

National Fish and Wildlife Foundation

NFWF/Legacy Grant Project ID: 1701.09.019619

Pulling Together: Managing Invasives 2009 - Submit Final Programmatic Report (Activities)

Grantee Organization: Bureau of Land Management - Bishop Field Office

Project Title: Fish Slough Area of Critical Environmental Concern Weed Control and Spring Restoration (CA)

Project Period 04/01/2010 - 09/30/2013
Award Amount \$25,000.00
Matching Contributions \$25,000.00
Project Location Description (from Proposal) The Fish Slough Area of Critical Environmental Concern (ACEC) is in eastern California at the north end of the Owens Valley, 5 miles north of Bishop, CA.

Project Summary (from Proposal) Work to restore Fish Slough, a rare desert wetland system that contains isolated stands of perennial pepperweed. Project will identify and treat weed infestations, implement wetland restoration tasks such as design and construction of a spring enclosure, and propagation and outplanting of native riparian and alkali meadow species.

Summary of Accomplishments One of the primary accomplishments that the Project has achieved is better control of the invasive plant perennial pepperweed (*Lepidium latifolium*). Progress has been made at Northwest (NW) Spring and elsewhere in Fish Slough. Additional accomplishments include; 1) Repair and maintenance of a grazing enclosure fence. 2) A better understanding of Fish the Slough alkali meadow system and how it responds to disturbance and the techniques required to restore it. 3) A renewed commitment of the ACEC working group to control perennial pepperweed throughout Fish Slough.

The key outcome of these accomplishments is the continued protection of the ecological integrity of Fish Slough which provides habitat for the Federally Endangered Owens pupfish (*Cyprinodon radiosus*) as well as the Federally Threatened Fish Slough milk-vetch (*Astragalus lentiginosus* var. *piscinensis*). It is anticipated that the Owens pupfish will be re-introduced to the Northwest Spring within the next few years.

Lessons Learned A general lesson that was learned was to set realistic goals for a project. This project set high expectations that were not necessarily feasible given the existing condition and the time frame of the project. Overall, steps were made towards reaching the stated goals but actually reaching those goals was not feasible.

As noted above in the Activities and Outcomes sections, a Conservation Field Trial (CFT) was initiated to test various treatment methods for feasibility of success. At this time not enough data has been obtained to determine which methods are most successful in the existing conditions.

In areas where the soil surface was not entirely composed of dense peat, out-planting native plant plugs is effective. Out-planting appears to be an effective way of restoring the spring area, however in many areas the peat layer needs to be removed or broken up prior to out-planting. However, soil manipulation of the peat layer is what resulted in the increase of non-native species, therefore this step still needs more research to determine the best method.

Conservation Activities	Control and Removal of (pre) existing perennial pepperweed populations
Progress Measures	Other (Complete eradication of of perennial pepperweed)
Value at Grant Completion	60% removed
Conservation Activities	Construction of grazing enclosure fence at NW Spring

Progress Measures Spring)	Other Activity Metric (Construct 5 acre grazing exclusion fence at NW
Value at Grant Completion	100% complete
Conservation Activities	Propagate and out-plant native species
Progress Measures	Other Activity Metric (Increase the ratio of native vs. non-native species)
Value at Grant Completion	Propagation and out-planting successful.
Conservation Activities	Locate and treat new infestations
Progress Measures	Other (No metric given)
Value at Grant Completion	Successful





















Final Programmatic Photos

Fish Slough Area of Critical Environmental Concern Weed Control and Spring Restoration Project

Photo 1 – General photo of the NW Spring area

Photo 2 – First Bloom participants at the 2011 Sierra Discovery Days event out-planting native plant plugs

Photo 3 – Group photo of First Bloom participants at the 2011 Sierra Discovery Days event

Photo 4 – Photo in 2011 of one the areas where plant plugs were planted during the Sierra Discovery Days event

Photo 5 – Photo in 2012 the area where plants were out-planted during the 2011 Sierra Discovery Days event

Photo 6 – Area of soil manipulation conducted as part of the CFT

Photo 7 – Seeding CFT plots

Photo 8 – Preparing CFT plot for plant plugs

Photo 9 – Final layout of CFT plots



Final Programmatic Report Narrative

Instructions: Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the on-line final programmatic report task as instructed.

1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured.

Fish Slough Area of Critical Environmental Concern Weed Control and Spring Restoration Project

One of the primary accomplishments that the Project has achieved is better control of the invasive plant perennial pepperweed (*Lepidium latifolium*). Progress has been made at Northwest (NW) Spring and elsewhere in Fish Slough. Additional accomplishments include; 1) Repair and maintenance of a grazing enclosure fence. 2) A better understanding of Fish the Slough alkali meadow system and how it responds to disturbance and the techniques required to restore it. 3) A renewed commitment of the ACEC working group to control perennial pepperweed throughout Fish Slough.

The key outcome of these accomplishments is the continued protection of the ecological integrity of Fish Slough which provides habitat for the Federally Endangered Owens pupfish (*Cyprinodon radiosus*) as well as the Federally Threatened Fish Slough milk-vetch (*Astragalus lentiginosus* var. *piscinensis*). It is anticipated that the Owens pupfish will be re-introduced to the Northwest Spring within the next few years.

2. Project Activities & Outcomes

Activities

- **Describe and quantify (using the approved metrics referenced in your grant agreement) the primary activities conducted during this grant.**

I. Control and removal of (pre)existing perennial pepperweed populations.

Treatment of pre-existing populations has been marginally successful in controlling perennial pepperweed at NW Spring. Complete removal (eradication) has not occurred and control has only been achieved in the sense that; 1.) The pre-existing populations have been reduced in density and size and 2.) Newly documented occurrences receive early treatment. Early detection and rapid treatment prevent new infestations from increasing in extent or density. Perennial pepperweed treatment will continue to occur into the future.

Treatment of perennial pepperweed has been a coordinated effort between the California Department of Fish and Wildlife (CDFW), the Inyo County Agriculture Department, the Bureau of Land Management (BLM) and Los Angeles Department of Water and Power (LADWP). CDFW conducted mapping of perennial pepperweed at NW Spring in 2009. In 2010 CDFW coordinated (and continues to coordinate) efforts with the Inyo County Agriculture Department to ensure treatment of perennial pepperweed. The BLM and LADWP have assisted in monitoring treated sites and searching for new infestations and LADWP has treated occurrences of perennial pepperweed on their land throughout Fish Slough.

i. Construction of grazing enclosure fence at NW Spring.

In concert with the treatments of perennial pepperweed at NW Spring, a livestock exclusion fence was repaired to prevent livestock from entering the area around NW Spring. There is existing use of

livestock on the land surrounding NW Spring. Livestock can spread invasive plant seed or plant parts from infected areas to non-infected areas, therefore preventing livestock from entering the area was one of the first steps in reducing the potential for the spread of perennial pepperweed and other non-native invasive plants into or within the NW Spring area.

An existing fence was previously in place at NW Spring however the fence was in need of major repair. Between 2009 and 2010 the fence was repaired and improved to prevent livestock intrusion into the NW Spring area. The fence is maintained yearly to prevent livestock intrusion.

ii. *Propagation and out-planting of native plant species.*

An additional activity associated with the control and removal of perennial pepperweed is the seeding and out-planting of alkali meadow species in treated areas. Native seed was collected from the Fish Slough area starting in 2010 and has been collected each subsequent year. Some of the collected seed has been used for propagation. The remaining seed was either directly seeded into treated areas or will be directed seeded at the site in the future (post weed control). Propagation was conducted at the locally run, interagency, Deepest Valley Cooperative Native Plant Nursery. Alkali meadow species including alkali sacaton (*Sporobolus airoides*), alkali cordgrass (*Spartina gracilis*) and creeping wildrye (*Elymus triticoides*) have been grown-out and out-planted in treated areas.

The majority of the out-planting occurred in 2011 during Sierra Discovery Days, a community outreach/education/volunteer event. As part of Sierra Discovery Days, approximately 20 participants that are part of the First Bloom group turned out to learn about NW Spring, invasive plants and habitat restoration. First Bloom is a tribal (Bishop Paiute Tribe), environmental education program that connects 4th and 5th grade kids to the outdoors. Participants planted over 500 grass plugs to help with the restoration at NW Spring. Several hundred more plants were planted in the fall of 2013. The 2013 planting was done by local high school students who partnered with Friends of the Inyo (a local “friends” group), the BLM and CADFW.

II. *Locate and treat new infestations.*

Each year NW Spring and other portions of Fish Slough have been surveyed for new infestations of perennial pepperweed.

New infestations have been found at NW Spring. These occurrences have been treated. Treatment has prevented spread and allowed for near complete removal of these new occurrences.

A new infestation was documented south of NW Spring. Early detection and rapid treatment has kept this new infestation from spreading and becoming more difficult to eradicate.

III. *Monitor treated sites to determine treatment efficacy.*

Throughout the growing season treated areas were revisited to assess treatment efficacy. Many sites were treated more than once throughout the season.

Research (Renz et al. 2012) has documented that treating larger, dense stands of perennial pepperweed may result in only limited success compared to treating smaller, less established infestations. These findings are consistent to those observed at Fish Slough. The larger, denser patches of perennial pepperweed have been slow to respond to treatments, while the smaller patches generally respond favorably to treatments.

The first year of treatment appeared to have little effect on existing populations. During the second year of treatments, informal experiments were done to determine if treating at different times of the day (i.e. not treating during the heat of the day when the plants stomata may be closed) yielded more favorable results. Qualitative monitoring supported the hypothesis that treating earlier in the day would yield more

favorable results. The third year of treatments appears to have been the most successful. This may be a product of the repeated treatments, better timing of treatments and/or the low moisture year experienced in 2012. Renz et al (2012) noted that perennial pepperweed infestation is positively correlated with increased water availability. The Fish Slough area received less than normal precipitation in 2012 and significantly less precipitation than what it received in 2011.

Overall treatments at NW Spring were slow to yield results but at the conclusion of this grant period several small satellite populations at NW Spring have been eradicated and the remainder have decreased in density or extent or both.

IV. *Initiation of a Conservation Field Trial.*

The Conservation Field Trial (CFT) was initiated to determine the potential suitability and sustainability of applied re-vegetation strategies, technologies, and selected plant materials for site restoration/re-vegetation. The study emphasized: a) native species selection and adaptation; b) re-vegetation species response to mechanical techniques for peat manipulation and seedbed preparation; and c) augmentation of soil moisture regime with polyacrylamide polymer and Zeolite™ columns.

Activities associated with the implantation of the CFT included experiments on different soil manipulation techniques and seeding methods. See the attached report, *2011 Installation Completion Report, Conservation Field Trial, Owens Valley Native Fish Sanctuary at Northwest Spring (Fish Slough)* for more detailed information.

This fourth activity was not one of the initial activities discussed in the in the grant and will be explained below.

- **Briefly explain discrepancies between the activities conducted during the grant and the activities agreed upon in your grant agreement.**

Eradication of small, satellite occurrences of perennial pepperweed did occur but overall perennial pepperweed was not eradicated from the NW Slough area or Fish Slough. Complete eradication of perennial pepperweed can be very difficult once it has become established therefore complete eradication in a three to four year time period was not realistic for those populations that were dense and well established.

The grant stated that a livestock exclusion fence would be built around the NW Spring area. A fence was present at the site and therefore a new fence was not needed, however the fence did require significant repair in order to be functional in preventing livestock from entering the NW Spring area.

The initiation of the Conservation Field Trial (CFT) was not originally planned. The CFT was initiated as a result of several factors including the loss of a vital project team member and difficulty in achieving clear steps toward project success. The project team member (BLM botanist Anne Halford) who initiated the grant proposal for this National Fish and Wildlife Foundation grant and the associated restoration project left the area shortly after the project began. Anne was not the project lead but she was the person with the overall vision for the NW Springs restoration project. The incoming BLM botanist was less familiar with wetland and alkali meadow restoration techniques and the overreaching vision of the project. Therefore, after achieving only limited success the first year and the realization that restoration of the NW Spring area was a larger task than initially believed, the Natural Resource Conservation Service (NRCS) was contacted for advice. The NRCS was able to provide their technical expertise, experience and time. The NRCS designed and helped implement the CFT. The CFT is expected to provide results that can be used to determine effective restoration techniques that can be used to meet the long-term desired goals at NW Spring.

Outcomes

- **Describe and quantify progress towards achieving the project outcomes described in your grant agreement. (Quantify using the approved metrics referenced in your grant agreement or by using more relevant metrics not included in the application.)**

- I. *The anticipated outcome of the planned activities was that after the course of this grant period the NW Spring site would have the necessary vegetative and aquatic constituents needed for pupfish re-introduction.*

It is expected that pupfish will be re-introduced at the NW Spring Site following the 2013 growing season.

In the grant agreement the aquatic and vegetative constituents that were going to be measured include; 1) eradication of non-native bass; 2) an increase in desirable aquatic vegetation (three-square – *Scirpus pungens*) and; 3) a reduction in non-desirable vegetation (cat-tail – *Typha domingensis*).

- 1) Eradication of non-native bass did not occur. The initial intent was to prevent bass from entering the area planned for pup-fish re-introduction by installing a fish barrier. Non-native fish already occurring in the area would be eradicated. Unfortunately the fish barrier was ineffective at preventing fish entry into the planned re-introduction area. The most feasible method to prevent non-native fish from entering the area is to create a higher fish barrier. However by having a higher fish barrier the water table of the pup-fish re-introduction area would be raised. Raising the water table would flood some of the areas that occur within established CFT vegetation treatment sites. Therefore, it was decided to delay raising the water table until after more data is collected from the experimental treatment sites.
- 2) Desirable aquatic vegetation has been increased within the pup-fish re-introduction area. Three-square naturally re-colonized areas where cat-tail were removed. Cat-tail removal has been suspended (see below) therefore there has not been a greater than 50% increase in three-square.
- 3) Approximately 0.5 acres of cat-tail have been re-moved from the area planned for pup-fish re-introduction. As noted above, cat-tail removal was halted following the discovery that the water table of the re-introduction area would be raised. A change in the water table will cause a shift in where both cat-tail and three-square would occur, therefore, resuming cat-tail removal will not occur until after the new fish barrier is installed and the water table has risen and stabilized.

II. Planned monitoring metrics included;

1. *Decrease the area of currently mapped polygons of perennial pepperweed: Eradicate perennial pepperweed within 3-5 years and reduce other associated weed densities by 75%.*

The size of the perennial pepperweed infestations at NW Spring have been reduced compared to the size of the infestations that were mapped in 2009. Several of the individual infestations have been completely eliminated or reduced to just a few plants. However some of the infestations are the same as they were in 2009. These unchanged infestations are more established (higher density of plants) and are intermixed with other vegetation. It is estimated that complete eradication will require several more years of continued treatments.

Other associated weed densities have not been reduced overall. In some areas where treatment occurred associated weed densities have been reduced by 50-75%, however, other areas where soil manipulation has occurred has had an increase in associated weed species.

2. *Increase the ratio of native vs. non-native species: increase the percentage of native plants versus non-native plants by 50% of the current volume; increase desirable aquatic vegetation by 50% and reduce less desirable vegetation by 65%.*

Quantitative monitoring was not conducted but these objectives have not been met. There are small sections of the NW Spring area where treatment (invasive plant removal and out-planting) have increased the ratio of native plants.

In the restoration area where the CFT was established, pre-treatment quantitative data was collected. Post treatment data collection was initiated but due to the dramatic increase in early succession non-natives, quantitative monitoring has been delayed. It is expected that many of the early succession plants will natural disappear once seeded species take hold. In the past year it appears that native species are becoming more abundant and beginning to successfully compete with non-native species.

As indicated under Outcome #1 cat-tail removal has been suspended until after the water table has been raised. Changing the water level will result in a natural re-distribution of both desirable and less desirable aquatic vegetation, therefore continuing cat-tail removal would not have been productive.

3. *Increases in native species diversity and cover in previously treated sites.*

Treated areas (herbicide treatment of perennial pepperweed and manual treatment of other non-natives) had mixed results. Some of the treated areas did have an increase in cover of native species, but the species diversity remained about the same. For example, perennial pepperweed was often growing in with stands of milkweed (*Asclepias* species) or basin goldenrod (*Solidago spectabilis*). Treatment resulted in a decrease in perennial pepperweed however the native diversity remained unchanged. In other areas, efforts to break up the soil with remnant clumps of cat-tail roots resulted in an increase in non-natives such as five-hook (*Bassia hyssopifolia*), prickly lettuce (*Sonchus asper*), white sweet-clover (*Melilotus albus*) or beard grass (*Polypogon* species). For example, in many of plots set up as part of the CFT, the soil disturbance resulted in almost the entire plot being covered by one or two non-native species. For this reason quantitative monitoring was delayed.

4. *Survivorship of out-planted natives.*

Survivorship of out-planted natives was good. Survivorship is estimated to be about 50-75%. On initial appearance out-planting appeared to be ineffective. Areas that were cleared of non-natives and followed up with out-planting had a high cover of non-natives the following year. However, the out-planted species were still alive and appeared to be healthy and expanding. It is expected that continued out-planting and manual removal of non-natives will be a successful strategy for continued restoration at NW Spring.

Public information kiosk with information on current restoration work at the site.

The information kiosk at NW Spring was not kept current with information about the on-going restoration at the site. However public out-reach did occur through public volunteer restoration activities and classroom education exercises at NW Spring.

- **Briefly explain discrepancies between what actually happened compared to what was anticipated to happen.**

Discrepancies between the actual outcomes and those that were anticipated were touched on above. Overall, progress has been made towards the long-term restoration of NW Spring, specifically a reduction in perennial pepperweed.

In general, discrepancies in the actual outcome compared to the expected outcomes are due to setting high expectations for the outcome of work being done in complex system with more than one variable. Due to multiple variables including the presence of a highly invasive perennial plant (perennial pepperweed), the

presence of several other invasive non-native plants and a very disturbed soil regime, treatments were less effective than originally hoped and also had unexpected, undesirable consequences.

- **Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.**

One of the unexpected outcomes was the increase in associated non-natives (five-hook - *Bassia hyssopifolia*, prickly lettuce - *Sonchus asper*, white sweet-clover - *Melilotus albus* and beard grass - *Polypogon* species) within the project area. These non-native species increased in areas where soil manipulation treatments were conducted. Soil manipulation was done with the intent of breaking-up the peat soils in order to promote native plant colonization. The unexpected increase in associated non-native species added a layer of complexity that was not expected and therefore slowed the restoration process.

3. Lessons Learned

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt their projects to build upon some of these key lessons about what worked best and what did not?

A general lesson that was learned was to set realistic goals for a project. This project set high expectations that were not necessarily feasible given the existing condition and the time frame of the project. Overall, steps were made towards reaching the stated goals but actually reaching those goals was not feasible.

As noted above in the Activities and Outcomes sections, a Conservation Field Trial (CFT) was initiated to test various treatment methods for feasibility of success. At this time not enough data has been obtained to determine which methods are most successful in the existing conditions.

In areas where the soil surface was not entirely composed of dense peat, out-planting native plant plugs is effective. Out-planting appears to be an effective way of restoring the spring area, however in many areas the peat layer needs to be removed or broken up prior to out-planting. However, soil manipulation of the peat layer is what resulted in the increase of non-native species, therefore this step still needs more research to determine the best method.

4. Dissemination

Briefly identify any dissemination of lessons learned or other project results to external audiences, such as the public or other conservation organizations.

Public have been informed during volunteer restoration events at the site and a Conversation Field Trial Installation Report has been prepared.

5. Project Documents

Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi and must be accompanied with a legend or caption describing the file name and content of the photos;
- Report publications, GIS data, brochures, videos, outreach tools, press releases, media coverage;
 - Flyers from Sierra Discovery Days (2011, 2012) advertising restoration volunteer event at NW Spring
- Any project deliverables per the terms of your grant agreement.
 - None stated grant agreement.

POSTING OF FINAL REPORT: *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final*

report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as “PROTECTED” and provide an explanation and complete citation to the statutory or regulatory source for such protection.

Literature Cited

Renz, Mark J., Scott J. Steinmaus, David S. Gilmer, and Joseph M. DiTomaso. 2012. *Spread Dynamics of Perennial Pepperweed (Lepidium latifolium) in Two Seasonal Wetland Areas*. *Invasive Plant Science and Management*, 2012 5:57–68