Climate Smart Actions
for Natural Resource Managers

Principles & Case Studies Summary
San Francisco Bay Area, California
November 2012

Workshop sponsored by:
Bay Area Ecosystems Climate Change Consortium
The Nature Conservancy
California Landscape Conservation Cooperative
California State Coastal Conservancy
The Gordon and Betty Moore Foundation

Presentations:
http://climate.calcommons.org/article/featured-workshop-climate-smart-actions

Photo by Jerry Ting

Principles for Designing and Implementing Climate Smart Actions

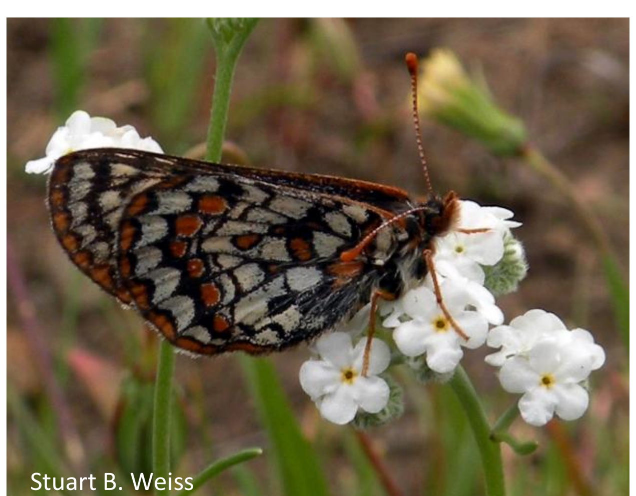
Resources Legacy Fund Expert Panel
Guiding Principles for Ecosystem Adaptation
October 2012

1. Conserve the variety of ecological settings that will support California's biodiversity and ecosystems as they shift in response to the changing climate.
2. Conserve and restore landscape linkages and connectivity areas that will allow diverse species to move to new locations and will enhance their persistence.
3. Set priorities for watershed protection and management that will yield conservation and societal benefits as water flows become more variable and potentially decline.
4. Adjust flows below dams and protect coldwater habitats to support native species and aquatic ecosystems.
5. Develop and implement strategies that will ensure the persistence of coastal ecosystems as sea level rises.
6. Manage ecosystems for resilience in the face of extreme events.
7. Align adaptation and mitigation strategies to optimize the co-benefits for people and for ecosystems
8. Use best available scientific information and technical know-how to make informed decisions now in an adaptive management framework
9. Manage for the future.

———

Excerpted from the forthcoming report soon to be posted online at http://www.resourceslegacyfund.org.

Resources Legacy Fund. 2012. *Ecosystem Adaptation to Climate Change in California: Nine Guiding Principles.* Resources Legacy Fund, Sacramento, California, 32 pp.



National Wildlife Federation
Climate Change Adaptation Principles
June 2011

1. Actions Linked to Climate Impacts. Conservation strategies and actions are designed specifically to address the impact of climate change in concert with existing threats; actions are supported by an explicit scientific rationale.

2. Forward-Looking Goals. Conservation goals focus on future, rather than past, climatic and ecological conditions; strategies take a long view (decades to centuries) but account for near-term conservation challenges and needed transition strategies.

3. Broader Landscape Context. On-the-ground actions are designed in the context of broader geographic scales to account for likely shifts in species distributions, to sustain ecological processes, and to promote collaboration.

4. Robust in an Uncertain Future. Strategies and actions provide benefit across a range of possible future conditions to account for uncertainties in future climatic conditions, and in ecological and human responses to climate shifts.

5. Agile and Informed Management. Conservation planning and resource management is capable of continuous learning and dynamic adjustment to accommodate uncertainty, take advantage of new knowledge, and cope with rapid shifts in climatic, ecological, and socio-economic conditions.

6. Minimizes Carbon Footprint. Strategies and projects minimize energy use and greenhouse gas emissions, and sustain the natural ability of ecosystems to cycle and sequester carbon and other greenhouse gases.

7. Climate Influence on Project Success. Considers how foreseeable climate impacts may compromise project success; generally avoids investing in efforts likely to be undermined by climate-related changes unless part of an intentional strategy.

8. Safeguards People and Wildlife. Strategies and actions enhance the capacity of ecosystems to protect human communities from climate change impacts in ways that also sustain and benefit fish, wildlife, and plants.

9. Avoids Maladaptation. Actions taken to address climate change impacts on human communities or natural systems do not exacerbate other climate-related vulnerabilities or undermine conservation goals and broader ecosystem sustainability.

California Climate Adaptation Strategy
DRAFT Climate Smart Principles for State Agencies
July 2012 (to be finalized in 2013)

1. Make Climate Appropriate Decisions in Project Evaluation: Consider the potential effects of climate change on existing and proposed projects to evaluate project merit. Avoid investing in projects that are likely to be undermined by climate-related changes.

2. Plan for Co-Objectives of Climate Mitigation and Adaptation: Develop a planning process that supports comprehensive climate response, aligning greenhouse gas mitigation strategies with adaptation actions.

3. Develop Goals for Forward-Looking and Progressive Time-Scales: Focus conservation goals on future climatic and ecological conditions rather than those of the past. Develop strategies for near-term and long-term timescales.

4. Design Actions from a Landscape, Ecosystem, and Watershed Perspective: Design actions in the context of broader geographic scales and regional contexts to account for likely shifts in species distributions and other ecological changes. Promote collaboration among various stakeholders to develop multi-scale and large-scale actions.

5. Use Adaptive Management: Employ an adaptive management decision making framework that is flexible and responsive to changes in climate, ecology and economics.

6. Prioritize Actions: Prioritize actions based on their risks and benefits, as well as the likelihood that they will reduce the vulnerability of built and natural environments.

a. No Risk Actions: Prioritize actions that have high probability of producing beneficial adaptation outcomes.

b. High Vulnerability Actions: Prioritize actions that improve the capacity of highly vulnerable ecosystems to adapt to climate change impacts.

c. Multi-benefit Actions: Prioritize actions that produce the greatest combination of benefits under a range of possible future climate scenarios.

7. Align Adaptation Strategies with Overall Biodiversity Goals: Prioritize biodiversity as a climate adaptation strategy that builds resiliency in ecological systems.

8. Safeguard People, Wildlife and the Economy: Employ strategies that enhance the capacity of human communities to adapt to extreme, climate change driven events by implementing nature-based solutions that also benefit fish, wildlife, and plants. Prioritize activities that provide co-benefits for people, wildlife, and the economy.

9. Plan for Climate Variability: Ensure that actions address the impacts of increasing climate variability in addition to the impacts of temperature change.

Climate Smart Actions for Natural Resource Managers Workshop
Case Study: Redwood Creek Restoration at Muir Beach

By Carolyn Shoulders, National Park Service

November 29, 2012

Lead Agency/Organization and Partners: National Park Service (NPS), Golden Gate National Recreation Area - Lead agency for planning and implementation. Other partners: Marin County – planning and implementation; Golden Gate National Parks Conservancy – implementation. Funders: California Dept. of Fish and Game, State Coastal Conservancy, U.S. Fish and Wildlife Service, Wildlife Conservation Board, National Park Service.

Project Description: The project is a 46-acre landscape-level restoration at Muir Beach, in southern Marin County, where 20th Century land management actions disrupted the function of fluvial and coastal processes at the mouth of the watershed. The site provides habitat for federally listed coho salmon, steelhead, and California red-legged frog (CRLF), and attracts about 260,000 visitors per year.

This project was not planned as a climate change adaption project. However, its actions are appropriate for climate change planning since they will allow better ecosystem adaptation to changing groundwater elevations, storm surge, tidal influence and more intense flood events.

The purpose of the project is to restore a functional, self-sustaining ecosystem, including wetland, riparian and aquatic components and to conduct the restoration in a manner that will recreate habitat for sustainable populations of special status species, reduce flooding on an adjacent public road, and accommodate visitors in a manner that is compatible with natural resource function.

The historic pre-European landscape featured an open water lagoon that persisted for 5,000 years when sedimentation rates exceeded sea level rise. The lagoon was lost in the 19th Century when sedimentation exceeded sea level rise. In an early phase of project planning, a detailed Watershed Sediment Budget was prepared by Stillwater Sciences and its findings of high sedimentation rates influenced NPS to select a preferred alternative that focused on fluvial restoration, instead of creating the big lagoon. However, extreme sea level rise could lead to conditions more similar to the historic “Big Lagoon” at the site.

Primary objectives for the project are as follows:

1. Remove constraints to natural geomorphic processes such as sediment transport, channel migration, channel-floodplain interaction, and seasonal and long-term beach change.
2. Rely on geomorphic processes to maintain and support the restoration.
3. Accommodate future watershed sediment delivery.
4. Restore natural beach processes.
5. Accommodate physical disturbance (*i.e*., extreme hydrologic event, storm surge, sediment pulse, etc.).
6. Restore physical complexity of creek channel.
7. Improve coho salmon and steelhead winter rearing habitat.
8. Maintain or improve breeding and rearing habitat for CRLF (*Rana aurora draytonii).*

9. Re-establish natural lateral and longitudinal connectivity among channel, floodplain, riparian, and upland habitats.
10. Enhance native dune processes and increase diversity of native dune communities.
11. Enhance native wetland and riparian plant assemblages.
12. Accommodate visitors in a manner that is compatible with natural resource function.
13. Provide opportunities for public engagement and education.

The estimated project cost is $10 million.

Approach to Vulnerability Assessment: Vulnerability to climate change effects was evaluated as part of a feasibility analysis and again during preparation of a Final EIS/EIR by consulting hydrologists and engineers, Phil Williams and Associates (PWA). Intergovernmental Panel on Climate Change (IPCC) projections for sea level rise changed during the 5-year period of project planning, and analyses were repeated. Hydraulic models used extreme high tides to estimate the effect of potential sea level rise on upstream flood elevations. Project actions alleviate flood elevations due to the removal of hydraulic constraints and the reconnection of the broad floodplain, and the flood control improvements are generally achieved even with sea level rise. A qualitative approach was used to identify a landward shift of tidal influence, expected increase in groundwater elevations, and beach retreat of 80 to 100 feet, each of which could convert vegetation cover.

Adaptation Actions: Primary actions include relocating a visitor parking lot that functions as a hydraulic obstruction, removing a 1,300 LF levee road bisecting the floodplain, relocating about 2,000 LF of channel to its natural topographic location, expanding an intermittent tidal lagoon, creating off-channel habitat for coho and other salmonids, reconnecting the floodplain by removing artificial fill, constructing a pedestrian boardwalk bridge over a new floodplain for visitor access to the beach, and rerouting a beach access trail to allow foredune restoration.

Implementation: Plans for the project are described in the Final EIS/EIR for the Wetland and Creek Restoration at Big Lagoon, Muir Beach (Dec. 2007). Planning began in late 2002. The first phase of construction began in summer 2009, and as of 2011, the first three of about five phases of implementation have been completed.

Phase 3 actions achieved a primary goal of the project by completing and activating flow in a new 1,437-LF channel alignment. Most of the channel is now fully connected to its floodplain, and the system has an extensive new set of habitat features for coho, steelhead and CRLF. Most of the levee road is removed and a portion of the lower parking lot is removed, with a new 225-LF pedestrian bridge over the floodplain. A new 0.4-acre tidal lagoon expansion and an associated 2-acre floodplain have been restored by removing artificial fill. Some 70,000 native plants have been installed, and about 3,000 hours per year are contributed by volunteers.

The new channel has functioned for only one winter since it was completed, but overbank flows and sediment transport processes thus far appear to function as expected.

Phase 4 actions, expected in 2013, will relocate the visitor parking lot out of the floodplain, construct a boardwalk/bridge over the floodplain for beach access, and restore native foredunes.

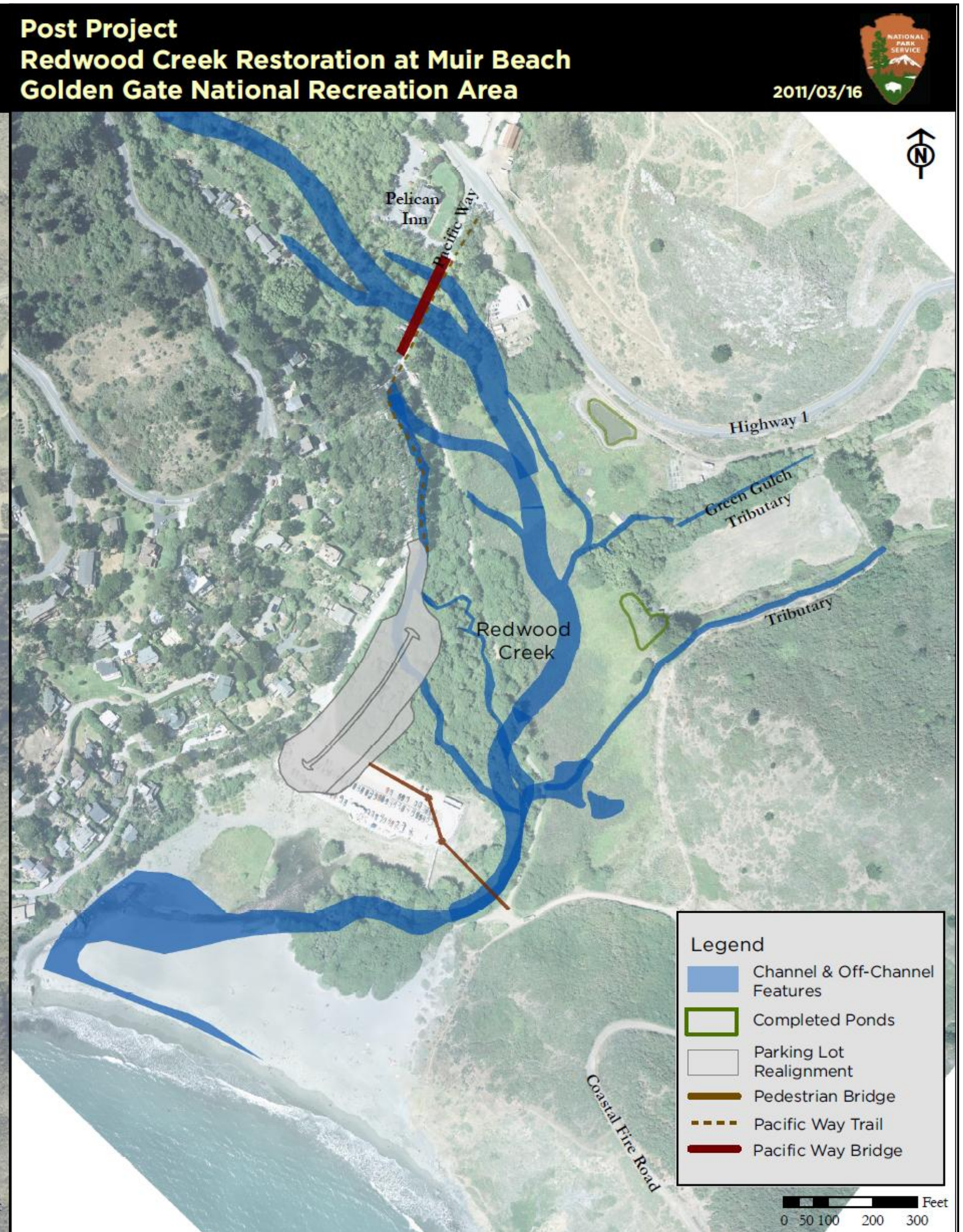
Monitoring and Management: Extensive post-project monitoring addresses geomorphology, hydrology and ecology objectives for the project. Adaptive management will be conducted as needed.

Lessons Learned: The project had extensive technical input from hydrologists, ecologists, fish biologists and others at every stage of planning, including the preparation of construction designs. At each stage, refinements were made to the overall conceptual model. This was an expensive and time-consuming process, but the project function was improved as a result.

One of the few things I would do differently is to understand subsurface conditions better as part of early planning processes. This would allow improved planning for soil types, material reuse, likely construction issues, especially for pedestrian crossing over a new floodplain.

For Further Information: Carolyn Shoulders, project manager: Carolyn_Shoulders@nps.gov and two websites: www.nps.gov/goga/naturescience/**muir-beach**.htm and www.parksconservancy.org/park-improvements/current-projects/marin/redwood-creek.html**.**


Pre Project
Redwood Creek Restoration at Muir Beach
Golden Gate National Recreation Area
2011/03/25
N
Pelican Inn
Pacific Way
Pacific Way Bridge
Levee Road
Highway 1
Green Gulch Tributary
Redwood Creek
Tributary
Parking Lot
Tidal Lagoon
Coastal Fire Road
0 50 100 200 300 Feet


Post Project
Redwood Creek Restoration at Muir Beach
Golden Gate National Recreation Area
2011/03/16
N
Pelican Inn
Pacific Way
Highway 1
Green Gulch Tributary
Redwood Creek
Tributary
Coastal Fire Road
Legend
Channel & Off-Channel Features
Completed Ponds
Parking Lot Realignment
Pedestrian Bridge
Pacific Way Trail
Pacific Way Bridge
0 50 100 200 300 Feet

Climate Smart Actions for Natural Resource Managers Workshop
Case Study: Upper Pajaro River Floodplain Restoration Project

By Sasha Gennet and Kirk Klausmeyer, The Nature Conservancy
November 29, 2012

Lead Agency/Organization and Partners: This project is highly collaborative with different partners focusing on different actions/areas:

- The Nature Conservancy – planning, research/monitoring, implementation.
- Santa Clara Valley Water District
- Pajaro Valley Water Management Authority and the Integrated Regional Water Management Plan partners
- Natural Resources Conservation Service
- Silicon Valley Land Conservancy
- Santa Clara County Open Space Authority
- Living Landscape Initiative partners
- San Benito and Santa Cruz Resource Conservation Districts
- PRBO Conservation Science
- Watsonville Wetlands Watch
- Wild Farm Alliance

Project Description: The Mt. Hamilton, Santa Cruz, and Gabilan Mountain ranges meet at the Pajaro River, an area rich in wildlife, water, agriculture and ranching (Figure 1). Birds use the coastal and floodplain wetlands as major resting points along the Pacific flyway. Wild animals such as mountain lions and badgers migrate and disperse through the landscape. The watershed contains some of California's most productive farmlands and many of the remaining large ranches in and around Silicon Valley.

Upper Pajaro River floodplain looking east. Photos courtesy William K. Matthias and Living Landscape Initiative.

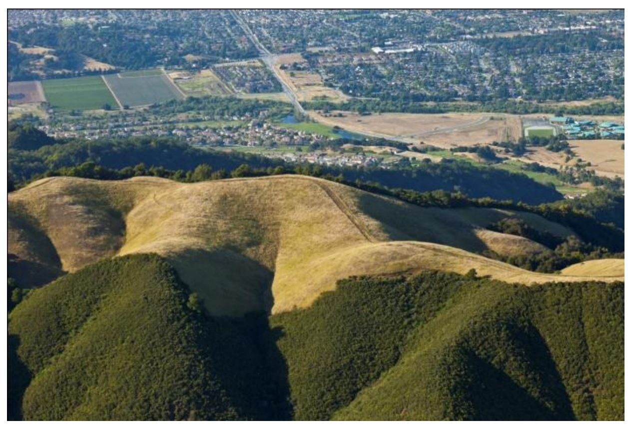
The region contains some of the last streams supporting steelhead trout along the Central Coast. These streams flow into the Pajaro River, which in turn drains into the Monterey Bay, a National Marine Sanctuary. As our climate changes and habitats shift, keeping these lands intact and connected will be critical for allowing plants and animals to persist and adapt.

The critical corridor of the Upper Pajaro River floodplain and the adjacent foothills of the three coastal mountain ranges are threatened by conversion to intensive agriculture and development. This landscape is part of the beautiful Santa Clara Valley, is just 30 minutes from San Jose and has been proposed for a number of transportation and housing development projects. While focused on the entire landscape our immediate goal is to protect - through conservation easements and habitat restoration projects - several properties in that landscape to conserve the ecological values and function of the upper floodplain and wildlife corridors. The protection of the upper floodplain also ensures critical flood protection for the lower floodplain, more specifically for the towns of Pajaro, Watsonville and the surrounding strawberry and lettuce farms.

Approach to Vulnerability Assessment: Protecting the upper Pajaro River floodplain was a conservation priority of The Nature Conservancy even before we began comprehensive climate change planning and vulnerability assessments for this area. Our vulnerability assessment indicated this landscape provided climate as well as conservation values, and helped to drive more organizational focus toward protecting the region.

Our climate change planning effort began by identifying six key species and habitats in the Mount Hamilton project area, which includes the upper Pajaro River floodplain, that are likely to be vulnerable to climate change. We then used a step-by-step approach to develop adaptation strategies following a method similar to the one described by Poiani *et al.* (2011)[1]. This approach involved developing climate change informed "hypotheses of change" for each species/habitat, and then bringing a team of experts together in a workshop setting to develop adaptation strategies to minimize the negative impacts of climate change. We relied on climate change data and modeled species range shifts developed by TNC. The entire process took about one year. Full details about the species, methods, and workshop participants, and the prioritization process are available here: http://conserveonline.org/workspaces/CA.climate.change/documents/mount-hamilton-climate-adaptive-strategies/view.html.

Adaptation Actions: As a result of our climate change planning, we developed a large list of potential actions to help the 6 focal species/habitats adapt to climate change. We looked for areas where multiple focal species were found, and identified the Pajaro as one important area because it contains a steelhead stream, supports important amphibian habitat for species like the California Tiger Salamander, and has the potential to add connectivity for wide-ranging mammals like the Badger. We also chose this site because it helps humans adapt to climate change by storing floodwaters and helping to protect the downstream agricultural lands and the towns of Watsonville and Pajaro.



Development pressure from Santa Clara Valley.. Photos courtesy William K. Matthias and Living Landscape Initiative.

The key actions we selected to implement in the Pajaro include land protection and restoration of riparian habitat. We chose these actions because much of the potential corridor is not protected, and land protection is designed to last in perpetuity. These actions are well suited to TNC's capacity, and they also align with existing priority actions from previous planning efforts.

[1] Poiani, K., R. Goldman, J. Hobson, J. Hoekstra, and K. Nelson. 2011. Redesigning biodiversity conservation projects for climate change: examples from the field. Biodiversity and Conservation 20:185-201.

Implementation: Through the years, we have documented our planning and anticipated actions in initial assessments, restoration plans and grant proposals. To date, several properties have been protected by TNC and partners; restoration has been completed on at least two properties and two additional are in the planning/fundraising phase. In addition, baseline wildlife monitoring has been completed.

Monitoring and Management: For the lands we protect through conservation easement, annual monitoring will be completed in perpetuity. For the restoration projects in planning phase, our partners will complete several years of post-restoration monitoring, and adaptive management actions (e.g., planting, invasive species control) will be based on survivorship and wildlife use monitoring.

Lessons Learned: From the climate change planning, we distilled the following lessons learned:

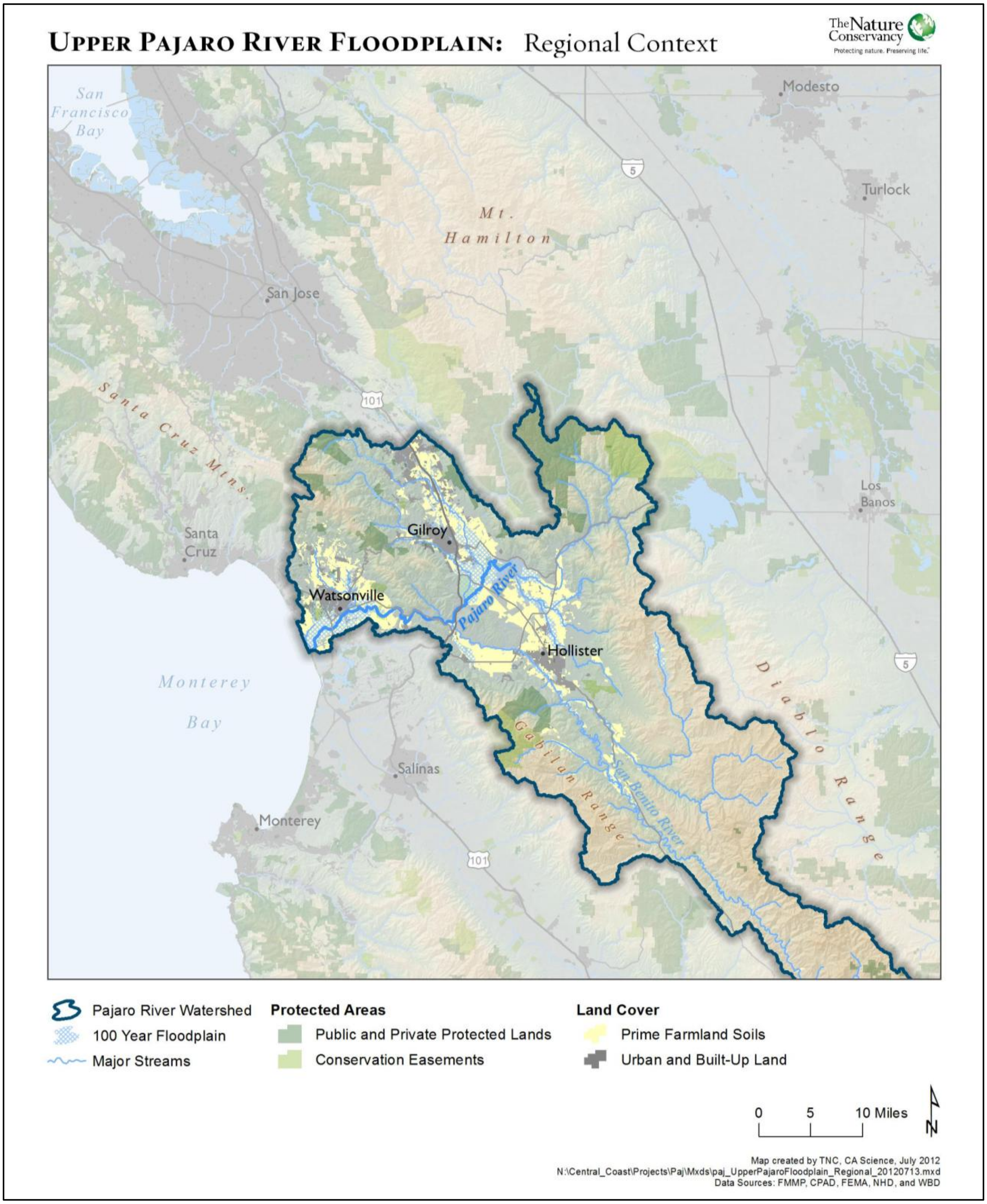
1. Keep it simple. Existing conservation plans, a history of successful implementation, narrow focal target lists, and scenario planning approaches that limit the number of futures considered all streamline decisions about what to do for climate adaptation.
2. Give ample time to set goals and objectives that define what you would like to adapt and what successful adaptation looks like, because the process often takes more time than expected.
3. When developing hypotheses of change, identify vulnerable ecological attributes of each species/habitat, then consider how these are impacted by historical climates as well as future climate projections.
4. Consider human response to climate change because in many cases this trumps the direct impacts of climate change on targets.
5. Pull from diverse stakeholder expertise and experiences.
6. Situational diagrams are a good way to capture complex interactions between humans, nature and climate, that also allow you to trace positive or negative effects on focal targets.

A full report on our lessons learned is available here: http://conserveonline.org/workspaces/CA.climate.change/documents/planning-for-adaptation-to-climate-change-methods**.**

In the implementation phase, we are finding that having a long-term commitment to goals, and ongoing communication with partners and landowners/community members are key elements that are working well.

For Further Information: Sasha Gennet, TNC Ecologist, 201 Mission St., 4th Floor, San Francisco, CA 94105, sgennet@tnc.org.

Figure 1


UPPER PAJARO RIVER FLOODPLAIN: Regional Context
The Nature Conservancy
Protecting nature. Preserving life.
San Francisco Bay
Modesto
Turlock
Mt. Hamilton
San Jose
Santa Cruz Mtns
Santa Cruz
Gilroy
Watsonville
Pajaro River
Hollister
Los Banos
Monterey Bay
Salinas
Monterey
Gabilan Range
San Benito River
Diablo Range
Pajaro River Watershed
100 Year Floodplain
Major Streams
Protected Areas
Public and Private Protected Lands
Conservation Easements
Land Cover
Prime Farmland Soils
Urban and Built-Up Land
0 5 10 Miles
N
Map created by TNC, CA Science, July 2012
N:\Central_Coast\Projects\Paj\Mxds\paj_UpperPajaroFloodplain_Regional_20120713.mxd
Data Sources: FMMP, CPAD, FEMA, NHD, and WBD

Climate Smart Actions for Natural Resource Managers Workshop
Case Study: Sears Point Restoration Project

By Julian Meisler, Sonoma Land Trust
November 29, 2012

Lead Agency/Organization and Partners: Sonoma Land Trust (SLT) is leading the Sears Point Restoration Project. Since its establishment in 1976, SLT has invested in acquisition and restoration of the Sonoma Baylands, protecting nearly 5,000 acres there. Ducks Unlimited (DU) is SLT's primary partner on the project providing design, permitting, and construction management services as well as assistance with fundraising. US Fish and Wildlife Service San Pablo Bay National Wildlife Refuge and California Department of Fish and Game serve as lead agencies.

Project Description: Since the late 1800s the San Francisco Bay Estuary has lost an estimated 80% of its tidal marshes and nearly that amount of the seasonal freshwater wetlands that surround its margins.

In 2005 SLT acquired the 2,327-acre Sears Point property, a vital link along the northern San Pablo Bay shoreline connecting nearly five miles of protected and restored tidal marsh habitat from the Petaluma River to Tolay Creek. Unique among nearly all shoreline conservation properties, Sears Point extends deep into the adjacent uplands reaching elevations of nearly 400 feet. Some nine miles of riparian corridors traverse its grasslands, willow groves, and broad plains of seasonal wetlands to connect upland to Bay. Slated for casino development prior to SLT's acquisition, Sears Point is protected in perpetuity offering an unparalleled opportunity for landscape-scale restoration of multiple habitats in the North Bay.

Climate change was just one of the factors to be considered during restoration planning. Endangered species recovery and water quality were also considered, but today it is clear that all these drivers fit under the umbrella of climate change because each will be affected by projected changes.

Over the next several years SLT, will restore/enhance 960 acres of tidal marsh and nearly 1,350 acres of associated ecotonal seasonal wetlands, riparian corridors, and upland grasslands at Sears Point. As part of the project, SLT will construct 2.5 miles of the Bay Trail for public use. However, this case study focuses primarily on the tidal marsh restoration element.

The total cost of the restoration is expected to be $18 million with roughly 90% of the project cost related to the tidal marsh project elements.

Approach to Vulnerability Assessment: While no formal vulnerability assessment was done per se, the planning process included an extensive inventory of biological and physical (*e.g.*, elevation) attributes of the property. Its juxtaposition to other conservation properties and infrastructure were evaluated. The likelihood of success was evaluated on these factors as well as the local and regional supply of suspended sediment, which would be needed to build the marsh. Several restoration scenarios were developed. All of the diked agricultural baylands along the San Pablo Bay shoreline are subsided and vulnerable to catastrophic flooding with or without sea level rise. Sears Point is separated from the Bay by a 5-mile long, 120-year old levee that has been capped, patched, and raised on numerous occasions over the past century.

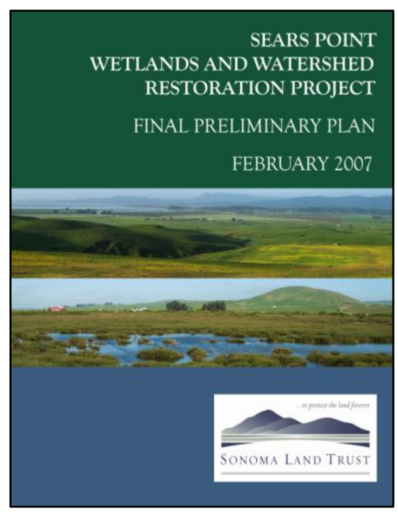
The planning process spanned two years and was conducted by SLT and a team of contracted hydrologists, ecologists, and engineers working with a technical review committee.

Adaptation Actions: Successful tidal marsh restoration depends in large part on three factors: suspended sediment supply, site elevation, and rate of sea level rise. While only the site elevation can be known for certain, we used knowledge of a relatively rich sediment supply from the Petaluma River watershed and other local sources to determine that Sears Point tidal marsh development has a strong chance of keeping pace with sea level rise, particularly if implemented in the near term.

Specific design elements included to hasten marsh development and provide resilience against sea level rise (see map on following page) include:

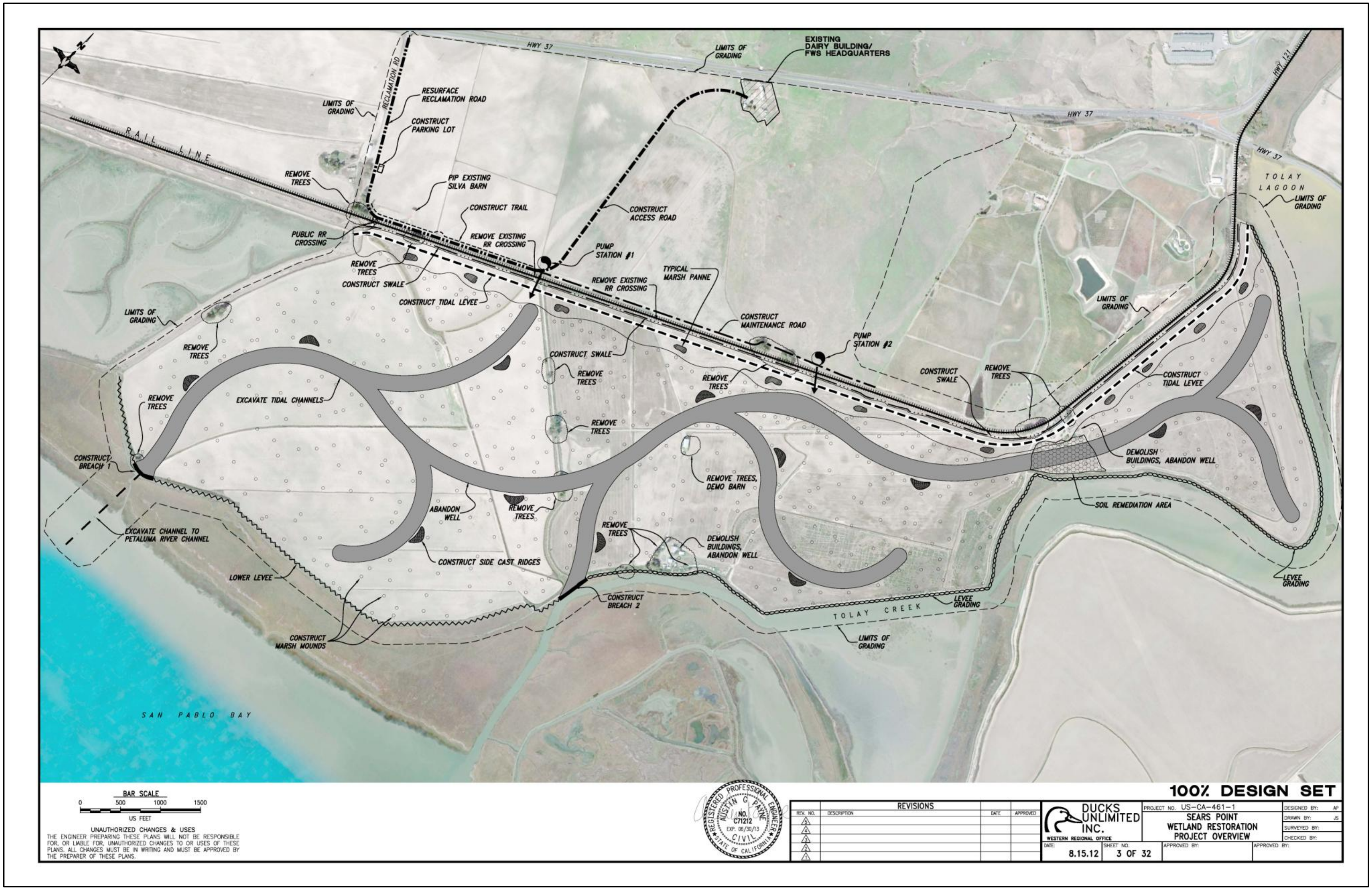
- Construct topographic features (*e.g.*, marsh mounds) in the tidal basin to reduce wind fetch and associated wave energy to maximize sediment deposition.
- Construct a gradually sloping levee (10:1 to 20:1) to enable elevation zones of tidal marsh to shift upslope as sea level rises. This also provides high tide refuge for marsh wildlife during extreme tides and storm surge.
- Stockpile material to enable raising the levee up to 7 feet to accommodate higher levels of sea level rise.

Implementation: A detailed conceptual restoration plan was completed in 2007. This was followed by a more detailed engineering design plan that underwent review at the 30%, 60% and 90% completion levels. Implementation will begin in summer 2013.



Monitoring and Management: Typical post-project monitoring includes tracking of various water quality parameters, rate of sedimentation, vegetative cover, and wildlife use. If monitoring reveals that the project is not meeting objectives, several potential adaptive management measures are built in. For example, if the two levee breaches are not providing sufficient tidal exchange and therefore import of sediment, one or two additional breaches could be excavated. If sea level is rising more quickly than expected and threatening to overtop the new levee, it can be raised up to seven feet.

Funding permitting, monitoring will continue for 10-15 years.


HWY 37
EXISTING DAIRY BUILDING/ FWS HEADQUARTERS
LIMITS OF GRADING
RECLAMATION RD
RESURFACE RECLAMATION ROAD
CONSTRUCT PARKING LOT
RAIL LINE
REMOVE TREES
PIP EXISTING SILVA BARN
CONSTRUCT TRAIL
CONSTRUCT ACCESS ROAD
PUBLIC RR CROSSING
REMOVE EXISTING RR CROSSING
PUMP STATION #1
CONSTRUCT SWALE
CONSTRUCT TIDAL LEVEE
TYPICAL MARSH PANNE
CONSTRUCT MAINTENANCE ROAD
PUMP STATION #2
HWY 121
TOLAY LAGOON
EXCAVATE TIDAL CHANNELS
CONSTRUCT BREACH 1
EXCAVATE CHANNEL TO PETALUMA RIVER CHANNEL
ABANDON WELL
REMOVE TREES, DEMO BARN
DEMOLISH BUILDINGS, ABANDON WELL
SOIL REMEDIATION AREA
CONSTRUCT SIDE CAST RIDGES
LOWER LEVEE
CONSTRUCT BREACH 2
LEVEE GRADING
TOLAY CREEK
CONSTRUCT MARSH MOUNDS
SAN PABLO BAY
BAR SCALE
0 500 1000 1500
US FEET
UNAUTHORIZED CHANGES & USES
THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.
REGISTERED PROFESSIONAL ENGINEER
AUSTIN G PAYNE
NO. C71212
EXP. 06/30/13
CIVIL
STATE OF CALIFORNIA
REVISIONS
REV. NO. DESCRIPTION DATE APPROVED
100% DESIGN SET
DUCKS UNLIMITED INC.
WESTERN REGIONAL OFFICE
PROJECT NO. US-CA-461-1
SEARS POINT WETLAND RESTORATION PROJECT OVERVIEW
DESIGNED BY: AP
DRAWN BY: JS
SURVEYED BY:
CHECKED BY:
DATE: 8.15.12
SHEET NO. 3 OF 32
APPROVED BY:

Lessons Learned: Anticipating sea level rise is challenging. As new information emerges, projections change and previous planning, adaptation measures, and resilience tools can quickly become dated. This is vexing for large projects like Sears Point.

Uncertainty of the projections is also challenging: should we build out for the worst case scenario? What is the planning horizon that makes sense? There is the danger of doing nothing while waiting for all the answers.

An important lesson we have taken is to look not only at our own project's resilience but also at the matrix of lands and infrastructure in which it sits. Building a towering levee that could resist the worst-case scenarios makes little sense if the adjoining levees won't weather even a moderate rise. Cost is a major factor as extraordinary measures - such as planning for a worst case future may doom a project simply by being too expensive. Final project design is inevitably a compromise between the most "climate smart" design and the available funds.

Consideration of future actions by others must also be factored into the restoration design. The Sears Point levee will protect State Highway 37 and the SMART railroad for up to 50 years, even if the levee has to be raised. But in 50 years both Caltrans and the railroad will have been forced to address their own vulnerabilities. Perhaps the Sears Point levee will no longer be needed. Economic feasibility and a common sense look to the future are required as we are faced with vulnerability decisions.

For Further Information: Julian Meisler, Baylands Program Manager, Sonoma Land Trust, 707-526-6930 x109, Julian@sonomalandtrust.org.

Climate Smart Actions for Natural Resource Managers Workshop
Case Study: STRAW Climate Smart Stream Restoration

By John Parodi, PRBO Conservation Science

November 29, 2012

Lead Agency/Organization and Partners: The STRAW (Students and Teachers Restoring a Watershed) Project of PRBO Conservation Science collaborates with resource conservation districts, the Natural Resource Conservation Service, federal, state and county agencies and land trusts to complete restoration projects in partnership with schools. In the last 20 years, STRAW has included over 30,000 students in the restoration of approximately 25 miles of riparian habitat in the northern San Francisco Bay Area. Its goals are to empower students, support teachers, restore the environment, and reconnect communities.

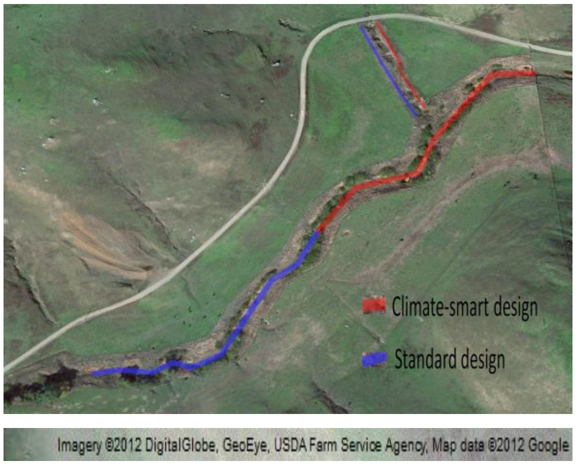
Project Description: We are developing and implementing climate smart streamside restoration designs that can accommodate changes in temperature and precipitation (usually warmer and drier), changes in extreme events (*i.e.*, more frequent drought and more intense precipitation events), and disrupted wildlife and plant phenology. The overarching goal is that restoration projects will be designed with enough elements to be effective regardless of future climatic scenarios. In addition, we want to include the greater public in active adaptation to climate change.

Approach to Vulnerability Assessment: We used a literature review **(**http://data.prbo.org/apps/bssc/uploads/Ecoregional021011.pdf), a vulnerability assessment of California birds **(**http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0029507), and expert opinion to identify vulnerabilities of streamside vegetation and the wildlife that use it. Based on this assessment, we identified two major vulnerabilities (1) increased plant mortality associated with extreme weather events and other disturbances (*e.g.*, more frequent droughts, floods, and (to a lesser extent) fire and (2) vulnerability of wildlife to phenological mismatches – when the seasonality of plant resources (*e.g.*, fruits the birds feed on) do not occur at the time they are needed (*e.g.*, during bird migration).

Adaptation Actions: To help us develop climate smart restoration designs, we created a tool that describes plant life history characteristics related to these vulnerabilities. The tool is a simple matrix with a list of plants and whether or not they tolerate full sun, wet conditions, dry conditions, are fire adapted, provide a wildlife food source, and the timing (by month) of the food source. Using this tool, we have developed climate smart restoration designs that have plant species with wider environmental tolerances, and address vulnerability to disrupted phenology. We expect that these new

STRAW students implementing our climate-smart design in Marin County, CA.

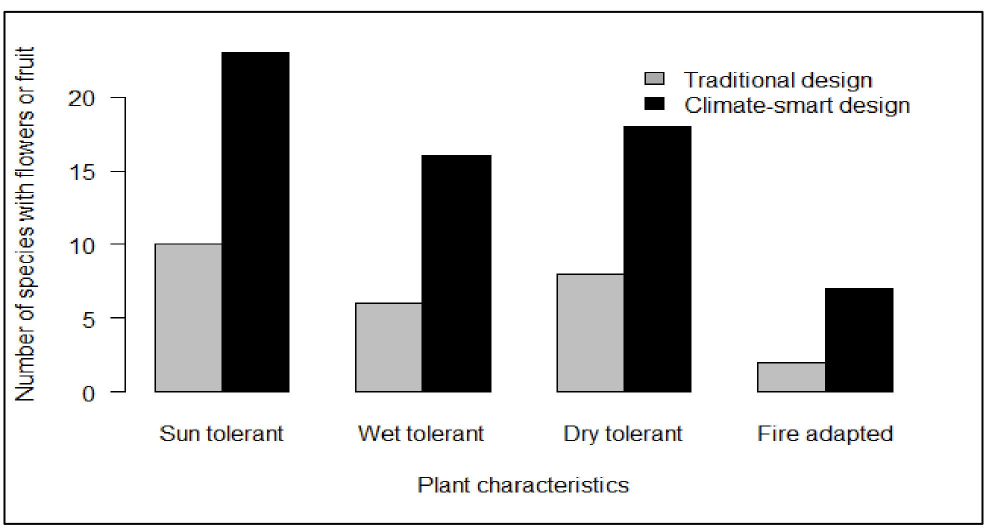
planting palettes will increase the survival of restored vegetation under future climatic conditions and provide more robust resources for wildlife as the climate changes.

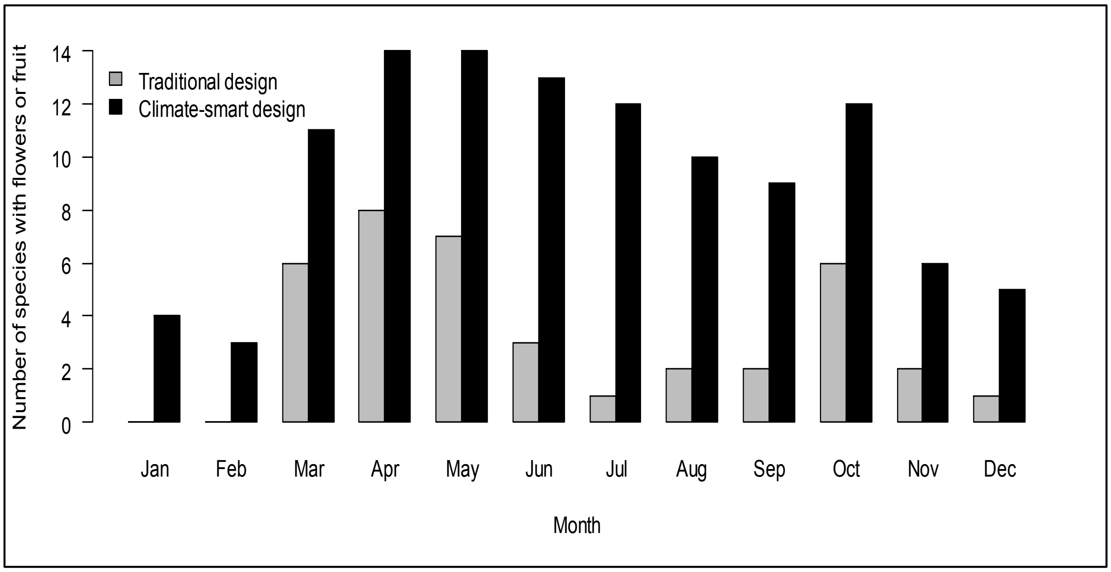


Implementation: With 282 students and 82 parents, we implemented a climate smart stream restoration project in coastal Marin County, California to explore how incorporating our two climate vulnerabilities into restoration design changes the way we do restoration. We restored half of a site using a traditional restoration design, contracting with a consultant to develop a planting palette as he has done with us for over 20 years. On the other half of the site, we used the climate smart planting palette (selecting species that would address our two identified vulnerabilities).

Using climate smart principles in our planning process resulted in a restoration design that was substantially different from the traditional design. Our climate smart design called for 24 species of trees and shrubs, whereas the traditional design called for only 10 species. Because these sections were relatively small, planting more species required higher planting densities in the climate smart restoration; 249 individual plants compared to only 123 individuals in the traditional restoration. Despite the fact that our climate smart restoration had roughly twice the number of species and density of trees and shrubs than the traditional restoration, the cost of the climate smart restoration was only 1.5 times that of the traditional design. Many of the additional species in the climate smart restoration were smaller and less expensive compared to those in the traditional restoration. This restoration site will receive three years of maintenance support (weeding, browse control and irrigation) as well as annual plant establishment and photo monitoring.

Comparisons between traditional and climate smart designs.





Monitoring and Management: How will we know if our climate smart restoration project is successful? There are some relatively simple short-term metrics of success that are not appreciably different from what we would do in a traditional restoration. We will monitor by the plant species for vigor and height class for at least three summers following the restoration. Similarly, we plan to implement long-term monitoring of the bird response to the project. In the short-term, we should be able to tell if (1) we have established a streamside vegetation community that has species that can survive environmental uncertainty and provide resources for wildlife, and (2) whether some of the species that are used less-frequently in traditional restoration designs are effective with regards to establishment. Over the long-term, we will be successful if these sites have consistent healthier vegetation and bird communities than sites with the standard restoration designs.

Lessons Learned: In terms of implementation, some of the species we hoped to install in the climate smart design were not available from nurseries, limiting the final project design. Also, to incorporate the increased number of species into projects, a larger minimum project size is necessary to provide adequate species redundancy and encourage self-propagation. This would also decrease costs, as planting densities could return to normal.

Normalizing restoration design to include climate change poses some additional regulatory challenges for projects with strict performance criteria. Using some un-tested species would be a risk that could discourage practitioners from implementing climate smart designs. Finally, there is a need to look beyond revegetation. In addition to changes for the plant community, climate change will also mean more extreme precipitation events that create extreme streamflows. In the future, we will work with engineers to investigate the cost, logistics, and implementation of designing in-stream engineering projects to withstand anticipated extreme precipitation events. This will both ensure that the in-stream infrastructure can withstand these events and also provide suitable habitat for aquatic organisms (*e.g.*, young salmonids) during exceptionally high flow events.

A critical lesson learned from this initial project is that the public, especially students and teachers, are inspired and hungry to take actions to adapt to climate change. Participating in this project was motivating and encouraged a hopeful path forward given the daunting threat of climate change. STRAW has been fortunate to engage the public in professional restoration projects for over 20 years. This project, however, was unmatched in the enthusiasm and hope that it gave to the participants.

For Further Information:

Thomas Gardali, Director, Pacific Coast and Central Valley Group, **tgardali@prbo.org**
Nathaniel Seavy, Research Director, Pacific Coast and Central Valley Group**,** **nseavy@prbo.org**
John Parodi, STRAW Restoration Manager, **jparodi@prbo.org**

PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954, 707.781.2555