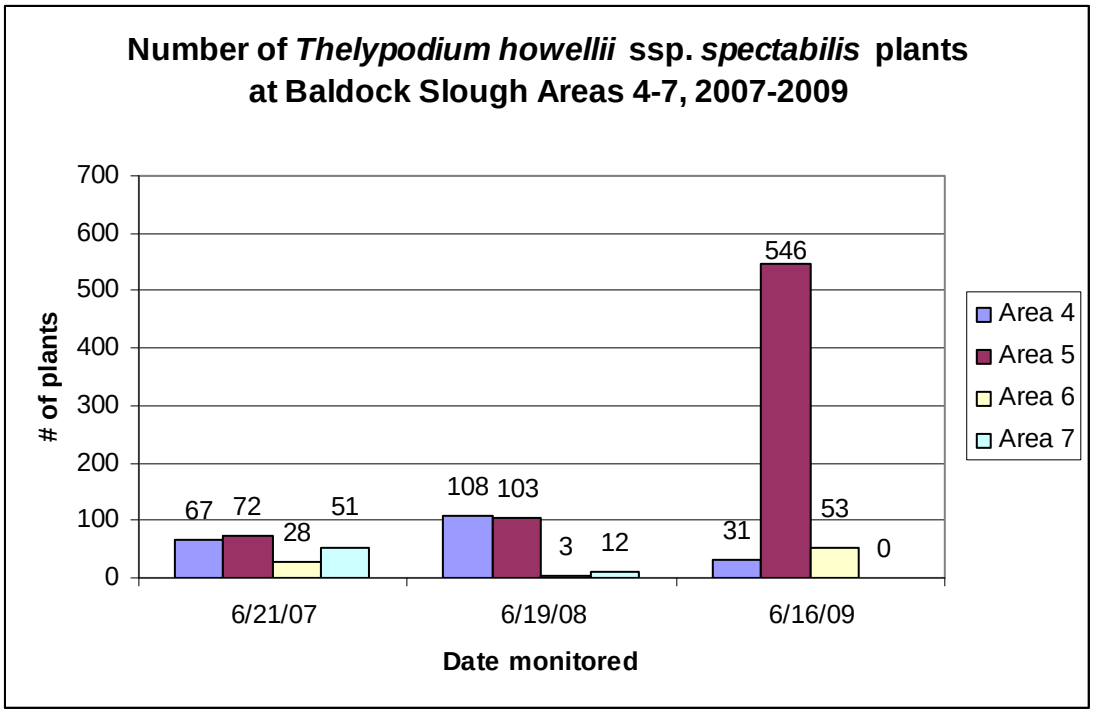

Figure 15. Number of *Thelypodium howellii* ssp. *spectabilis* plants present in transplant plots at Baldock Slough in Areas 4-7. 2007 survivors were all vegetative. By 2008, all but one survivor were reproductive. By 2009 the counts reflect recruitment from seed either directly sown in 2007 or produced by 2007 transplants; the majority of the 2009 recruits were vegetative, although 7 reproductive individuals were found.

DISCUSSION AND CONCLUSION

Seven years after introduction, the three original experimental *Thelypodium howellii* ssp. *spectabilis* populations (Areas 1-3) continue to persist. A total of 543 flowering individuals were found in these three areas in 2009, a slight increase from the 415 flowering individuals located in 2008. However, the distribution of plants across the three areas shifted this year, with Area 2 having the largest number of individuals (335 flowering plants), a six-fold increase from the number found at this site the previous year (55 flowering plants). This is the most plants found within this area to date.

The thelypody population of in Area 1 continued to decline in 2009, with a disappointing zero flowering plants found at the time of monitoring (although there were many unidentifiable seedlings, some of which quite possibly could be *Thelypodium howellii* ssp. *spectabilis*). This is after only 50 flowering individuals were found in 2008. It is difficult to

identify the cause of the decline in Area 1, as environmental conditions appear similar to those of previous years. Future monitoring will be needed to determine if this reduction in flowering plants reflects a cyclical dip in population numbers, or a permanent decline.

Population size in Area 3 has also declined, with this site containing 208 flowering individuals in 2009 (as opposed to 310 in 2008 and 248 in 2007). Although population numbers in the last three years are down from those of 2006 (when over 600 flowering individuals were found) this area appears to be slightly more consistent in maintaining larger numbers of plants. The overall decline since 2006 could be at least partially attributed to a continuing infestation of whitetop (*Lepidium draba*) in this area (Figure 16).

Figure 16. One lone *Thelypodium howellii* ssp. *spectabilis* individual is growing amidst a sea of the non-native weed whitetop (*Lepidium draba*). This invasive species continues to be a concern at Baldock Slough. Photo by R. Currin.

Once again, it is too early to determine if these results indicate a long-term trend. All sites will require additional monitoring of both the thelypody and any non-native species that might compete with it.

By 2009, original transplants installed in Areas 4-7 in 2007 had senesced. In these more recently established populations, Area 5 had by far the highest number of seedlings recruited from seeds that were either directly sown in 2007 or produced by transplants in 2008. An estimated 543 vegetative plants were observed at this site. The vast majority of them were observed in the transplant plots; only three vegetative thelypody plants were found in the seed plots. However, one reproductive individual was observed in an Area 5 seed plot as well – presumably this individual came from a seed that was sown in 2007, but did not germinate until 2008. Area 5 had the second highest transplant survival and reproduction rate in 2008, so it is not surprising that it performed well in 2009. This area is located in habitat that had been restored to native vegetation in the last several years, and although it is too early to declare success at this site, it appears to have excellent potential for the establishment of a new *Thelypodium howellii* ssp. *spectabilis* population.

Area 4 also had a large number of transplants survive and reproduce in 2008. However, only 31 vegetative recruits were observed at this site in 2009. Like Area 5, this site resides in an area that has been recently restored to native vegetation. Further monitoring and an assessment of environmental variables might be necessary to determine the cause of the difference in recruitment between Areas 4 and 5.

No thelypody individuals of any sort (vegetative or reproductive) were observed in Area 6 transplant plots in 2009. As this site only had 1% of its original transplants survive and reproduce in 2008, these results are not altogether unexpected. However, there were 53 individuals located in the Area 6 seed plots. Forty-six of these were vegetative, showing that Howell's specatular thelypody seeds can remain viable for at least two years after being sown. The other six plants had bolted and were in flower at the time of monitoring, and assumed to be last year's vegetative recruits that survived to reproduce the second year after sowing. Unlike Areas 4 and 5, Area 6 is located in relatively intact native

greasewood/saltgrass habitat. The soil appears to be drier and more alkaline in this area (there is a large *Distichlis spicata* salt flat nearby), as compared to that of Area 4 or Area 5.

In spite of the fact that 6% of the original transplants in Area 7 survived to reproduce in 2008, no thelypody plants (vegetative or reproductive) were observed in any of this site's plots in 2009. Like Area 6, this site is located in greasewood/saltgrass habitat. However, there appears to be more of a problem with non-native invasives (especially *Lepidium* spp.) in this area, which may account for the lack of recruitment observed.

In spite of the fact that direct seeding might be considered the more favorable method to use in thelypody introductions (seeds being easy and inexpensive to collect and sow on the ground, and plugs of a biennial only serving to produce and disperse seeds), the higher than anticipated final survival rate of the plugs and the poor initial results of most of the seed plots lead to the conclusion that introduction attempts should include both plugs and direct sowing of seed. The results of ongoing monitoring efforts demonstrate that thelypody recruitment occurs in both seed and plug plots. However, the initial three study sites (Areas 1-3) contained many more transplant plug plots than seed plots, limiting the ability to reach definitive conclusions from these percentages. Additional monitoring of the Baldock Slough introduction sites (especially in Areas 4-7, which contain 7-8 seed plots each) will provide more information regarding the effectiveness of seeds versus plugs in establishing and augmenting thelypody populations. Further monitoring would also yield additional insight regarding the impact of the whitetop infestation in the cultivated plots on *T. howellii* ssp. *spectabilis* plants.

Once again, although the ongoing persistence of thelypody in Areas 1-3 and initial survival of many of the transplants in Areas 4-7 are encouraging, the true measure of success of an introduction project is long-term recruitment, which can only be established by monitoring the introduction sites over an extended period of time.

SUMMARY

- Reintroduction/augmentation of *Thelypodium howellii* ssp. *spectabilis* into suitable sites at Baldock Slough has the potential for success. Initial results are encouraging, and further monitoring of these sites is needed to determine the ultimate fate of these populations.

- In 2009, a total of 543 flowering thelypody plants were present in Areas 1-3 (installed in 2002). This represents a slight increase after two years of decline for these populations (415 plants were present in 2008, 637 in 2007, and 1,028 in 2008). A certain amount of fluctuation in population numbers is expected, due to the fact that this species is a biennial, and seedling recruitment and establishment appears to be sensitive to weather conditions. However, in at least one area the invasion of a non-native weed (whitetop) is a growing concern, and may be impacting the longer-term ability of these new populations to become sustainable.

- Three out of four of the most recently established populations (Areas 4-7, outplanted in 2007) showed recruitment in 2009, both in transplant plots (from seed produced by 2007 transplants) and in directly-sown seed plots (sown in 2007). These early recruitment data confirm previous conclusions that both greenhouse grown plugs and site-sown seeds are suitable propagules for reintroduction and augmentation efforts (Currin et al. 2007).

- In Areas 1-3, planting into cultivated sites increased success of seeds and plugs in the first year, but cultivation ultimately contributed to site degradation by the invasion of exotic weeds. Long-term thelypody recruitment should be monitored to gauge the effectiveness of all sites, including cultivated sites. Planning for the ongoing treatment of weed infestations is essential when cultivation is included in transplant protocols.

- In Areas 4-7, initial results indicate that planting into sites that have been restored (cleared of non-native species, planted with native species, and controlled for weeds) increased the success of the transplants in the first two years. However, it is possible that

the lower rates of success within the non-treated areas (dominated by native greasewood and saltgrass) are due to a difference in other environmental factors (such as the alkaline content of the soil or hydrology). Seed plots in one of the non-restored areas appeared to initially outperform those in restored areas.

RECOMMENDATIONS

- Locate additional sites for future reintroduction efforts, especially in the portions of Howell's spectacular thelypody range that do not currently contain a viable population on lands that are protected and managed for thelypody. New populations should be installed on administratively protected lands. Reintroduction projects should be limited to sites without livestock grazing, or grazing should be managed to minimize habitat disturbance (i.e. increased weeds) and avoid damage to transplants and plot markers. ***(Recovery Tasks 1.5, 2)***

- Continue to utilize information from reintroduction efforts to further refine protocols to promote success of future reintroduction projects. Information on cultivation techniques, site suitability and the benefit of nurse shrubs, propagule selection, the necessity of weed control, pre-planting site preparation, and outplanting methods should be incorporated into protocols for reintroduction of this species. ***(Recovery Task 3.3)***

- Use protocols developed from previous studies to implement reintroduction and augmentation projects. Once a series of sites within the historic range of the taxon are selected and protected, planting sites should be prepared, and populations should be created by transplanting greenhouse-grown plants in combination with site-sown seed. Plans for weed control and annual monitoring should be instigated at the time of transplanting. ***(Recovery Task 3.3)***

- Continue annual monitoring of all introduction sites to determine the ultimate feasibility of reintroduction/augmentation projects for *Thelypodium howellii* ssp. *spectabilis*. Because this taxon is biennial, and there are concerns about the overall decline in

population numbers in Areas 1-3, several more years of data are required to confidently evaluate the ability of reintroduced populations to become self-sustaining and contribute to recovery of the species. ***(Recovery Task 3.2)***

- Continue annual monitoring of vegetation transects to evaluate community composition changes at the Haines Rodeo mitigation site (see Currin et al. 2007 for more discussion on previous monitoring efforts). Data from these transects are essential components of an adaptive management plan to control non-native species in this high-quality site. In addition, this site should be extensively surveyed at least once a year for noxious weeds. Because this mitigation site still supports many native alkali prairie species, as well as a large thelypody population, priority should be given to maintaining the integrity of this site as an important seed source for future thelypody reintroduction and augmentation projects and a resource for identifying the key habitat requirements of *Thelypodium howellii* ssp. *spectabilis*. ***(Recovery Tasks 1, 1.6.3)***

- Develop and implement an updated monitoring plan for the Haines Rodeo mitigation site population of *Thelypodium howellii* ssp. *spectabilis*. (GPS cluster population monitoring, the method used in 2000 and 2003, is extremely labor intensive and yields imprecise population estimates. See Widener and Associates 2002 and Currin et al. 2004 for a description of the GPS cluster population monitoring methodology.) Because this site is one of only two administratively protected populations in existence, it is crucial that the status of this population is monitored regularly, and that results are incorporated into the adaptive management plan for the site. ***(Recovery Task 4)***

- Develop and implement a monitoring plan for the Miles Easement population of *Thelypodium howellii* ssp. *spectabilis*. The Miles Easement site contains the second of only two administratively protected thelypody populations. The continued protection and management of this property for thelypody is crucial to preventing additional decline (and encouraging recovery) of this species. This population has not been monitored since 2001, and the results of that monitoring were insufficient to provide baseline population estimates (Widener and Associates 2002). ***(Recovery Task 4)***

- Use Haines Rodeo mitigation site vegetative transect data when characterizing habitat preferred by *Thelypodium howellii* ssp. *spectabilis* in order to assist in the selection of suitable reintroduction sites. ***(Recovery Task 1.4)***

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APPENDIX 1

Map of experimental *Thelypodium howellii* ssp. *spectabilis* populations at Baldock Slough in Baker County, Oregon.