

FINAL DRAFT July 31, 2015

Executive Summary

**Bushy Lake Restoration, Monitoring and Adaptive Management on the American River,
Sacramento, CA USA**

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Executive Summary

The Bushy Lake Restoration Project is a wetland/riparian restoration, monitoring and citizen science/community education project located near Cal Expo on the American River Parkway, Sacramento, CA. This is the first time that a long-term collaborative project has been developed between Sacramento County Parks Department and CSUS Environmental Studies Department. The collaborative Earth Stewardship Initiative was initiated at the Ecological Society of America Conference in Sacramento last August with Yale, U.C. Davis, Sacramento County Parks, and the American River Parkway Foundation.

The 2014 fire at Cal Expo burned over 160 acres of the American River Parkway (ARP) and provided an opportunity to create a fire-resilient landscape and long term monitoring and adaptive management at Bushy Lake and in the Lower ARP. The restoration experiment was established in January 2015 with the assistance of volunteers from the American River Parkway Foundation. Weekly monitoring and adaptive management has occurred continuously since January, and helps achieve policy goals designated in the American River Parkway Plan. Three students (Mary Xiong, Tom Henry and Kayla Henry) from CSU Sacramento completed their Senior Thesis in Environmental Studies and graduated spring semester 2015. All three students have submitted abstracts to present oral presentations on their Bushy Lake projects at the 2015 Bay Delta Science Conference. The restoration experiment was designed for a one year time frame: Mary Xiong, Mary Maret and I plan to submit this research for publication in a peer reviewed journal. Lastly, I plan to request the Sacramento State campus adopt the Bushy Lake restoration project for community service so we can continue monitoring, adaptive management, and implementation of further restoration experiments in the coming years. This provides community service for students and citizen monitoring for Sacramento County Parks to fulfill obligations and policies under the American River Parkway Plan. Citizen science, positive publicity through CSU Sacramento, and public restoration projects all create good will in the greater community by enrolling students and volunteers in land stewardship and citizen science. This project provides value added for Sacramento County Parks by providing publicity for the good works they are doing on the ARP, building public confidence, and letting the public and policy-makers know that Parks are doing good things in the Parkway. Another intended outcome is to create long term monitoring on the Parkway.

The primary goal of the restoration experiment is to provide a cost-effective ecologically relevant restoration prescription for the Bushy Lake area into a sustainable wetland with fire-resilient native understory vegetation. The restoration experiment is designed to study vegetation and soils responses to fire and the opportunity to enhance post-burn recovery based on our current ecological knowledge. The area around Bushy Lake provides a suitable location for ecological restoration using native plant species that are resilient to fire. Before European settlement, the Miwok and Maidu tribes practiced Traditional Resource Management through burning and other tending practices of culturally significant resources. Santa Barbara sedge (*Carex barbarae*) and creeping wild rye (*Elymus triticoides*) are native species that have adapted to frequent fires, and were chosen for understory restoration because they are resilient to fire. Restoring the native understory vegetation will promote accelerated succession of habitat for ARP flora and fauna, as well as controlling invasive species. One of our experiments is directly adjacent to the public trail to provide a public education opportunity on ecological restoration and fire resiliency; we recommend expanding this area in the coming year. Project experiments will provide a visible example of the proactive effort to manage fire in the parkway with volunteer participation, public education and monitoring.

Another major goal is to monitor the entire Bushy Lake Nature Study Area using the California Rapid Assessment Method (CRAM) module for depressional wetlands; quantitative vegetation assessment soils

evaluation; monitoring for avian species and biotic structure for bird habitat. This data provides insight into habitat conditions and overall health of the ecosystem and can be used to monitor the success of conservation efforts.

This project is consistent with Policies of the American River Parkway Plan and provides monitoring and adaptive management recommendations to meet ARP goals as follows:

- 3.2.0 – Developing a collaborative relationship with colleges for assistance with research, monitoring and survey projects,
- 3.2.1 – Maintain and enhance native vegetation in the parkway,
- 3.2.2 – Reintroduce native vegetation in the parkway (*Carex barbarae* and *Elymus triticoides*),
- 3.2.4 – Removal of non-native invasive vegetation,
- 3.3 – Increase wildlife habitat connectivity and corridors,
- 3.4 – Improve parkway resources, environmental quality and natural resources including ecological restoration of degraded resources,
- 3.11 – Manage, enhance and protect riparian aquatic habitat (Bushy Lake) especially as concerns federally or state listed or watch species (for example Valley Elderberry Longhorn Beetles, western pond turtles, Swainson’s hawks, wood ducks, river otters),
- 4.4 – Water Quality Protection - Beneficial uses – wildlife habitat and recreation,
- 10.19 – Operate and Manage Bushy Lake in a manner that maximizes value to fish and wildlife. This includes maintenance (monitoring and adaptive management) to provide suitable habitat, including adequate water depths and appropriate vegetation,
- 10.20 - Restore and enhance wetland and riparian habitat around Bushy Lake. and
- 10.21 – Remove non-native weeds and create grassland foraging habitat for raptor species.

Preliminary Project Results:

- Ch 2 – Soils - Collect soil samples for area soil survey and assessment.

We measured the soils health at Bushy Lake in the restoration area, as well as the ability of soils to sequester carbon. Soil C stocks to a depth of 25 in were estimated to range from approximately 38-60 t ha⁻¹ with a mean of 50.9 t ha⁻¹. Restoring vegetation and mulch to disturbed soils at Bushy Lake is a management option that increases surface soil C and is therefore a potential strategy to increase net C storage in soils. Restoration of grasslands has been found to increase C storage at rates of 0.3-6 t ha⁻¹ yr⁻¹. Studies indicate that restoration of soils and native vegetation promotes resiliency to disturbance and increased the potential to out-compete invasive plant species.

- Ch 3 – California Rapid Assessment Method (CRAM)

We established baseline monitoring at Bushy Lake using the California Rapid Assessment Method (CRAM) depression module to determine overall wetland area health. CRAM results varied within each of the four assessment areas and closely matched the extent to which each area was impacted by fire. Statewide, CRAM points range from 39 to 94, and are compared to other depression wetlands scores recorded on eCRAM. Index scores for Bushy Lake averaged of 67 in the northern part of Bushy Lake and 61 on the southern part of the lake. A difference of 6 points is considered significant, meaning a significant difference in “wetland health” between the northern unburned assessment areas and the southern burned assessment areas. The overall scores are low to middling compared to other depression wetlands in the state. We anticipate changes to these scores over time, and intend to use the CRAM methodology to monitor changes in wetland health over time and to evaluate and the contribution of

restoration and management. The Northwestern corner of the lake had the highest CRAM score (75) and was the least disturbed. Key stressors include invasive species encroachment, unreliable water supply, and the constant threat of wild fire.

- Ch 4 –Monitoring Avian Species, Flora and Fauna

Historically, Bushy Lake has provided vital habitat for a variety of birds and is a popular birding location (Audubon Society). Birds are more easily observed than other wildlife and respond quickly to changes in their environment; therefore, they are ideal candidates to measure ecosystem improvement during the Bushy Lake restoration project and post-restoration monitoring. Furthermore, in the absence of a specific indicator species, birds can be used to gauge overall ecosystem success. Within the Northeast assessment area 18 avian species were detected and 87 individual birds; in the Northwest assessment area a total of 16 avian species and 102 individual birds were detected. The Southeast assessment area received the lowest scores for Biotic Structure and also had the lowest number of avian species observed (10 species). There were many snags which were not as prevalent on the Northern end that provided habitat for woodpeckers. Within the Southwest assessment area, 14 total different avian species were observed. There were less species observed in the Southern areas where the riparian areas suffered great impacts from the fire; this area is taking longer to and potential avian habitat will improve in these areas with restoration, vegetation regrowth, and control of invasive species. The following fauna were observed while conducting monitoring.

- The western pond turtle (*Actinemys marmorata*) relies on a permanent water source with floating woody vegetation and muddy banks for basking. The Western Pond Turtle has suffered a 99% decline in some areas and is listed as a species of special concern in California. Although this species is not yet recognized as federally endangered in California, its status is currently under review (Center for Biological Diversity, 2015). If Bushy Lake is allowed to dry up, the 700m distance to the American River may result in extirpation of the turtles from the area.
- The North American River Otter (*Lontra Canadensis*) is keystone carnivore and another Bushy Lake resident that requires a permanent water source.
- Elderberry (*Sambucus Mexicana*) is spouting and growing prolifically through the study area. Lengthy spring rains and nutrient supplements from ash have resulted in rapid re-growth. The elderberry provides habitat for the Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*), a threatened species known to occur on the American River. We looked for but did not observe any exit holes, and recommend monitoring next year.
- Nesting pair of red tailed hawks (*Buteo jamaicensis*) were observed on the west side of Bushy Lake
- We observed one species of flycatcher in the Southwest assessment area. Although we were unable to identify the exact species, it is important to note because there is an endangered species of flycatcher that migrates through the Sacramento region in the spring. The Willow Flycatcher (*Empidonax trailii*) shows a nearly exclusive preference for areas with riparian cover (Sedgwick & Knopf, 1992). This species is listed as level S1 endangered by ESA (CNDDDB, 2015).

Monitoring Vegetation - We observed species richness of 12 plant species. Fifty two percent of the plants sampled were native. The prolonged spring rains and additional nitrogen from ash stimulated invasive species, with 39% invasive plants, and 9% non-native plant species. The poison hemlock (*Conium maculatum*) (23% relative cover) and prickly lettuce (*Lactuca serriola*) (3.8% relative cover) were over six feet tall and dominate the site. Tall whitetop (*Lepidium latifolium*) (0.4%) were beginning to invade the disturbed sites. Himalayan blackberry (*Rubus armeniacus*) was patchy; without management these tall invasive species are shading and eliminating the native understory species.

- Ch 5 – Bushy Lake Understory Restoration Experiment

Experiment provides high-visibility demonstration of effective restoration in response to fire. We have one “demonstration site” near the trail to demonstrate our experimental block design to the public (see before and after pictures below). A field experiment was established near Bushy Lake on January 24, 2015 with American River Park Foundation volunteers. Two native riparian understory plant species, *Carex barbarae* (CaBa) and *Elymus triticoides* (ElTr) plugs were planted in areas where invasive species have encroached. The experiment is intended to test the effect of density and species composition on the survival and absolute cover of CaBa and ElTr and on the interaction between the plant density and species. Experiments were weeded and monitored weekly. We implemented adaptive management practices of watering and application of mulch when plant survival began to decline.

Preliminary results showed significant differences between density treatment (higher relative cover with high density plantings), and *Elymus tritoides* has the highest relative cover at this time. The experiment is designed for a one year time period, and results are very preliminary. We anticipate changes in results of restoration over time.

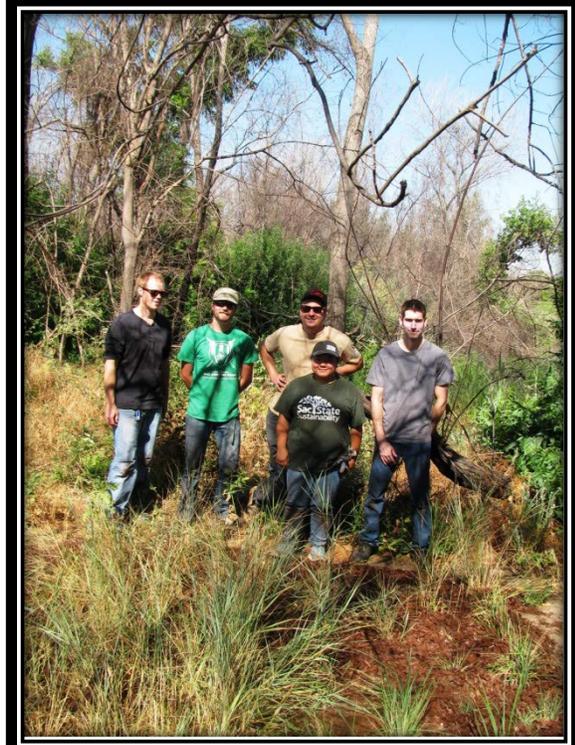
In addition to the experimental results, these five experimental “blocks” will serve as restoration “islands” to provide recolonization sites for future restoration of the adjacent areas. Control of invasive species will allow existing native species on site to expand and flourish if they survive the summer.

- Ch 6 – Monitoring and Adaptive Management

Long term monitoring and adaptive management will be necessary on this site. A weed control plan will be essential to implement. Weeds, with the stimulation of nutrients from ash and extended spring rains, grew over six feet tall in 2015. The best way to control invasive species is to establish healthy soil and competitive vegetation on site. Watering new plants will also be important to get plants established if drought conditions continue to persist.

The experiment demonstrates a proactive effort in restoring a riparian habitat into a fire resilient area which would allow for increase in habitat value and native plants. Recommendations to ensure that proactive efforts will continue to expand restoration and protect this region are to 1) utilize the public, community, CSU Sacramento students, and American River Parkway Foundation volunteers to engage in citizen science for long-term monitoring and adaptive management of the project, and 2) improve public outreach to community to bring together and educate the public about the significance of wetlands, riparian forests, and wildlife residing there. Restoring native plant species, removing non-native weeds, enhancing the ecological resiliency of Bushy Lake and its surroundings, strengthening community outreach, stewardship, and accessibility along the Parkway are all consistent with the policies and goals of the American River Parkway Plan (County of Sacramento et al., 2008). With the continuation of the experiment and future research, the plan would be one step further to reaching its goals.

In order to help the Sacramento County Parks achieve these goals, we recommend/ volunteer Sacramento State students to “adopt” the Bushy Lake project and utilize volunteers to manually weed and replant areas. We would also like to expand experimental research and long-term monitoring and adaptive management, to establish a long term and reciprocal relationship with county Parks.



Public demonstration restoration plot, January 2015 and July 2015, with hardworking volunteers from Environmental Studies, CSU Sacramento at Bushy Lake

This project is part of the *Earth Stewardship Initiative Post-Burn Vegetation Demonstration Project*. We would like to thank Mary Maret and the Sacramento County Department of Regional Parks for funding and support. We would also like to thank Matt Ocko, American River Parkway Foundation, and the many volunteers from ARPF who helped install our restoration experiment. We especially want to thank Matt Owens, Nhan Cao, Josh Hudnall, and other Environmental Studies students for volunteering to assist us with this project.

Student Achievements

- Xiong, Mary and Michelle Stevens. October 2015. Poster Presentation Riparian Understory Restoration of White Root (*Carex barbarae*) and Creeping Wild Rye (*Elymus triticoides*) in Post Burn Areas at Bushy Lake, Sacramento, CA. Abstract submitted to Bay Delta Science Conference 2015.
- Henry, Kayla, Tom Henry, and Michelle Stevens. October 2015. Poster Presentation: Monitoring post-fire resiliency in a depressional wetland using California Rapid Assessment Methodology (CRAM) and intensive vegetation and Avian Species Richness to establish long-term monitoring using citizen science. Abstract submitted to Bay Delta Science Conference 2015.
- Henry, Kayla. 2015. Avian habitat Availability in the Bushy Lake Wetland Restoration Site: A CRAM Based Evaluation. Completion of ENVIS Senior Thesis, Spring 2015.
- Henry, Tom. 2015. Evaluation of Bushy Lake as a Depressional Wetland Reference Site Under the California Rapid Assessment Method (CRAM). Completion of ENVIS Senior Thesis, Spring 2015.
- Xiong, Mary. 2015. Riparian Understory Restoration of White Root (*Carex barbarae*) and Creeping Wild Rye (*Elymus triticoides*) in Post-Burned Areas at Bushy Lake, Sacramento, CA USA. Completion of ENVIS Senior Thesis, Spring 2015.