Project Name: Wildlife Corridors for Flood Escape on the Yolo Bypass Wildlife Area
Applicant Name: Yolo County Resource Conservation District

Monitoring and Adaptive Management Plan

PHASE 1: PLAN

Problem Statement

The Yolo Bypass Wildlife Area (YBWA) is owned and managed by the California Department of Fish and Wildlife (CDFW) to restore and manage a variety of wildlife habitats in the Yolo Basin, a natural basin in the north Sacramento-San Joaquin River Delta (see Location Map). The 16,770-acre YBWA is part of the Yolo Bypass flood control channel that protects Sacramento and other cities from flooding, and is also a haven for fish, waterfowl, shorebirds and wading birds, Neotropical migrants, raptors, invertebrates, reptiles, amphibians and bats. However, wildlife in the YBWA can often become stranded during flood events. As flood waters rise from east to west, wildlife, including deer, furbearers and ground nesting birds, lack adequate cover to move out of lower areas or to escape aerial predation. YBWA staff have observed wildlife mortality during flooding for a number of years. They report deer climbing trees in an attempt to survive (Jeffrey Stoddard, personal communication). Local farmers and ranchers in the area report a variety of wildlife including coyote, fox, rabbit and others seeking rooftops of nearby barns and structures to wait out flood waters (Greg Schmid, personal communication). Yolo Bypass Wildlife Area staff have observed wildlife mortality during flooding for a number of years and see this project as an opportunity to address that problem and restore habitat and ecosystem function on the Wildlife Area. Plans to restore habitat within the Sacramento San-Joaquin Bay Delta include large acreages within the Yolo Bypass. Significant portions of the Bypass acreage are under agricultural operation (grazing or cultivation). The restoration project sites we have selected are a mixture of grazed and unmanaged grasslands consisting primarily of annual grass and noxious invasive weeds offering generally poor quality year-round habitat for mammals, birds and invertebrates such as native bees and butterflies. The project plan is to enhance wildlife habitat adjacent to and compatible with the agriculture operations in the Bypass by establishing 5 miles (22 acres) of new, floodway-compatible wildlife and pollinator corridor habitat to provide an exit and transit corridor for wildlife species to escape advancing floodwater and move to higher ground and enhancing year-round habitat for mammals, birds and invertebrates.

Conceptual Models and Scientific Basis for Planning

The Yolo County Resource Conservation District (RCD) pioneered native plant hedgerow planting on the edges of agricultural land in

Yolo County in the mid-1990s (Robins, et al. 2001). Since then, many other organizations and agencies throughout the state have taken up the practice under a variety of names (pollinator strips, habitat strips, wildlife corridors, etc.) and in a variety of cultivated and wildland settings. Research to understand effectiveness has occurred and continues, but many aspects of these corridors are still not well studied or understood.

Documentation of habitat fragmentation, species isolation, the importance of patch size, and the impacts on reduced genetic diversity go back several decades (Wilcox 1985, Wilcove 1986). Studies of wildlife corridors and their benefits began in the early 1990's and have continued (Beier 1992, Harrison 1992, Fahrig 2003). More recent studies emphasize the importance of re-connecting separated habitat areas and providing safe, diverse corridors for wildlife movement to allow response to changing weather, climate, food, population and other life-history needs (Harrison 1992, Fischer 1999, Bond 2003,). There are documented benefits to improved native plant movement with the establishment of wildlife corridors (Brudvig 2009). The USDA Natural Resources Conservation Service produced a publication dealing specifically with wildlife corridor planning and management and highlights the environmental, social and economic benefits (Johnson 1999). The 2012 Wilderness Society publication, Designating Wildlife Corridors on the Public Lands (Protection through the Bureau of Land Management's Land Use Planning Process), describes how crucial wildlife populations are to quality of life, developing a framework to define and preserve wildlife movement patterns through habitat-connecting corridors.

There are multiple studies on beneficial insect use of native plant hedgerows from the last decade. They document the use and dispersal from hedgerows by crop pest-predators and various pollinator species, including lacewings, lady bugs, assassin bugs, honey bees, native bees, wasps, syrphid flies and butterflies (Long and Anderson 2010; Morandin et al. 2011; Morandin and Kremen 2013). Morandin and Kremen studied pollinators along edges of agricultural fields for benefits to biodiversity and ecosystem services such as pollination (Morandin and Kremen 2013). They found that native bees and syrphid flies were more abundant, species-rich, and diverse in these hedgerows than in weedy, unmanaged edges. In particular, uncommon species of native bees were 7 times more abundant on native plant flowers than on flowers in weedy edges, and that these pollinators dispersed readily from the native plant borders into areas where pollination services could be provided. In the report, Hedgerows enhance beneficial insects on farms in California's Central Valley, Morandin and Long (2011) documented that California native plant field borders attract far more beneficial than pest insects.

Controlled studies on bird use of hedgerows, particularly in California, are harder to find. Hinsley and Bellamy's (2000) review of

published articles in 2000 found evidential support for substantial use of hedge-type corridors by migratory and resident songbirds. K. Velas (Velas, et al. 2014) of Audubon California, in an as yet unpublished technical report, conducted a statistically analyzed survey comparing bird use of planted hedgerows vs unplanted areas, finding that hedgerows increase bird species richness (significantly more taxa) and average abundance.

Johnson and Beck (1988) confirmed that shelterbelts provide wildlife wind and weather protection, escape cover, food and foraging sites, reproductive habitat and travel corridors. They found at least 108 species of birds and 28 species of mammals use shelterbelts, extending the ranges of several bird and small mammal species. The authors recommend enhancing benefits by designing for the needs of the most desired wildlife with attention to complexity. They also note that shelterbelts may provide economic, educational, recreational and aesthetic benefits.

There is a paucity of research on the benefits of wildlife corridors during flood events. It follows that wildlife corridors would provide shelter and cover during escape from rising flood waters. Wildlife monitoring is notoriously difficult and/or costly. Our proposal to use game trail cameras during strategic times of the year, and during any flood events that occur during the contract period, will serve as pilot documentation of this type of benefit, to inform future similar work and will keep costs low. The University of California Davis Road Ecology Center's research program in-progress is tracking wildlife movement and connectivity effects (http://roadecology.ucdavis.edu/research/programs/wildlife-movement-connectivity). We will use those program principles and practices as a model for our wildlife corridor use observations. We bring the experience of 20 years of hedgerow installation in a variety of working landscape and wildland conditions, to installing the proposed wildlife corridors, using methods that demonstrate greatest plant survival and selecting species that survive and thrive under the potential extremes of drought, heat and flood. Pre-plant weed control and site preparation begins well in advance of planting. Native grasses will be seeded and plants installed in late fall/winter. Maintenance begins during the following spring. The start of irrigation is dictated by weather conditions and could continue into fall. Specific nuances within each of these steps are catered to specific site conditions and needs.

Goals and Objectives

Project Goal: Create wildlife habitat on the Yolo Bypass Wildlife Area (YBWA) to solve wildlife flood-safety problems and enhance year-round wildlife habitat;

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Project Objective: Create new habitat as diverse in design, structure and composition as is allowable within the Yolo Bypass floodway by replacing non-native vegetation with native vegetation along two east-west corridors totaling five miles (22 acres) and a public demonstration planting. The project sites will not be an isolated habitat patch, but will instead be designed to connect with existing, mature riparian habitat, promoting safe wildlife movement and expanding and diversifying habitats currently accessible. The restored habitat will be planned to provide food and cover benefits to a range of species including birds, mammals, reptiles, amphibians and insects. It will be as structurally diverse as hydraulic models allow within the constraints of channel roughness limitations, with varying height levels from shrubs to semi-woody forbs to groundcovers and grasses. This will provide cover for birds that nest in grassland or shrubland and a travel connection between upland habitat and riparian forest for mammals, birds, reptiles, amphibians and insects. The plant species selected will include a wide range of bloom times, supplying pollen and nectar for native beneficial invertebrates such as lacewings, lady bugs, assassin bugs, honey bees, native bees, wasps, syrphid flies and butterflies, which can in turn can provide food for birds, reptiles, amphibians and other insectivores. Plant selection will also consider species that produce fruits and seeds, supplying a food source for a range of birds, mammals and other herbivores. There is a 75% survival rate for native vegetation planted.

PHASE 2: DO

Project Actions

The following actions are required to implement project objectives and evaluate the success of completing the project goal:

Action 1 – Design. The RCD will work with CDFW, project partners and stakeholders to conduct ground survey assessments and finalize planting design and species list for restoration activities on project sites.

Performance measures: 1) Ground surveys/baseline assessments completed; 2) species list completed for each of the 3 areas to be planted; 3) planting design completed for each area to be planted.

Action 2 – Permitting. The RCD will work with CDFW and project partners to complete all plans and analyses needed to obtain required permits.

Performance measures: 1) CEQA Categorical Exemption; 2) Notice of Exemption under California Code of Regulations Title 14 Section 15304 d, encroachment permit from CVFPB/Reclamation Board; 3) USACE Section 408 approval; 4) USFWS consultation on existing Biological Opinion for Giant Garter Snake in YBWA to ensure planned activities are in compliance.

Action 3 – Restoration.

In coordination with project partners, the RCD will prepare the project sites by removing standing debris and existing invasive weeds from project sites. The sites will be monitored and treated for noxious weeds as needed until the sites are planted with carefully selected native plant seed, nursery stock and cuttings. Temporary drip irrigation systems will provide irrigation to tree and shrub species as needed during the dry season. Weeds will be treated as needed using appropriate chemical and mechanical techniques. Plants that do not survive will be replaced as needed to achieve a desired 75% survival rate.

Performance measures: 1) All three sites adequately prepared for planting – standing debris and weeds removed; 2) all three sites planted with specially selected native plants nursery stock and cuttings and seeded with native plant seed; 3)Miles of corridor and acres of demonstration planting established will be physically measured.

3) drip irrigation installed on all three sites; 4) Irrigation and weed control performed regularly throughout growing season to acceptable management standards; 5) plants that do not survive are replaced to achieve a minimum 75% survival rate.

Monitoring

We will monitor the above actions in the following ways:

For Action 1, above – Ground-based surveys and baseline assessments will be completed before any on-the ground activities take place and used to refine plant species selection and complete design plans.

For Action 2 above – A checklist of all permits needed will be developed and used to track permitting progress and completion.

For Action 3 above:

1. A timeline and checklist will be used to track progress toward adequate site preparation, seed/plant installation and irrigation line installation.
2. Baseline plant count will be conducted after the initial restoration planting has been completed.
3. During the two subsequent growing seasons, plant counts will be conducted to determine mortality.
4. Wildlife use will be monitored before and after implementation of planting activities.
    a. During the grant cycle, the RCD will document wildlife use, working with the Point Blue Conservation Science NRCS Partner Biologist to collect baseline and post-installation data on summer/winter bird counts from area bird searches, bee and butterfly use from spring and summer surveys, and annual wildlife species indexes through the use of trail camera visual capture.
    b. Given that the funding timeframe is shorter than the timeframe needed for woody plants to mature and provide intended habitat, and that there are limitations to monitoring wildlife use during flood events, monitoring will emphasize protocols that wildlife enthusiasts and hobbyists with minimal training can execute, and thus, they would lend themselves to citizen scientist or university students continuing the work after the funding cycle.
    c. Bird use of the project sites will be monitored using the Area Search Bird Count Protocol [http://data.prbo.org/cadc2/index.php?page=songbird-area-searches]. This method is designed for people who have good bird identification skills, but not necessarily training in bird count methods. Bird clubs like the Audubon Society

or seasoned birders could complete these counts.

d. The pollinator monitoring will combine elements of the UC Davis and partners' Streamlined Bee Monitoring Protocol [http://www.xerces.org/streamlined-bee-monitoring-protocol/] and simple butterfly counts, both of which can be performed by enthusiasts or with minimal training and good observational skills.

e. Lastly, we hope that citizen scientists recruited by Yolo Basin Foundation can continue developing data on baseline and to review the photo or videos from the remote camera traps on the corridor, from the start of the project to beyond the grant cycle.

Over the course of the four year project, we expect to monitor as follows:

2017 - Baseline wildlife monitoring completed
2018 - Restoration activities completed and plant baseline survey completed. Measure miles and acres of project areas restored.
2019 - Year 1 plant survival and wildlife monitoring completed.
Replace all dead plants.
2020 - Year 2 plant survival and wildlife monitoring completed.
If 75% or greater plant survival, no replanting need. If less than 75% plant survival, replant to at least 75% of plan.

Annual monitoring activities	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
plant count												
camera trap I												
camera trap II												
bird count I												
bird count II												
bird count III												
bee survey I												
bee survey II												
butterfly count I												
butterfly count II												

PHASE – 3: EVALUATE AND RESPOND

The table below defines the project goal related to the project's covered action, its desired output and outcome indicators, our measurement tools and methods for evaluating the project's success in achieving the desired outcomes. Initial targets have been set, however, depending on baseline and subsequent analyses of data collected, these may change to be provide a more meaningful understanding of biological services provided by the project.

Project Goal	Desired Project Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
Goal 1. The YCRCD has led efforts during the contract period to create wildlife habitat on the YBWA that solves wildlife flood-safety problems and enhances habitat year-round.	1. Increased use of floodway-escape corridor area by target species. 2. Higher survival of target species during flood events 3. Greater plant diversity that concurrently promotes enhanced food and cover for wildlife. 4. Increased abundance or density of target wildlife throughout the year.	1. 5 miles of corridor established. 3. 22 Acres of habitat and publicly accessible demonstration planting established. 3. Numbers of plants surviving in corridors and demonstration area. 4. Pollinator, butterfly, bird and mammalian wildlife monitoring data.)	1. Numbers of target wildlife species using the habitat corridors.' 2. Abundance and species diversity of native bees, butterflies and birds.	1. Plant survival counts. 2. Bee and butterfly surveys 3. Bird counts – "Area Search" standard method 4. "Capture" photo data from game cameras deployed during 2 yearly sessions – "Wildlife Use Index" standard method.	1. 75% plant survival at each project location by the end of the project. 2. Two-fold increase in numbers of target wildlife species using habitat corridors. 3. Native bee numbers double from baseline to three years after planting at each transect. 4. Butterfly species richness increased by at least 3 species and numbers of target butterflies increased by 50% between baseline and counts 3 years after planting.

Data Collection and Management

We are not aware of existing efforts to monitor flood escape corridor establishment or efficacy. However, there are inventories of restoration projects installed, and if desired, data on this project will be contributed. Data monitoring project installation success will be measured against outcome indicators in the Performance Measures table and reported to the Delta Conservancy's grant manager. All documents, data, images, graphics and communication associated with the project will be stored on the YCRCD server,

which is backed up daily to "the cloud" through our external IT service provider. Invoices and reports will be sent in timely fashion to the grantor; reports will be distributed to project partners, as partners' desire. Appropriate elements, such as wildlife monitoring data, will be generated by the Point Blue Conservation Science Partner Biologist in the NRCS office and shared with other Point Blue biologists and staff and with NRCS staff as determined appropriate by the biologist. We consider information generated through this project to be public and so will share it with the public or other agencies upon request. Any information that generates publishable data will be prepared for and published in appropriate publication venues. We do not expect to generate information appropriate to existing statewide databases, with the possible exception of some of the wildlife monitoring data. If appropriate, those will be entered by the Partner Biologist. If it is determined that data generated is appropriate to EcoAtlas or CEDEN, that data will be uploaded.

Analyze and Adapt

Monitoring for baseline conditions and plant survival are parameters that can be responded to within the project funding period. Collection of survival data by species planted will allow us to evaluate and verify species appropriateness to site conditions and if needed, different species can be selected for replanting if appropriate. This is a simple adaptive approach. Evaluation of the success of wildlife corridors for flood escape will need to occur outside of the grant period - over time after plants have matured and as volunteer citizen scientists collect wildlife use data in post-project years. If wildlife escape cover objectives are not met, local and regional experts will need to determine most likely reasons, what current or future actions should change and if objectives and the desired outcomes should change.

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