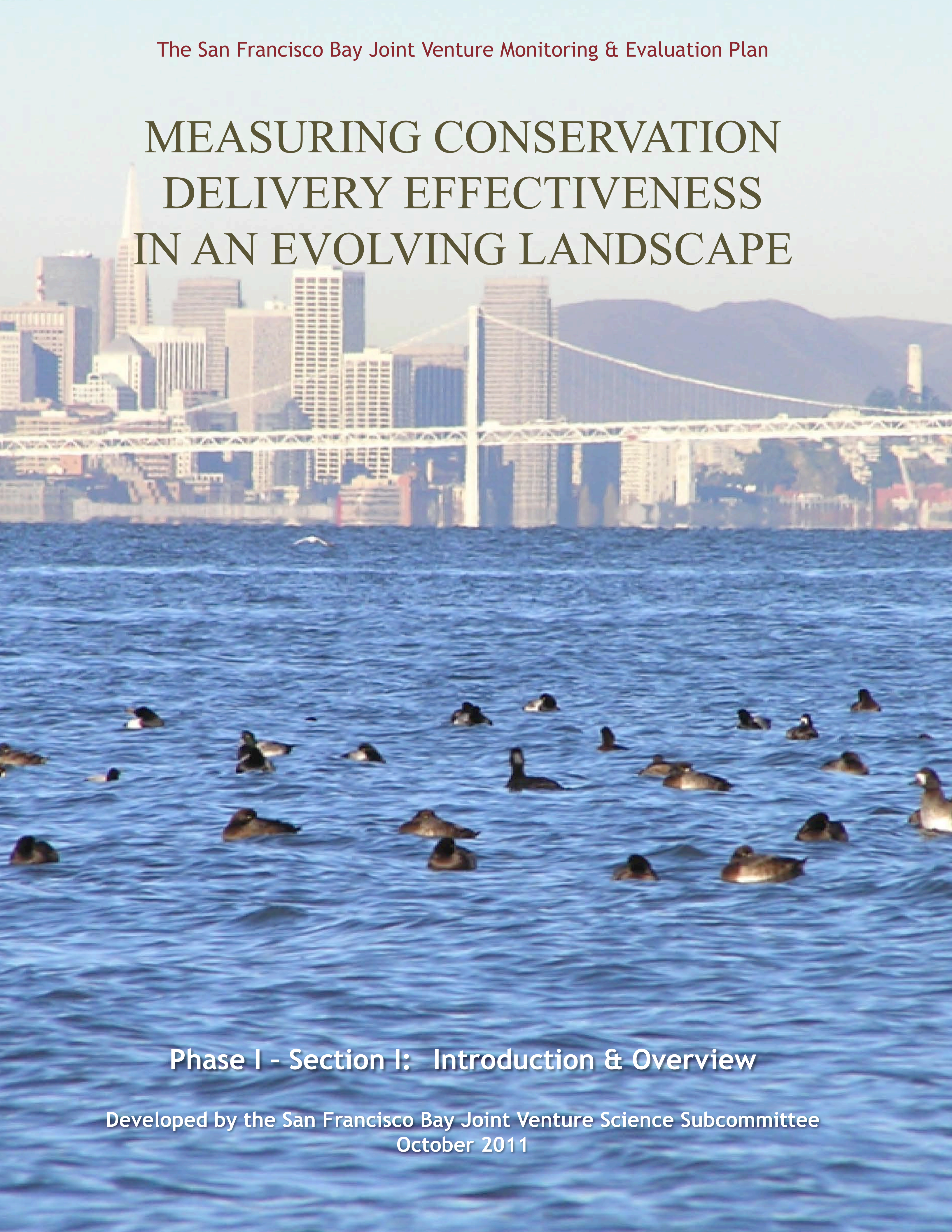
The San Francisco Bay Joint Venture Monitoring & Evaluation Plan

MEASURING CONSERVATION DELIVERY EFFECTIVENESS IN AN EVOLVING LANDSCAPE



Phase I – Section I: Introduction & Overview

Developed by the San Francisco Bay Joint Venture Science Subcommittee

October 2011

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I. Introduction & Conceptual Overview

San Francisco Bay Joint Venture

Background

The San Francisco Bay Joint Venture (SFBJV), first launched in 1996, is one of eighteen habitat Joint Ventures (JVs) established under the North American Waterfowl Management Plan, an international agreement signed in 1986 by the United States and Canada and later joined by Mexico, in response to a decline in waterfowl populations. As vehicles for accomplishing the NAWMP's major goal, JVs were formed to "maintain and enhance the habitat values of areas identified as internationally significant to waterfowl." As of early 2000, a total of 14 such habitat-based partnerships had been formed in North America, 11 in the United States and three in Canada, plus three species-focused JVs, bringing together the fiscal resources and management capabilities of a spectrum of agencies and organizations. Joint Venture partnerships have been very successful since their inception, having directly or indirectly influenced the conservation of > 50 million acres of waterfowl habitat in the U.S. and Canada (NAWMP Assessment Steering Committee 2007).

Funded under the annual Interior Appropriations Act, the SFBJV brings together public agencies, conservation groups, business interests, landowners, and others to protect, enhance, and restore wetlands and wildlife habitat in the SFBJV region (Figure 1.1). In 2001, the SFBJV Management Board (Board) adopted its Implementation Plan (SFBJV 2001), based on the *Baylands Ecosystem Habitat Goals Report* (Goals Project 1999), to help its partners fulfill their shared habitat objectives by continuously building on accomplishments and planning for the future within an adaptive management framework. In 2004, in response to the FWS Director's Order 146 to JVs to expand their species scope, the SFBJV Board adopted a companion document to address conservation delivery guidelines for all bird groups (PRBO 2004). It delineates conservation objectives for the SFBJV region as outlined in planning documents of North America's major bird initiatives (CalPIF 2000, 2002, 2004; Hickey et al. 2003; Kushlan et al. 2002; RHJV 2004; Rich et al. 2005)

The SFBJV provides a framework for sharing skills, funding, and information. Using an integrated and non-regulatory approach, it has been working through its partners to complete on-the-ground habitat conservation and improvement projects by leveraging resources, developing new funding sources, and creating project-specific partnerships to benefit wildlife populations. Partners of the SFBJV recognize wetland habitats to be vital not only to wildlife, but also to "ecosystem services" benefitting humanity, such as flood control, water storage and quality, and helping to recharge overdrawn water supplies. The diversity of project partnerships being created within the SFBJV suggests a growing awareness that wetlands also provide economic and other benefits, including open space and recreational opportunities. In short, wetlands help to sustain a higher quality of life for residents in the densely populated SFBJV region.

The San Francisco Bay (SFB) is the nation's second largest estuary and one of its most biologically significant. Understanding the current and potential importance of the SFB and the region's coastal, riparian, and seasonal wetlands, the 27 organizations and agencies on the SFBJV Board have agreed to pursue the mission: "To protect, restore, increase, and enhance all types of wetlands, riparian habitat, and associated uplands throughout the San Francisco Bay region for all types of wildlife."

SFBJV Overarching Implementation Objectives

- Protect, restore, and enhance wetlands, riparian habitat, and associated uplands to benefit birds and other wildlife by applying incentives and by using non-regulatory techniques
- Strengthen and promote new sources of funding for such efforts
- Improve habitat management on public and private lands through cooperative agreements and incentives
- Within an adaptive management framework, support the regular assessment of habitat restoration projects to consistently evaluate and improve habitat improvement outcomes and management techniques.

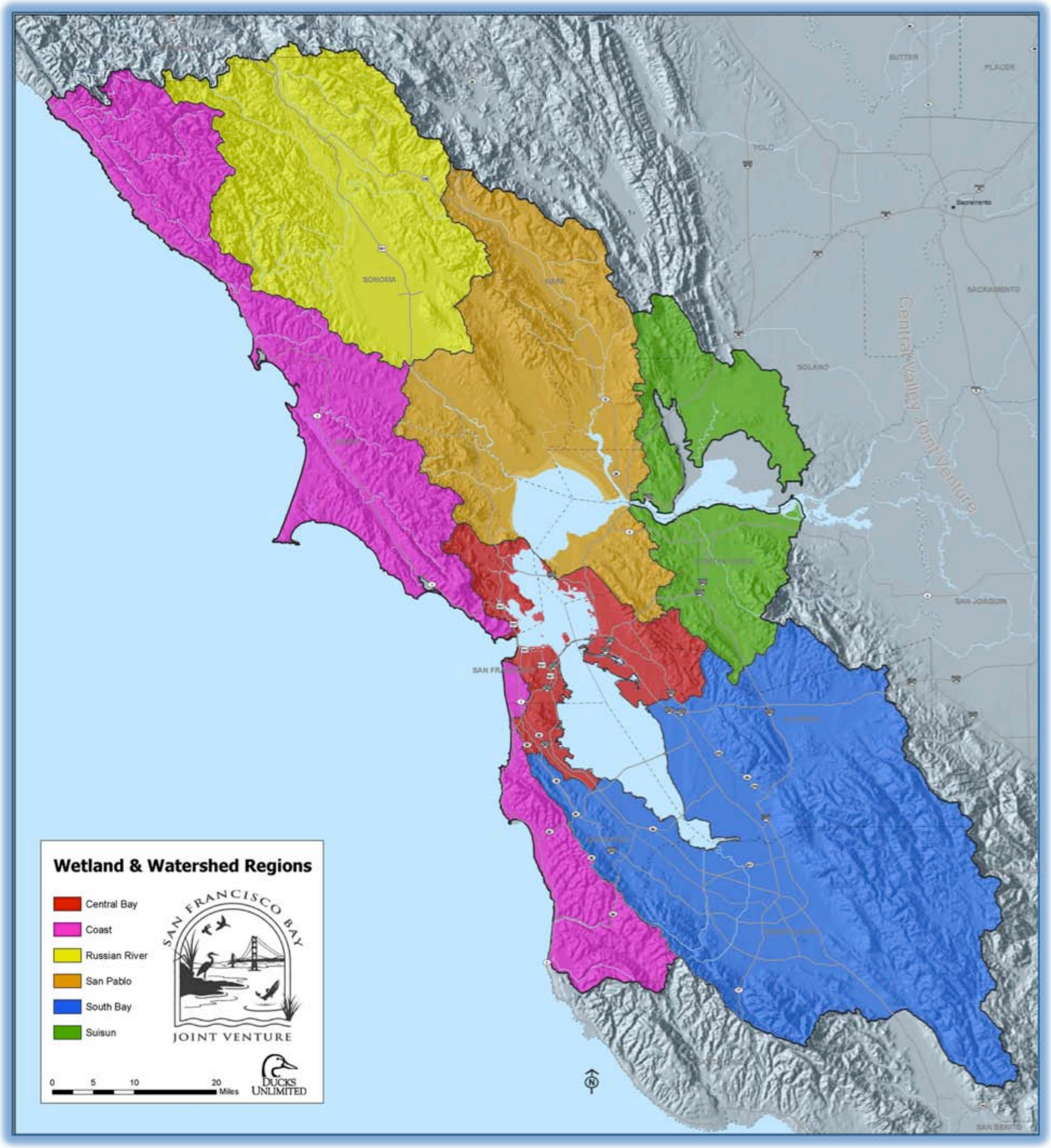

Figure 1.1: SFBJV region.

Conservation Delivery

Implementation Goals

The SFBJV Implementation Plan (SFBJV 2001) established region-wide habitat goals and sub-regional objectives for the protection, restoration, and enhancement of specific wetland habitats (Figure 1.2) in the SFBJV region (Figure 1.1) under three broad categories: bay and coastal habitats, creeks and lakes, and seasonal wetlands. It also presents population objectives for regional waterfowl indicator species (SFBJV 2001). It defines *protection* as "land that needs to be acquired, or placed in protective ownership." *Restoration* is defined as the "conversion of one habitat type to another," and *enhancement* as an "improvement in the functioning and biological diversity of an existing habitat."

Outlined habitat goals include protection of 63,000 acres, restoration of 37,000 acres, and enhancement of 35,000 acres of bay habitats (Figure 1.2) that include tidal flats, marshes, and lagoons over 20 years. Habitat goals outlined for creeks and lakes include the protection of 7,000 acres, restoration of 5,000 acres, and enhancement of 22,000 acres. Interim goals for seasonal wetland acreage protection are 12,000 acre, for restoration are 7,000, and for habitat enhancement are 11,000 acres.

The conservation delivery, defined as the on-the-ground implementation of outlined habitat goals, is directed by the principles of Strategic Habitat Conservation (USFWS 2008), where within an iterative, adaptive cycle, conservation-planning stages are followed by implementation actions that are evaluated and reassessed via outcome-based monitoring and assumption-driven research (Figure 1.3). Research to evaluate and refine biological planning assumptions, and monitoring of management effects on habitats and individuals or species to make inferences at multiple scales that have a bearing on future management decisions are crucial components of the SHC cycle.

Black-necked Stilt

Photo: Beth Huning

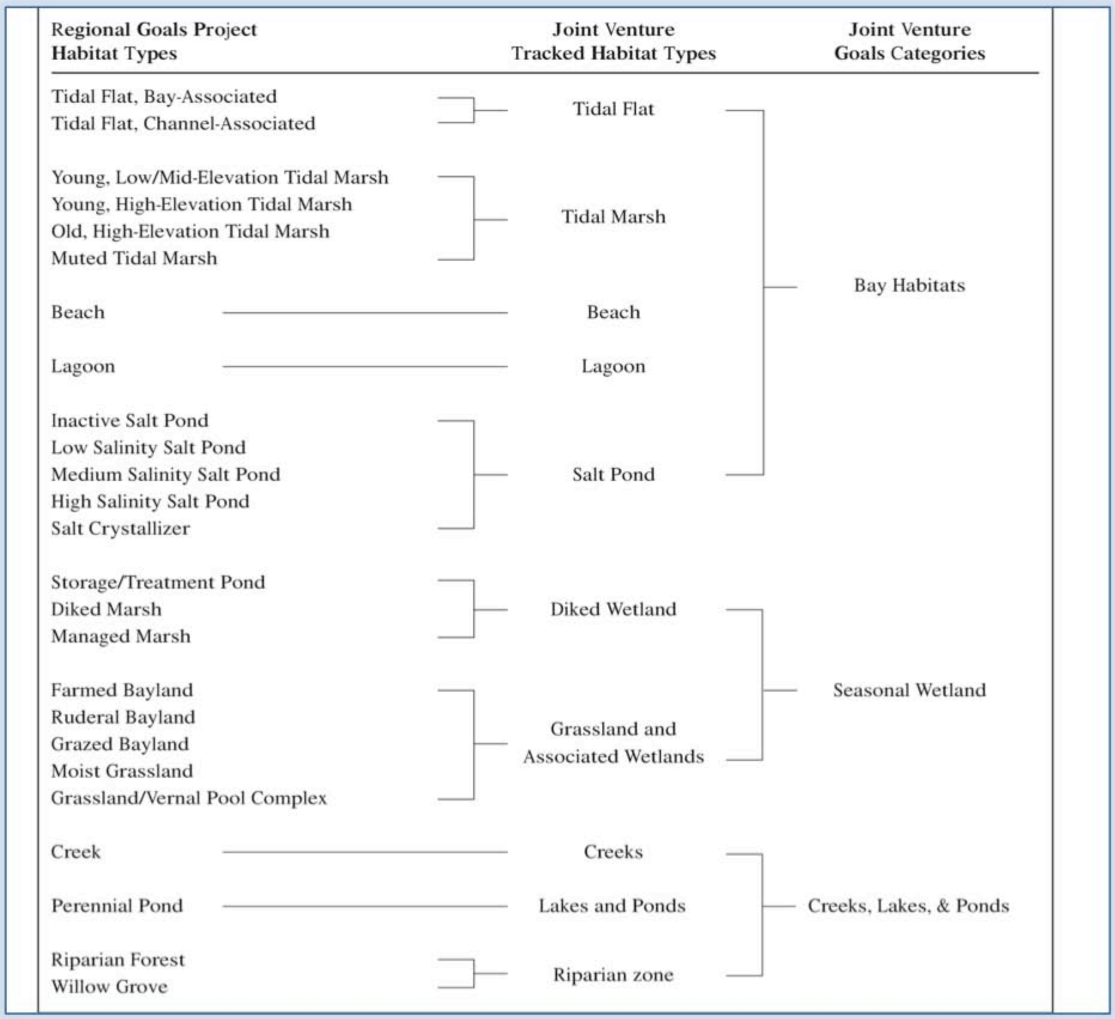

Figure 1.2: San Francisco Bay Joint Venture wetland habitat classifications (Source: SFBJV 2001).

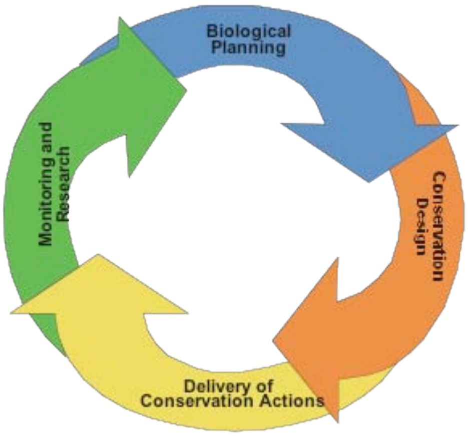

Figure 1.3: *Strategic Habitat Conservation (SHC):* Cyclic strategy where detailed biological and conservation planning is followed by conservation delivery that is evaluated via monitoring and research. Evaluation results are considered in a new planning phase that spurs changes to conservation actions, which are then again evaluated, and again inform next cycle planning, and so on.

Conservation Achievements

A major focus of the SFBJV over the last decade has been to protect and restore diminishing wetland habitats. As a result, almost 50% of total wetland, and more than 60% of Bay habitat (Figure 1.2) acquisition goals have been reached (Table 1.1). While there are still critical acquisitions to achieve, the priority of SFBJV actions has now shifted to restoration, enhancement, and the monitoring and evaluation of conservation delivery impacts on priority indicators and targets. In addition, current SFBJV priorities include planning and coordination for potential climate change impacts, finalizing revisions of seasonal wetland goals, and coordination of effective monitoring and adaptive management, needed to assure that we create viable habitats for the species we strive to protect and support.

Since 1996, nearly 150 habitat protection, restoration or enhancement projects have been completed. This includes the conservation of more than 70,000 acres of bay, seasonal wetland, and riparian habitat.

Table 1.1:

SFBJV Completed Project Acreage Summary as of 9/15/11			
Habitat Categories	**Activity Categories**		
	Protection	***Restoration***	***Enhancement***
Bay Habitat	39,243.00	12,038.02	5,420.50
Creek and Lake	4,849.55	358.72	134.05
Seasonal Wetland	3,558.00	1,879.24	2,295.00
Upland	1,316.00	54.00	60.00

In order to regularly assess regional habitat protection, restoration, enhancement progress towards the outlined habitat goals, a SFBJV habitat project tracking system was built and implemented in 2005. This SFBJV region-specific database system holds information on habitat projects: acquisition, restoration, enhancement, monitoring, and associated education and outreach projects. A GIS section allows partners to map projects and perform relevant queries (http://cjvp.ducks.org/cajv/CAJVLogin.cfm) .

Why Monitor?

The San Francisco Bay Joint Venture (SFBJV) Monitoring and Evaluation Plan (M&E Plan) will offer a 20-year region-wide monitoring and research framework to measure effectiveness of SFBJV partner conservation delivery actions. A fundamental challenge for examining the effectiveness of JV conservation actions remains in understanding how waterfowl populations, and other target wildlife are influenced by JV habitat programs (NAWMP, Plan Committee 2004). Conservationists now emphasize quantifying biological responses to habitat projects rather than merely counting dollars invested, acres restored, and partners (NAWMP Assessment Steering Committee 2007). Although more difficult, this direct cause-effect analysis will also resonate better with the public and with funding entities.

Impacts on wetland functions can also eliminate or diminish the values of wetlands to humanity. In assessing SFBJV conservation delivery effectiveness, it is thus valuable to consider its beneficial contribution to ecosystem services such as: sequestration of carbon, flood protection, sea level rise buffering, recreation, water filtration, sustainable fisheries, water storage, and more, and their related resource economic benefits. Many SFBJV activities directly contribute to improving a variety of ecosystem services (Appendix 1.A).

Within the cycle of SHC (Figure 1.3), outcome-based monitoring and assumption driven research are vital for evaluating responses to habitat restoration, and impacts from stressors such as climate change, habitat fragmentation or loss, invasive species, pollution, or human disturbance. Indicator-based surveillance monitoring is also paramount in providing empirical baselines for detecting and evaluating changes in target organism status and trends, and ecosystem structure and function. Monitoring data thus serve to calibrate and inform vulnerability and predictive models. Monitoring is therefore a cornerstone, crucial to evaluation of management effectiveness and to provide information to refine conservation strategies. Monitoring, evaluation, and research are not stand-alone activities, but instead are vital components of the larger SHC process (Nichols and Williams 2006; USFWS 2008).

Main Questions:

- **Have we been successful in meeting our conservation goals in the 20-year period outlined in the SFBJV Implementation Plan? To evaluate this question, what performance criteria should we set for additional target species or indicators of habitat condition?**
- **What (if anything) can be done differently in the next 10 years that will help us more effectively and efficiently meet our 20-year targets?**

The M&E Plan framework is being developed in a multi-stakeholder process in three planning phases, between 2010 and 2013. This planning Phase I document presents recommendations for the implementation of a suite of priority monitoring and research objectives for major conservation targets and stressors. Their completion will outline the net change in extent of SFBJV region wetland habitats, chart status and trends of conservation targets, and highlight the associated SFBJV contributions.

For the next 10-20 years, the M&E Plan will provide a set of regularly renewed or updated monitoring and research objectives within a cyclical SHC adaptive management framework. This will allow for the systematic evaluation of the response of conservation targets to conservation delivery actions and environmental change. The resulting data will offer crucial insights into habitat and wildlife responses to conservation actions and environmental change at a variety of spatial scales, key information upon which to base management, and conservation planning and policy decisions. They will so afford accountability to stakeholders and funders, and provide information useful to a wide array of conservation applications. If viewed in a resource economic context, conservation accomplishments reflect economic resources provided to the community at large, providing powerful evidence of the extended economic benefits of the SFBJV conservation delivery program.

Plan Purpose

The purpose of the M&E Plan is to provide a 20-year framework to measure effectiveness of SFBJV-partner conservation delivery in an evolving landscape and inform future conservation strategies and policies.

Plan Audiences

The SFBJV M&E Plan is aimed at the following audiences:

- **SFBJV region conservation, resource management, and science partners**
- **North American bird conservation programs, including:**
  - **North American Waterfowl Management Plan**
  - **Partners in Flight**
  - **Waterbird Conservation for the Americas**
  - **U.S. Shorebird Conservation Plan**
- **Regulatory agencies**
- **Funding institutions**

Plan Outcomes

The implementation of the objectives and strategies outlined in the M&E Plan will over time result in the systematic evaluation of the response of conservation targets to conservation delivery actions and environmental change. It will so present an increased understanding of SFBJV effectiveness in delivering conservation actions relevant to: (1) habitat net quantity, by assessing gains and losses of wetland acres in the region and evaluating the contributing role of the SFBJV conservation delivery; and (2) conservation target status and trends, by periodically determining habitat condition and the related target species population abundances and distributions. Once clear objectives are developed in upcoming phases, M&E Plan implementation will also help link conservation accomplishments to the ecosystem services provided to San Francisco Bay area communities, offering powerful evidence of the extended economic benefits of SFBJV conservation delivery.

Realization of M&E Plan monitoring and research objectives will inform adaptive management, and will allow use of empirical data to calibrate predictive and vulnerability models, informing managers of the uncertainty levels of threat impacts on conservation targets. By linking and integrating with goals and objectives of other relevant regional planning initiatives, such as the Upland and Subtidal Goals (The Conservation Lands Network[1], State Coastal Conservancy 2010), climate change update of the Baylands Goals (Goals Project 1999), the Bay Area Early Detection Network (BAEDN)[2] in Phase II, monitoring efforts relevant to the region in multiple contexts will be realized. By addressing all North American bird conservation initiatives, the M&E Plan will continue the integration of efforts among Joint Ventures and national partners, and will help aligning of metrics and methods to increase comparability and scalability across projects, regions and flyways.

As the product of a multi-stakeholder collaboration (Appendix 1.A), the implementation of the M&E Plan will increase local, regional, and national coordination, facilitate cooperation, and create efficiencies by identifying lead partners on priority objectives and programs. It will allow for better cross-disciplinary integration of applied science, and help focus data collection methods and create standardized datasets for easier comparison across scales, and straightforward transfer among managers and practitioners. It will facilitate steps to incorporate, or connect data repositories, linking relevant datasets for analysis at the regional and national scales. Implementation of the M&E Plan will inform the design of regional decision support systems, and so further heighten communication and collaboration among scientists, resource managers and regulators.

By creating a more streamlined and coordinated approach for assessment of multi-scale conservation status that informs local, regional, and national decision-makers, the M&E Plan will create better opportunities to acquire funding support for the outlined monitoring activities and research. The M&E Plan will benefit and provide guidance to the regional SFBJV conservation community and science partners, regulatory agencies, decision makers and funding institutions.

[1] http://www.bayarealands.org/
[2] http://www.baedn.org/

Benefits to SFBJV Conservation Partnerships

At a May 2011 M&E Plan vetting workshop, 45 SFBJV partners outlined the benefits they foresee the M&E Plan implementation will provide:

- Increased coordination, creating efficiencies by working together;
- Bridging the gap between management and science: Making information & data transferrable and translatable between scientists and land managers;
- Building a foundation for linking existing databases via a central regional data (or meta-data) repository, and developing data collection standards, devising the best strategy on how to most effectively collaborate on data management;
- Developing clear regional wetland conservation goals, targets, and indicators with an outcome-based assessment framework that ties into existing regional planning structures;
- Focusing limited resources to answer the key conservation/restoration questions that are linked to local or regional conservation goals;
- Creating better integration across species or functional groups;
- Improved and standardized protocols for monitoring;
- Growing access to funding for monitoring;
- Increasing communication and collaboration with regulatory agencies;
- Integration with larger landscape conservation efforts, such as the California Landscape Conservation Cooperative.

Monitoring & Evaluation Framework

Conceptual Overview

Assessment Strategies

Surveillance and targeted monitoring are two monitoring approaches utilized in conservation. Surveillance monitoring typically establishes broad baselines outlining natural system variability and trends over time. This may make it ineffective to trigger research and management, because it is often difficult to measure a biologically significant trend versus natural fluctuations, especially over short time scales (Nichols and Williams 2006). It is also difficult to directly assess the effect of specific conservation or management actions on perceived surveillance trends. Targeted monitoring with specific outcome scenarios is an important alternative to surveillance monitoring, since the ability to make predictions about ecosystem response to management actions or threats is key in a decision-making framework. The most difficult aspect of targeted monitoring, however, is to develop detailed hypotheses and associated models of system response to management actions (Nichols and Williams 2006). In many cases, previous ecological study is limited, making the development of hypotheses and associated models difficult. Therefore, the lack of greater understanding of system complexities and context dependence can limit our ability to develop realistic hypotheses and associated models, in turn limiting the targeted monitoring approach (Nichols and Williams 2006). Yet, even in situations of limited previous ecological study, the use of targeted monitoring is worthy of consideration (Yoccoz et al 2003).

Current ecological problems and human impacts to habitat do not allow us to postpone conservation and management. The collection of baseline information through surveillance monitoring is necessary and useful as a means of generating initial hypotheses about system behavior. This is especially true for cases, where large surveillance datasets are already at hand, and for targets with limited variability in natural fluctuations. Here, we propose a combined approach of initiating baseline surveillance monitoring if initial hypotheses need to be based on empirical data, and targeted monitoring for systems for which predictive models are available or once baseline data is gathered to help develop targeted hypotheses. A phased planning approach will allow us to implement initial sets of prioritized M&E and research objectives that are then refined to become outcome-oriented as more information becomes available.

The core variables included in this first M&E Plan phase are organized into three categories: *Habitat Quantity, Habitat Function* as indicated by *Target Organism Status & Trends*, and *Environmental Challenges*. These general categories overlap and are complementary for detecting and attributing change. Figures 1.5, 1.6, and 1.7 show example conceptual models and a strategy outcome diagram to be fleshed out In Phase II to shift the focus more on systematic evaluation of specific habitat types or ecosystems, and also include the transition zones between habitats (e.g. tidal marsh to intertidal to subtidal). For each habitat type a conceptual model will be built in a multi-stakeholder process to derive outcome hypotheses of management strategies that are summarized in an outcome diagram. From these diagrams specific indicators and metrics can be then be chosen, and specific monitoring schedules developed and implemented by relevant partners.

Habitat Quantity

Habitat quantity is the amount, type, and configuration of key habitats (Figure 1.2) identified in the SFBJV Implementation Plan (SFBJV 2001). At the onset of any investment, a simple accounting of what types and how much habitat is present is critical to evaluate gains and losses, or the "net landscape change." Key functional components of habitat quantity are the connectedness of habitat types, and the evolution of restored areas along a succession trajectory (i.e. former salt ponds opened to tidal action evolve to various stages of tidal marsh, defined by vegetation types). A periodic accounting of the amount, type, successional stage, and connectedness of habitats in the region will allow the SFBJV to assess whether the habitat acreage goals laid out in the SFBJV Implementation Plan (SFBJV 2001) have been met, and where future conservation delivery can be focused.

Habitat Function – Target Organisms as Functional Indicators

While an understanding of the amount and type of habitat available is critical for effective conservation delivery, the ecological function of wetland habitats is essential to ensure SFBJV long-term effectiveness. Monitoring habitat function can lead to evaluation of habitat needs and alternative habitat delivery plans, ultimately resulting in revisions of habitat goals. Habitat function is generally defined from the perspective of the organism, such that areas of higher habitat function provide more of the resources that a given organism or guild require to survive and reproduce (Johnson 2007). In many cases, the density or abundance of target species are used as assessment metrics, with the assumption that areas with more individuals are of higher habitat function (Bock & Jones 2004).

Consistent with the current SFBJV Implementation Plan (2001), various bird population metrics are used in this M&E Plan as indicators of habitat function. Target group specific metrics for waterfowl, shorebirds, waterbirds, and riparian landbirds are outlined in the relevant focus section modules of this Plan. More general indicators to help evaluate habitat function, include levels of biodiversity (the richness and relative abundance of ecosystems, species, or genetic diversity in a given area), condition of vegetation types and structure, water and air quality, available indices of biotic integrity (e.g., macro-invertebrates or birds), and the level of anthropogenic stressors. More details about relevant metrics that measure these general indicators can be found in the individual section modules.

The recovery status of special status species can provide another measure of habitat function. The indicator/habitat function relationship may be disrupted because individuals for some reason may select low-quality habitats (ecological traps), or may be unable to colonize high-quality habitat, e.g., due to constraints on dispersal. When new habitat is created for small populations typical of special status species, there may be a lag between the time when habitat is created, and when it is occupied. While the new habitat may be high in function, if the population is not large enough to provide individuals that disperse into these areas, then it may go unoccupied until the population increases.

Environmental Challenges

Beyond habitat loss, land-use change, habitat degradation and fragmentation, it is important to measure status and trends of other significant environmental threats in the SFBJV. For M&E Plan phase I, Teams therefore focused on the assessment of immediate threats to the outlined SFBJV conservation targets, associated with invasive and nuisance species, bioaccumulation of contaminants, human disturbance, and climate change (Figures 1.5, 1.6 show examples of these threats in the context of specific habitats). A more detailed overview of these environmental challenges is presented in Appendix 1.B.

Monitoring Focus

Multi-Stakeholder Process

The seven monitoring focus sections of this M&E Plan are written as independent plan modules. A focus team, composed of scientists and land manager partners (Appendix 1.C), guided the SFBJV science coordinator in designing each module. In a series of in-person meetings and phone conferences, all teams established lists of existing or needed performance criteria, focus-specific monitoring and research objectives, relevant metrics, protocols, and data repositories, key partners, and existing programs for potential integration.

All teams convened at a May 26, 2011 daylong, facilitated workshop to identify the top priorities of the identified monitoring, evaluation and research objectives (Tables 1.2 & 1.3). Each focus team ranked objectives based on these criteria: 1) ease of implementation 2) long-term importance; 3) a natural "early" step; 4) usefulness for managing or modeling; 5) help SFBJV conservation "effectiveness"; and 6) cost-effectiveness. For each of these priority objectives, relevant metrics, protocols, and key partners were identified. Seven monitoring focus themes are presented in separate M&E Plan modules. Each module will list these and other identified M&E Plan objectives and research needs for continued consideration over time.

Monitoring Focus Modules

Habitat Quantity

1) Net Landscape Change

Habitat Function – Target Organism Status & Trends

2) Waterfowl
3) Shorebirds and Waterbirds
4) Riparian Landbirds
5) Special Status Species

Environmental Challenge[*]

6) Invasive Species
7) Climate Change

Temporal Scales

The objectives outlined in this M&E plan are aligned with the 20-year time frame outlined in the SFBJV Implementation Plan (SFBJV 2001). This means that monitoring and research objectives implemented in the next 10 years will serve to evaluate effectiveness of SFBJV conservation delivery activities in relation to the outlined Implementation Plan goals. However, the effects and measurable outcomes of management and restoration actions on ecosystems vary along a temporal spectrum that exceeds this time frame. *Active* conservation actions often have more immediate measurable impacts or results than *passive* actions, which in turn require a much longer time frame for measurable results to manifest. Examples include the *active* removal of barriers to internal marsh hydrology at a given project site, where improved hydrologic impacts of the management action on the system can be measured fairly immediately. In contrast, the *passive* re-establishment of mature tidal salt marsh vegetation, after an active levee breach, involves a much longer time horizon. Measurable effects on habitat features and target organism appear in some instances only after many decades. Therefore, specific-habitat type acreages can be calculated and evaluated only as they evolve even beyond the next 10-years, and responses of target organisms to habitat evolution also vary over time scales that will similarly exceed this initial horizon. Therefore, important *a priori* considerations to be incorporated into the desired model for evaluating expected conservation outcomes within the SFBJV M&E framework are: (1) whether *active* or *passive* actions are to be assessed, and (2) at which time scales they will likely take effect.

Spatial Scales

The SFBJV is interested in monitoring at three nested spatial scales and within the context of a continental scale (Figure 1.4). *Projects* are discrete units of land where conservation investments are made. The size of these units is variable, but generally ranges from 100s to 1000s of acres. These projects are located within six *sub regions*: Russian River, Coast, Suisun, Central Bay, San Pablo, and South Bay (Figures 1.1, 1.4). These sub regions make up one larger-scale *region* – the geographic boundary of the SFBJV (Figures 1.1, 1.4). Scaling information up from project to region can provide an assessment of SFBJV conservation delivery effectiveness.

The SFBJV is also interested in providing information at the *Pacific flyway* and *Bird Conservation Region (BCR)* scale, and contribute to that of the entire *continent*. However, data from other JVs and partners are necessary to evaluate effectiveness at these scales, and similar 'currencies' or metrics are needed for combined model evaluation. In collaboration with other neighboring JVs, or those that assess aspects of the annual life cycles of SFBJV target organisms, the SFBJV can account for its contributions toward helping fulfill and help update the continental NAWMP objectives, and those set by the other national bird conservation programs and initiatives. The 5-year work plan of the NAWMP National Science Support Team (NSST) includes objectives to facilitate this process among JVs.

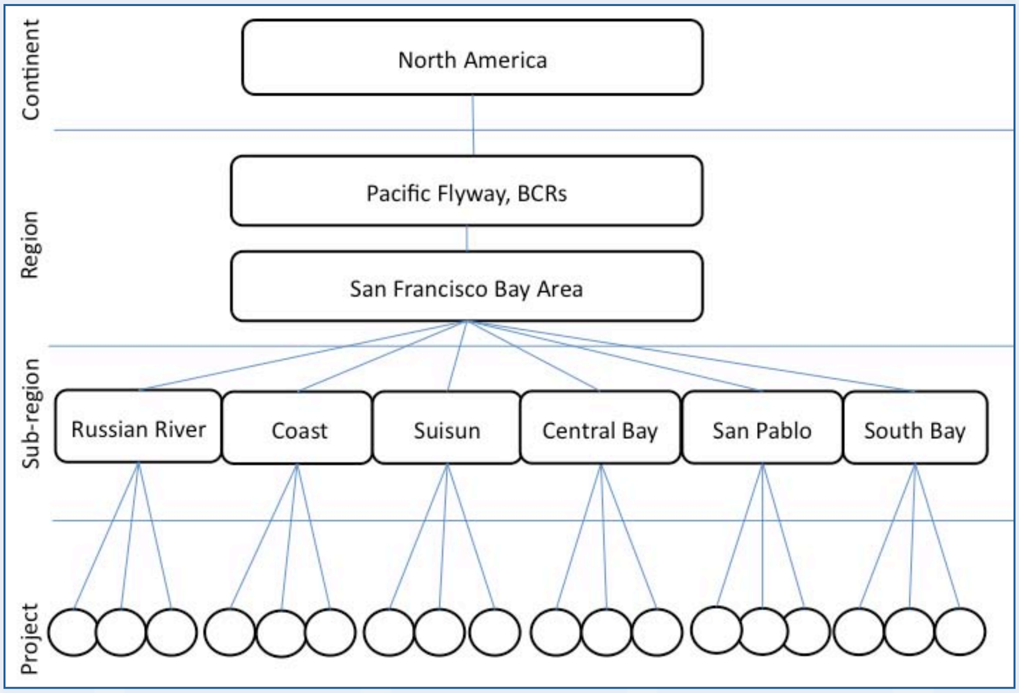

Figure 1.4: Nested spatial scales of the SFBJV M&E framework.

Integration of Multi-scale Objectives

The SFBJV M&E Plan is a first step in attempting to link project, regional, and continental scale assessments, and it likely cannot achieve full integration from the outset. It can serve as an initial force to continue the integration of efforts among JVs by integrating discussions of what approaches other JVs are taking in their M&E activities. It highlights the need to align metrics and/or methods to increase comparability and scalability of results across regions to flyway or continental scales. This way, it will be possible to better assess SFBJV's contribution to the larger scale.

Missing Performance Criteria

For evaluation of the status and trends of conservation target species, the SFBJV Implementation Plan (SFBJV 2001) at this time includes only broad target waterfowl population objectives, where regional population status is measured relative to estimated 1990 population peaks. It does not provide specific performance criteria for most bird groups or target organisms relevant to the SFBJV, nor for improving habitat function and reducing threats.

In order to evaluate conservation delivery actions, their collective ecosystem impacts need to be assessed, linking habitat impacts with target species response. Therefore, a suite of ecologically meaningful performance criteria is needed for measuring SFBJV conservation delivery effectiveness. Immediate needs include defining performance criteria for all birds, other target organisms, and ecosystem function and threat-reduction. Moreover, to allow translation across multiple scales, population objectives need to be put in the larger life cycle context of the many migratory target species addressed here.

The need and rationale for setting population objectives or performance criteria in bird conservation are currently discussed in numerous venues (e.g., NAWMP Committee 2004, Bart et al. 2005, NAWMP Science Support Team 2006). While setting demographic population objectives can be challenging, members participating in these discussions suggest that setting population objectives can 1) serve as the foundation for strategic conservation planning by establishing a biological target while accounting for natural variability, 2) provide a performance metric for assessing conservation accomplishments, 3) operate as a communication and marketing tool to demonstrate the need for conservation, 4) guide what management prescriptions or conservation actions are put on the ground, and 5) provide a method to integrate and promote SFBJV goals with other agency or organization planning. In this context, consistent M&E programs across JVs are needed to address conservation of target species at multiple scales.

The development, description, and application of target organism population objectives include identifying limiting factors, modeling species-habitat relationships, assessing landscape condition, developing decision support tools to guide conservation delivery, and establishing targeted habitat objectives. These are critical aspects of meeting the technical expectations associated with the comprehensive content for elements and sub-elements within the JV Matrix (the self-defined "Desired Characteristics for Habitat Joint Venture Partnerships"). Thus, there is a clear need to integrate population objectives, habitat models, landscape assessment, and habitat objectives within the JV conservation approach.

Planning Phases

The M&E planning process is structured into three phases (2010 – 2013) in recognition of the need to implement priority objectives, and continue the planning strategies initiated in Phase I, to refine outlined objectives and develop additional performance criteria to measure progress. For the Science Sub-committee focus teams (Teams) it was essential to finalize an initial set of monitoring objectives, metrics, and associated protocol suggestions for a prioritized sub-set of potential bird groups and topics. This approach will result in initial pathways to evaluating the effectiveness of SFBJV conservation actions (which cannot wait) and also would illuminate gaps that future phases could focus on. This M&E Plan is therefore considered a "living document" that will change over time with continually refined and focused content.

Future M&E Plan Phases Will Address:

- Securing opportunities for funding & implementation of prioritized Phase I objectives;
- Developing outcome-based objectives relevant to target habitat and organism conservation strategies;
- Setting performance criteria that are currently not yet defined for most target organisms;
- Evaluating the effect of habitat conservation delivery on target species population status;
- Using appropriate metrics (i.e. vital rates) to scale up to flyway and continental estimates;
- Establishing a better integration with other monitoring and evaluation frameworks.
- Expand the scope of the M&E Plan to include a more detailed consideration of habitat transition zones, subtidal habitats, and ecosystem services.

Planning Phase Overview

Phase I (current phase) includes setting priority monitoring and research objectives for evaluating net landscape change, assessing target organism status and trends, and determining impacts of priority environmental challenges, including invasive species and climate change.

Phase II will continue to engage established Teams to implement Phase I objectives. This phase will also utilize the Conservation Measures Partnership's *Open Standards for Conservation*[1] multi-stakeholder conceptual planning framework (e.g., Figures 1.5 to 1.7) to address the development of additional performance criteria and outcome-based assessment objectives to better evaluate the effect of habitat conservation delivery on target species population status. It will also include identifying priority metrics for habitat condition-based evaluation of target organisms, expanding the scope to include transition zones, subtidal habitat types, ecosystem services, and achieving better integration with other existing or emerging regional monitoring, evaluation or planning frameworks (Appendix 1.D).

Phase III will continue phase II, evaluate outcomes of prior phases, and develop additional conservation goals and target performance criteria for inclusion into an upcoming revision of the SFBJV Implementation Plan (2001).

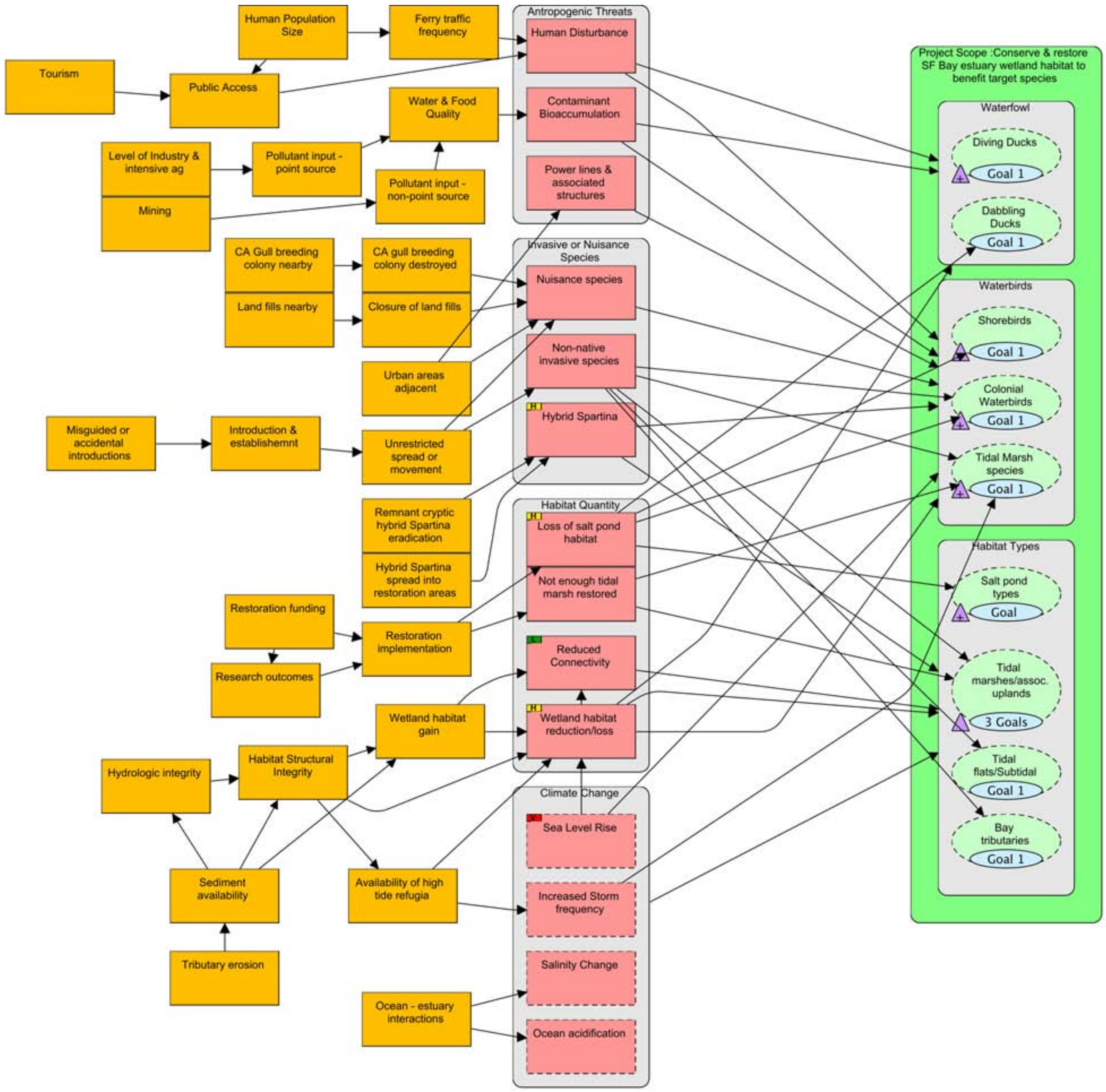

Figure 1.5: Example conceptual model of conservation targets (green ovals to the right) associated with direct threats (red center boxes), and contributing factors (orange boxes to the left) for the San Francisco *Bay Estuary*. Targets can be refined, conservation goals set per target, and strategies developed to address each threat or contributing factor for conservation delivery. For each strategy, monitoring objectives and success indicators developed. Small letters indicate threat level (L = low, H = high, V = very high); triangles indicate one or multiple (+) indicators are available to evaluate this conservation target.

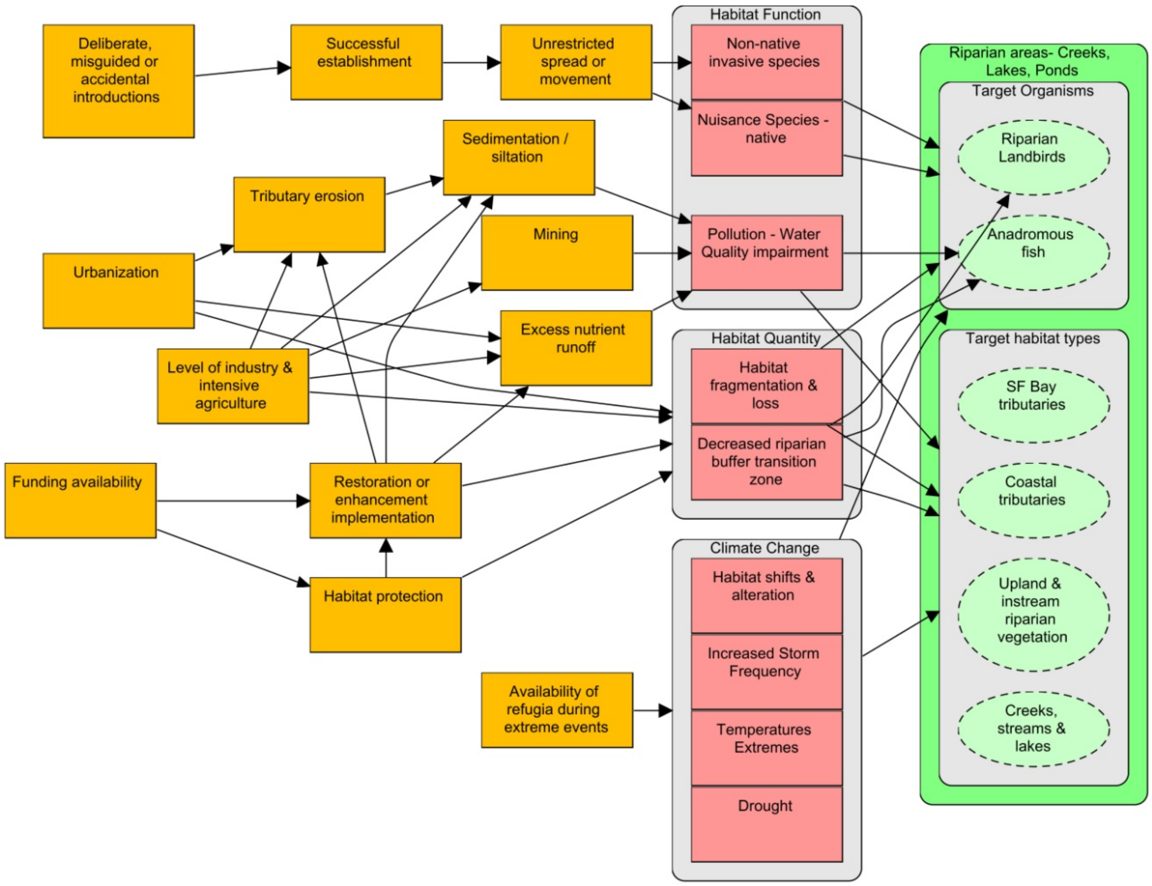

Figure 1.6: Example conceptual model of conservation targets (green ovals to the right) associated with direct threats (red center boxes), and contributing factors (orange boxes to the left) for the San Francisco area *Riparian creeks, lakes and ponds*. In phase II focus team members can refine targets, set conservation goals per target, and develop strategies to address each threat or contributing factor for conservation delivery. For each strategy, monitoring objectives and success indicators can also be developed.

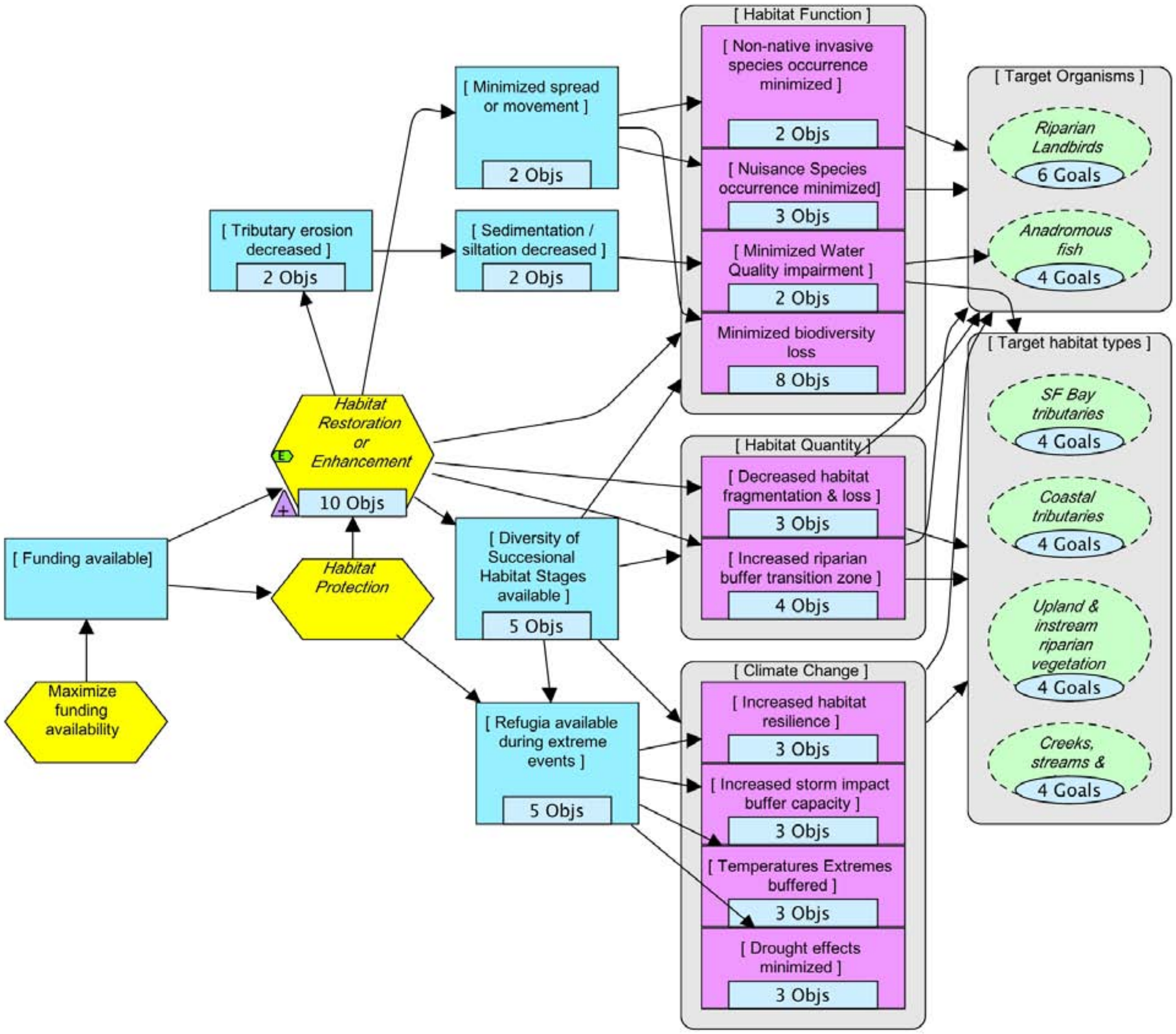

Figure 1.7: Example outcome (blue boxes) diagram of conservation strategies (yellow hexagons) to address threats (purple center boxes with grey trim) to conservation targets (green ovals to the right) for *Riparian creeks, lakes and pond* habitats. For each strategy outcome-based monitoring objectives can then be tested to assess outcome

List of Abbreviations

BAEDN – Bay Area Early Detection Network
BCDC – San Francisco Bay Conservation & Development Commission
CalIPC – California Invasive Plant Council
CRAB – Center for Research on Aquatic Bioinvasions
DFG – Department of Fish & Game
ISP – San Francisco Estuary Invasive Spartina Project
JV – Joint Venture
M&E – Monitoring & Evaluation
NAWMP – North American Waterfowl Management Plan
NLC – Net Landscape Change
NSST – NAWMP National Science Support Team
NWR – National Wildlife Refuge
PIF – Partners in Flight
PRBO – PRBO Conservation Science (PRBO – Point Reyes Bird Observatory)
SBSPRP – South Bay Salt Pond Restoration Project
SFB – San Francisco Bay
SFBBO – San Francisco Bay Bird Observatory
SFBJV – San Francisco Bay Joint Venture
SFEI – San Francisco Estuary Institute
SFEP – San Francisco Estuary Partnership
SHC – Strategic Habitat Conservation
SLR – Sea level rise
USFWS – U.S. Fish & Wildlife Service
WMA – Weed Management Area

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Appendices

Appendix 1.A. Overview of Wetland Ecosystem Services

This is a short overview of some of the resource economic opportunities directly relating to wetland habitat restoration and associated bird conservation:

Sequestration of Carbon. Restoring tidal salt marshes is one of the most effective measures for sequestering carbon that we can take to help reduce the levels of greenhouse gases in the atmosphere (Trulio et al. 2007). Therefore, the more tidal marshes we restore will proportionally help mitigate climate change impacts in the SFBJV region.

Flood & Storm Protection & Sea Level Rise Buffering. Protecting and restoring wetlands can reduce the destructive potential of flooding and is an important component of a comprehensive flood protection strategy. Preserving and reconstructing coastal marshes can help reduce storm damage, as coastal wetlands serve as storm surge protectors.[3] Wetlands buffering human communities will extend natural protection from sea level rise impacts.[4] Coastal wetlands persist when sediment is delivered to the marsh surface at the same pace as sea-level rise. Restored estuarine and coastal wetlands will thus help reduce flooding and climate change impacts in the SFBJV region.

Recreational Birding. Biodiversity conservation, scenic open space, and recreation are considerable ecosystem services in the Bay area. Economically viable activities that encompass one or more services are highly desirable. One example of this is recreational birding, which is becoming one of the fastest growing portions of the tourism industry nationwide. Birding activities generated trip and equipment expenditures of $36 billion in 2006, and $82 billion in total industry output across the United States (USFWS 2009). Considering the value of this industry, the relative value of birds as an ecosystem service becomes apparent, heightening the conservation bar, and monitoring responsibility.

Summary of Economic Benefits of Recreational Birding in the United States (USFWS 2009)

Revenue Source	Revenue $
Birders	47 Billion
Total Expenditures	36 Billion
Total Output	82 Billion
Jobs	671 Thousand
Employment Income	27 Billion
State Tax Revenues	6 Billion
Federal Tax Revenues	4 Billion

[3] http://water.epa.gov/type/wetlands/flood.cfm
[4] http://www.csc.noaa.gov/digitalcoast/wetlands/prioritize.html

Water Storage & Filtration. Wetlands function like natural tubs or sponges, storing water and slowly releasing it. This reduces flood heights, minimizes erosive potential, and allows for ground water recharge that contributes to base flow to surface water systems during dry periods. In many cases, the wetland water filtration process removes much of the water's nutrient and pollutant load by the time it leaves a wetland. [5]

Appendix 1.B: Environmental Challenges for SFBJV Conservation Targets

Invasive and Nuisance Species

Invasive species prevention, early detection, control and management are major challenges SFBJV partners face in their work to conserve, restore and enhance SFBJV area wetland ecosystems. As the effectiveness of SFBJV projects are evaluated, non-native invasive and nuisance species will play a role in how target wetland ecosystems and organisms respond to the implemented restoration and enhancement actions. Thus, providing a framework to detect and monitor these species is essential to the success of the SFBJV mission. A regional M&E framework must inform long-term prevention, detection, control and management of invasive and identified nuisance species (e.g., California gull impacts on sensitive breeding bird species, SFBBO 2011) most detrimental to critical resources and ecosystems. The framework must also detect projected novel invasions of recognized harmful species in the region projected to affect wetland habitat conservation, restoration and enhancement and related effects on target organisms. In addition, it is crucial that such a framework is built to also increase our understanding of the response of target invasive and nuisance species to climate change and other expected large-scale anthropogenic changes to Bay ecosystems and restoration areas (e.g., sediment regime changes, salinity gradients).

Contaminant Bioaccumulation

Contamination of avian food webs with heavy and trace metals such as selenium and mercury, organochlorine pesticides, and PCBs is a global problem, and one relevant to San Francisco Bay region wetlands (SFEI 2010). The tendency of these contaminants to persist in the environment and bio-accumulate has the potential to lead to both acute and chronic effects in birds (Ackerman et al 2008). Estuarine birds in the SFBJV region are particularly vulnerable because 1) estuaries are the ultimate drainage basins of urban and agricultural runoff from watersheds, making them potential contaminant hot spots, and 2) the birds are already stressed in urbanized regions by habitat loss and fragmentation and other anthropogenic impacts. Reproductive impacts of contaminants are especially problematic for threatened and endangered species, which likely have limited gene pools, and may suffer detrimental fitness effects (Reed and Frankham 2003). To estimate the risk of contaminant exposure in birds, contaminant concentrations are typically measured in various components of their diet and surrounding environment, as well as through direct indicators of exposure (i.e., bird eggs; Ackerman et al 2008). Risk thresholds need to be established and contaminant levels strategically monitored in

[5] http://www.epa.gov/owow/wetlands/pdf/fun_val.pdf

order to minimize detrimental effects. Additional stressors, such as human disturbance, should be addressed.

Human Disturbance

With the increase in human activities, such as motorized and non-motorized boating, hiking, running, fishing, dog walking, wildlife viewing, and off-road vehicle use in or near important wildlife areas within the estuary of the San Francisco Bay (BCDC 2001), we need to understand their individual and combined impacts on the millions of ducks and shorebirds that rely on the San Francisco Bay and other Bay area wetlands. While for many years it was assumed that such activities were harmless, and many waterbirds have been found to be vulnerable to human intrusion (Manuwal 1978, Carney and Sydeman 1999, Pease et al 2005). Human disturbance can cause birds to move, dive, or take flight, resulting in costly energy expenditure, or reduce foraging time and efficiency, resulting in potential population level consequences (Yasue 2005, Goss-Custard et al 2006). When approached by humans, nesting colonial waterbirds often endanger their clutch by flushing from nests in an attempt to either intimidate a potential predator or to flee from danger (Burger et al 2010). Boats, car, or foot traffic can disturb resting and nesting waterbirds near main vehicle routes, and facilitate depredation (White 2009, Evans 2007, Stolen 2003, Rodgers and Schwikert 2002). Yet, the high visibility, animated behavior and physical beauty of many waterbirds continue to attract human visitors. Therefore, assessment of human disturbance levels and likely impacts, particularly in sensitive areas, can help implementation of management actions to minimize wildlife stress and establish effective buffer zones (Rodgers & Schwikert 2002, Rodgers & Smith 1995).

Climate Change

Temperature changes, total precipitation in watershed and timing of runoff, sea level rise, frequency of extreme storm events, and ocean acidification are projected as the major impacts on San Francisco Bay region ecosystems (Kimmerer and Weaver 2010, Ackerly et al. in press). In addition, local and regional patterns of change may influence the outcomes of restoration and management. The most prominent and least predictable of these may be freshwater flow dynamics into the estuary, that will impact salinity (Kimmerer & Weaver 2010). Sea level rise represents one of the biggest uncertainties that will affect habitat restoration success. There is a great need for more precise projections of sea level rise and other climate impacts in order to assist with adaptive management decisions and response options for restoration. Therefore, long-term assessments of physical and biological systems need to be implemented and bridged, and baselines are needed to get at rate of change of both physical and biotic parameters. Climate change is already happening now, yet funding to support establishment of baselines and long-term monitoring is unavailable. There is also a need for vulnerability assessments in both biological and human contexts. Unfortunately, human communities resist flood risk assessments, due to concerns related to property values. Ecosystem assessments must be integrated with the human context, especially in assessing the effectiveness of wetland restoration and the ecosystem services it provides.

Appendix 1.C: Focus Team Participants

The SFBJV science coordinator Christina Sloop participated in all focus groups as team coordinator.

Net Landscape Change

Name	Affiliation
Cayce, Kristen	San Francisco Estuary Institute
Fulfrost, Brian	Consulting Scientist - South Bay Salt Pond Restoration Project
Gandesbery, Tom	State Coastal Conservancy
Grenier, Letitia	San Francisco Estuary Institute
Klochak, John	US Fish & Wildlife Service - Coastal Program
Petrik, Kevin	Ducks Unlimited
Schaefer, Nancy	Upland Habitat Goals
Scoggin, Sandra	San Francisco Bay Joint Venture
Valoppi, Laura	U.S. Geological Survey & South Bay Salt Pond Restoration Project
Ward, Kristen	Golden Gate National Recreation Area

Waterfowl

Name	Affiliation
De La Cruz, Susan	USGS
Demers, Jill	San Francisco Bay Bird Observatory
Herzog, Mark	US Geological Survey
Huning, Beth	San Francisco Bay Joint Venture
Oldenburger, Shaun	Calif. Department of Fish & Game
Spenst, Renee	Ducks Unlimited
Strong, Cheryl	US Fish & Wildlife Service –Don Edwards San Francisco Bay NWR
Taberski, Karen	SF Bay Water Board

Riparian Land Birds

Name	Affiliation
Demers, Jill	San Francisco Bay Bird Observatory
Doster, Rob	US Fish & Wildlife Service - Migratory Bird Program
Huning, Beth	San Francisco Bay Joint Venture
Gardali, Tom	PRBO Conservation Science
Geupel, Geoffrey	PRBO Conservation Science
Guldman, Sandy	Friends of Corte Madera Creek Watershed
Lorenzato, Stefan	Riparian Habitat Joint Venture - DWR
Scoggin, Sandra	San Francisco Bay Joint Venture
Stevens, Phil	Urban Creeks Council

Appendix 1.C cont.: Focus team participants.

Shorebirds & Waterbirds

Name	**Affiliation**
Allen, Sarah	National Park Service
Borgman, Kathi	Richardson Bay Audubon Center & Sanctuary
Brand, Arriana	US Geological Survey
Demers, Jill	San Francisco Bay Bird Observatory
Doster, Rob	US Fish & Wildlife Service - Migratory Bird Program
Page, Gary	PRBO Conservation Science
Richmond, Orien	US Fish & Wildlife Service - Refuges Inventory and Monitoring Program
Strong, Cheryl	US Fish & Wildlife Service –Don Edwards San Francisco Bay NWR
Wilcox, Kerry	Richardson Bay Audubon Center & Sanctuary
Wood, Julian	PRBO Conservation Science

Special Status Species

Name	**Affiliation**
Albertson, Joy	US Fish & Wildlife Service - San Francisco Bay NWR Complex
Gluesenkamp, Daniel	Calflora & BAEDN
Liu, Leonard	PRBO Conservation Science
Nur, Nadav	PRBO Conservation Science
Robinson-Nielsen, Caitlin	San Francisco Bay Bird Observatory
Salzman, Barbara	Marin Audubon
Steers, Robert	National Park Service
Strong, Cheryl	US Fish & Wildlife Service – Don Edwards San Francisco Bay NWR
Taylor, Karen	Calif. Department of Fish & Game
Williams, Andrea	Marin Municipal Water District and BAEDN
Woo, Isa	U.S. Geological Survey
Wood, Julian	PRBO Conservation Science

Invasive Species

Name	**Affiliation**
Archbald, Gavin	San Francisco State University
Brusati, Elizabeth	California Invasive Plant Council
Chapple, Dylan	Save the Bay
Gluesenkamp, Daniel	Calflora & BAEDN
Hogle, Ingrid	San Francisco Estuary Invasive Spartina Project
Johnson, Doug	California Invasive Plant Council
Marriott, Meg	US Fish & Wildlife Service - San Francisco Bay NWR Complex
Perlmutter, Mike	Bay Area Early Detection Network
Williams, Andrea	Marin Municipal Water District & BAEDN
Zaremba, Katy	San Francisco Estuary Invasive Spartina Project

Appendix 1.C cont.: Focus team participants.

Climate Change

Name	**Affiliation**
Albertson, Joy	US Fish & Wildlife Service - San Francisco Bay NWR Complex
Ball, Donna	H. T. Harvey & Associates
Ballard, Grant	PRBO Conservation Science
Block, Giselle	US Fish & Wildlife Service - Refuges Inventory & Monitoring Program
Ferner, Matt	SF Bay National Estuarine Research Reserve
Gardali, Tom	PRBO Conservation Science
George, Doug	ESA PWA
Gerhart, Matt	State Coastal Conservancy
Higgason, Kelley	Gulf of the Farralones National Marine Sanctuary
Kamman, Rachel	Kamman Hydrology
Kerkering, Heather	Central and North Coast Ocean Observing System
Micheli, Lisa	Pepperwood Preserve & "Ackerly Group"
Nur, Nadav	PRBO Conservation Science
Valoppi, Laura	U.S. Geological Survey & South Bay Salt Pond Restoration Project
Wainer, Laura	Save the Bay
Wood, Julian	PRBO Conservation Science

Appendix 1.D: Integration with Other M&E Frameworks & Initiatives

In phase II of the SFBJV M&E planning process we aim to evaluate new or continued integration into the following existing or emergent initiatives or frameworks:

Bay Area Early Detection Network (BAEDN).

BAEDN is a collaborative initiative that coordinates early detection and rapid response to harmful plant occurrences in the nine county Bay Area. The group includes hundreds of land managers. Most of the significant land management entities in the Bay Area are partners in BAEDN and have helped develop and implement the 9-county EDRR implementation plan. Committee members and staff developed the framework including guidelines and protocols to prioritize species, prioritize occurrences for eradication, and now are implementing this eradication plan. As part of the project, BAEDN has obtained invasive plant mapping information from partners and made it publicly accessible in the Calflora database; there are currently more than 100,000 point and polygon records for the Bay Area.

California Environmental Change Network (CA ECN)

The California ECN: http://data.prbo.org/apps/ecn/ aims to detect and attribute various elements of environmental change throughout California. The CA ECN is roughly modeled after the ECN in Britain, although the British ECN does not directly consider climate change. The CA ECN will establish a series of monitoring stations at 'easy existing locations'– existing field stations and preserve sites - with a variety of partners. Monitoring parameters still need to be established, but will include weather data, physical attributes, some measure of vegetation, some vertebrates, etc. The ECN plans an official series of field stations that could be complemented by regional finer scale efforts using their standard methods and protocols (i.e. assessing restoration sites alongside reference sites of specific habitat types, e.g. tidal marshes). Also, there will be certain region-specific, customized attributes that official CA ECN sites might monitor relevant to their ecosystems, with a subset of area-specific metrics that could be shared. The initial goal of CA ECN is to first determine where to monitor using current climate and future projections of where climate impacts will be most severe. The CA ECN is planning to array sampling sites according to 'climate space' or habitat type only, or a combination of both. The CA ECN's second order of business is to determine where there are current baselines.

North Bay Climate Adaptation Initiative (NBCAI)

The NBCAI is developing a surveillance vital sign monitoring program for Sonoma County in order to evaluate climate change impacts on ecosystems over time. The idea is to align closely with CA ECN methodology, but implement assessments at finer spatial scales, in order to increase understanding on the extent, variability, rate and severity of projected changes, as well as to evaluate adaptation strategies.

National Wildlife Refuge and National Park Service Inventory and Monitoring Programs

The NWRS is currently developing their inventory and monitoring program in close alignment with that of the NPS Vital Signs Program, implemented in the Bay Area in 2006.

South Bay Salt Pond Restoration Project (SBSPRP)

The SBSPRP planning framework for studies, monitoring and research is outlined in the SBSPRP Adaptive Management Plan and EIR/S. SBSPRP studies are geared toward answering specific management questions to feed the adaptive management process, which may be explored in their capacity to help evaluate M&E objectives and SFBJV performance criteria.

Wetland and Riparian Area Monitoring Program (WRAMP)

The State of California's WRAMP provides a set of standardized tools for assessing the extent and condition of wetlands and riparian resources and for evaluating the performance of wetland protection projects, programs, and policies in the Bay area region. This program needs to be evaluated to determine if the WRAMP scoring system matches the JV's habitat goals.

The San Francisco Bay Joint Venture is a partnership of public agencies, environmental organizations, the business community, local governments, and landowners working cooperatively to protect, restore, increase, and enhance wetlands and riparian habitat in the San Francisco Bay Watersheds. We bring an ecosystem and collaborative approach to developing and promoting wetland and riparian habitat conservation throughout the Bay Area.

The Joint Venture Management Board

Nonprofit and Private Organizations

Bay Area Audubon Council
Bay Area Open Space Council
Bay Planning Coalition
Citizens Committee to Complete the Refuge
Ducks Unlimited
National Audubon Society
Pacific Gas & Electric Company
PRBO Conservation Science
Save the Bay
Sierra Club
The Bay Institute

Public Agencies

Bay Conservation and Development Commission
California State Coastal Conservancy
California Department of Fish and Game
California Resources Agency
Contra Costa Mosquito and Vector Control District
National Fish and Wildlife Foundation
NOAA National Marine Fisheries Service
Natural Resources Conservation Service
SF Bay Regional Water Quality Control Board
San Francisco Estuary Partnership
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
Wildlife Conservation Board

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