ARNOLD SCHWARZENEGGER, Governor
LESTER A. SNOW, Secretary for Natural Resources

MEMORANDUM

TO: Wetlands Conservation Community

FROM: Lester A. Snow
Secretary for Natural Resources

DATE: October 18, 2010

SUBJECT: State of the State's Wetlands Report

Today, the California Natural Resources Agency is releasing the second *State of the State's Wetlands* report which summarizes the progress made by many state agencies, public and private partnerships, and the federal government to protect, restore, and monitor California's diverse wetland resources from 1999 through 2009. During this time period, Californians have invested billions of dollars to protect and restore wetlands and riparian areas. These investments have led to substantial increases in protected wetland acreage, primarily in San Francisco Bay, along California's south coast, in the Central Valley, and in the Sierra. Many of these gains are the result of partnerships between state and federal agencies, local citizen groups, and private sector/business partnerships. The need for these actions is underscored by the fact that from the 1780's to the 1980's California lost approximately 91 percent of its wetlands.

The report, which was prepared under the auspices of the Natural Resources Agency by staff from the Department of Fish and Game, the Southern California Coastal Water Research Project, the San Francisco Estuary Institute, and the State Coastal Conservancy, makes a number of recommendations on how the state and its partners can continue to make gains in wetlands and to provide state wetland managers with tools to better assess wetland quality and quantity. For example, these recommendations address:

- wetlands data collection and management,
- agency coordination and public information,
- wetland partnerships and their importance, and
- the potential for wetland restoration projects to sequester carbon

It is important to note that many of these recommendations require little or no additional state funding for implementation.

The *State of the State's Wetlands* report was funded under a grant from the U.S. Environmental Protection Agency, Region IX. Any questions regarding the report should be directed to Brian Baird, Assistant Secretary, Ocean and Coastal Policy, Natural Resources Agency. Mr. Baird can be reached by email at brian@resources.ca.gov and by phone at (916) 657-0198.

NATURAL RESOURCES AGENCY
STATE OF CALIFORNIA

STATE OF THE STATE'S WETLANDS

10 YEARS OF CHALLENGES AND PROGRESS

JUNE 2010

Cover Photo
Vernal Pool at Mather Field, Sacramento County
David Rosen (Wildside Photography)

SUMMARY

The *State of the State's Wetlands* report summarizes the importance of wetlands, what we know about them qualitatively and quantitatively, and efforts undertaken to implement the California Wetlands Conservation Policy (Executive Order W-59-93). The report identifies the progress made by many state agencies, public and private partnerships, and the federal government to protect, restore, and monitor California's diverse wetland resources. Conclusions are based on information readily available from representative programs located throughout the state; it was not feasible to describe all programs given the scope and budget for this effort.

The report also highlights future challenges and provides recommended steps to help achieve the goals of the Wetlands Conservation Policy. The policy calls for the implementation of 33 specific actions, ranging from performing wetland inventories, to developing mitigation banking policies, to creating regional wetland restoration and planning efforts. The policy's primary purpose is to ensure no overall net loss and achieve a long-term gain in the quantity, quality, and permanence of wetlands acreage and values throughout California.

Malibu Lagoon (Eric Stein, Southern California Coastal Water Research Project)

California has made substantial progress over the last 10 years in efforts to identify, acquire, restore and enhance wetlands. The state currently has approximately 2.9 million acres of wetlands, roughly a tenth of the wetland area that was present two centuries ago (see Figure 2.1). The state's wetland resources are concentrated in the San Francisco Bay, Sacramento-San Joaquin River Delta, Central Valley, Sierra, Modoc Plateau, and north, central and southern coastal regions. About 94 percent of the state's wetlands are freshwater wetlands, including those associated with lakes, vernal pools, streams, marshes, wet meadows, playas, seeps and springs.

Californians have invested billions of dollars to protect and restore wetlands and riparian areas over the years. These investments have led to substantial increases in protected wetland acreage, primarily in San Francisco Bay, along California's south coast, in the Central Valley, and in the Sierra. Many of these gains are the result of partnerships between state and federal agencies, local citizen groups, and private sector/business partnerships. For example, one of the most important projects is the Southern California Wetlands Recovery Project that has acquired 6,603 acres and restored 2,161 acres of wetlands at a cost of approximately $430 million since 1998.

Despite the gains, significant stressors continue to affect California's wetlands. Urban and agricultural development contributes to shifts in the type of wetlands found on the landscape, converting seasonal wetlands to perennial ponds and lakes designed for flood control, irrigation, and water supply. Unfortunately,

these activities are also resulting in some wetland losses. A 2007 study of the health of the state's 44,000+ acres of salt marshes showed that 85 percent of the wetland area was in "good" or "very good" condition. Similarly, approximately 60 percent of the miles of riverine riparian habitat in wadeable streams are considered "healthy". However, statewide surveys of salt marsh and wetlands associated with streams show declining health as a function of increased urbanization. These habitats will also be vulnerable to stressors associated with climate change.

Climate change is expected to affect the available area for wetlands, the hydrology of wetlands, and wetland habitat functions. Because wetlands provide a transition between uplands and completely aquatic areas, slight changes in the availability of water or water management practices can affect the distribution of wetlands. California's hydrology is one of the most modified in the world, with nearly every major stream dammed or diverted in order to supply water to homes, businesses, and agricultural lands. Competition for this limited water supply increases every year. Most freshwater wetlands in California now depend on these water delivery systems, not on natural flooding, for at least a portion of the year. Freshwater wetlands dependent on runoff or groundwater, such as vernal pools, are likely to be most impacted by climate change and reduced water supply. These wetlands are especially sensitive to the drier and warmer climate predicted for the future. Coastal wetlands may be affected by the combination of changes in sea level and in freshwater runoff into the wetlands. Coastal wetlands may also play an important role as buffers against rising sea levels and for sequestering carbon to help reduce the impact of emissions. In addition to these climate change impacts, changes in fire frequency and distribution of invasive species have the potential to impact California's wetlands.

The responsibilities for protecting, restoring, and managing California's wetlands are shared among nearly a dozen state and federal programs, including regulatory, non-regulatory, and land-management programs. Each of these programs makes substantial contributions to wetland protection and management. However, coordination among these programs remains a challenge. Effective coordination requires mechanisms that allow agencies and programs to share information, strategies, and resources. Central to this effort should be an integrated monitoring program and an associated data management and dissemination system. Such a system would allow agencies and the public to track status and trends in wetland extent and condition, assess the efficacy of existing programs, evaluate progress toward achieving stated goals, and to help establish priorities for future efforts.

According to the U.S. Fish and Wildlife Service's National Wetlands Inventory, to date, about 82 percent of California's wetlands have been mapped. Ongoing implementation of wetland monitoring will provide, over time, a more complete picture of the "State of the State's Wetlands," including new information on trends and assessment of gains on wetland area. In addition to mapping efforts, a coordinated data management system is rapidly emerging; however, much work remains to be done before this system will be able to assimilate information across agencies and programs.

To that end, the following recommendations are offered as a vision of the actions needed to continue the gains in wetlands and to better assess wetland quality and quantity.

1. **Establish a mechanism in state government to coordinate state wetland programs and to standardize wetland monitoring and assessment procedures**

    A. Formalize the interagency wetland workgroup to coordinate wetland monitoring and assessment in California and to take steps to implement a consistent framework for wetland monitoring and assessment programs throughout the state

2. **Adopt a common approach for wetland identification, mapping, and classification**

   A. The interagency wetlands workgroup should work to develop and seek adoption of a consistent statewide definition of wetlands and riparian areas

   B. The interagency wetlands workgroup should work to develop a common statewide classification system for wetlands and riparian areas that is tailored to California's wetlands

   C. The Department of Fish and Game should be the lead state agency responsible for maintaining and updating wetland and riparian maps and making them readily available to the public

3. **Provide common tools and approaches for wetland management**

   A. Establish standard methods to assess wetland condition in all state wetland programs

   B. Improve compensatory mitigation monitoring and assessment methods

   C. Establish California wetland reference sites to support evaluation of mitigation and restoration project success and help track the effects of climate change

4. **Share wetland and riparian area data and information with the public**

   A. Establish an Internet Web portal for managing and disseminating data on wetlands, riparian areas, and other associated habitats

5. **Consider long-term wetland costs in future bond measures**

   A. Ensure that operation and maintenance costs are considered for newly acquired or restored wetlands, including the cost of acquisition and, if necessary, the delivery of water

6. **Support the use of wetlands to sequester carbon**

   A. Establish a market for wetland carbon offsets as one way to reduce the impacts of climate change in California

7. **Increase state support for wetland partnerships and coordination with agricultural stakeholders**

   A. Encourage federal, public, and private partnerships to continue to develop and maintain partnerships to achieve gains in wetland area

ACTION NEEDED

In order to continue the efforts undertaken to implement the California Wetlands Conservation Policy goal of no-net loss, California wetlands conservation, restoration, and management efforts need improved coordination through the interagency wetlands workgroup, additional technical support, and sustainable funding. More federal funding, bond funding, and support through partnerships will be necessary to address identified wetland conservation, restoration, and management needs. Improvements must be made to build the capacity of state and regional agencies and local non-profits, such as watershed groups, to restore and enhance wetlands, monitor and assess wetlands and to maintain our wetland assets.

Progress is already being made regarding some of these recommendations because agencies see the value in moving forward where feasible. Other recommendations to achieve wetland restoration and protection goals will require new funding. Stable and continuous funding is needed to support operation and maintenance of wetland assets already acquired and restored. New bond measures that focus on the acquisition of wetlands should also address the ongoing costs of operation and maintenance. Finally, private-public partnerships should continue to be the centerpiece of future wetland acquisition and restoration, as these partnerships can help leverage limited state and federal funding to restore and protect California's wetland heritage.

ACKNOWLEDGEMENTS

This report was prepared under the auspices of the Natural Resources Agency by staff from the Aquatic Science Center, the California State Coastal Conservancy, the Department of Fish and Game, San Francisco Estuary Institute, and the Southern California Coastal Water Research Project. It has been funded wholly or in part by the U.S. Environmental Protection Agency as part of a project under Assistance Agreement number CD-96956601 to the Natural Resources Agency in the amount of $900,000. The contents of this report do not necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Petaluma Marsh Restoration (K. Bane, State Coastal Conservancy)

We would also like to acknowledge the many staff from a variety of local, state and federal agencies and non-profits whose hard work and commitment towards wetland conservation and management is reflected in this report.

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INTRODUCTION

Wetlands are important features that occur in all of California's varied landscapes. Wetlands serve California by providing important ecological and human services including flood control, water quality enhancement, recharge of groundwater, habitat for waterfowl, and breeding and feeding areas for resident and migratory fish, birds, and other wildlife. Losses in wetlands should be considered losses in California's plant and wildlife heritage, the economy, and, in some cases, public safety.

In 1998, the first *State of the State's Wetlands* report was published by the Natural Resources Agency. Since then, California has made significant strides to acquire, restore, protect, and assess the wetland resources of the state. These efforts and activities represent billions of dollars of public, private, and non-governmental organization investment and substantial community outreach and education.

This report focuses on the last 10 years of accomplishments and describes the ongoing work that still needs to be done. The report is divided into five major chapters: a background section describing wetlands and why they are important; a discussion of the extent and condition of wetlands throughout the state; a section describing our public and private investment in wetlands; a presentation of challenges and key programs implemented to protect wetlands; and a final section with recommendations to address future challenges.

CALIFORNIA'S WETLANDS CONSERVATION POLICY

California was one of the first states in the nation to set a "no-net loss" policy for wetlands. In 1993 the administration of Governor Pete Wilson, through the Natural Resources Agency, established the California Wetlands Conservation Policy.[1] This policy provides over 30 actions intended to reduce and eliminate loss of wetlands throughout California. The policy established several

San Dieguito Lagoon
(Eric Stein, Southern California Coastal Water Research Project)

[1] http://ceres.ca.gov/wetlands/policies/governor.html

statewide initiatives including:

- A Statewide Wetlands Inventory
- Support for wetlands planning
- Improved administration of existing regulatory programs
- Strengthened landowner initiatives to protect wetlands
- Support for mitigation banking
- Integration of wetlands policy and planning with other environmental and land use processes
- Support for regional wetland partnerships

This policy continues to provide the framework for many of California's programs and priorities.

Canoeing on Petaluma Marsh (K. Bane, State Coastal Conservancy)

WETLANDS AND THEIR IMPORTANCE

WHAT IS A WETLAND?

Wetlands are aquatic areas with attributes of terrestrial land (i.e., dry land). They are neither completely terrestrial nor completely aquatic. They get too wet for most terrestrial vegetation and tend to undergo wet and dry cycles due to fluctuating water levels. They are seldom covered with enough water to prevent rooted aquatic plants from reaching the water surface. Some wetlands form boundaries between uplands and deepwater areas, such as lakes and rivers. Other wetlands evolve where deepwater areas are receding (due to water diversions, withdrawals, or climate change) or where uplands are getting wetter (due to impoundment, irrigation, river migration, or sea level rise). Some wetlands stay wet all year every year, whereas others are seasonally wet, and some only get wet during major rainstorms and floods. Because of these considerations, wetlands are regarded as transitional areas located in-between completely aquatic areas and uplands.

Every California landscape has wetlands. They form where rainfall or runoff accumulates, or where groundwater saturates the topsoil. There are wetlands associated with desert playas, washes, and oases. Mountains and valleys have wet meadows, bogs, fens, sag ponds, vernal pools, and other kinds of wetlands along the shores of lakes, reservoirs, and ponds and on floodplains. The coastal landscapes have tidal flats and tidal marshes. Wetlands have been constructed to treat wastewater and prevent shorelines from eroding. Many parks, nature preserves, agricultural lands, and private lands have wetlands that are carefully managed for waterfowl and other wildlife.

Identifying Wetlands

Wetlands are important to the ecosystem, economy, and people; they are protected under both State and federal laws.

To implement these laws, there must be very specific rules for identifying wetlands and determining their boundaries. This can be done remotely, using aerial photography or satellite imagery, and it can be done on the ground, based on hydrology, soil condition, and vegetation. The on-the-ground approach of wetland delineation is more exacting. Both approaches depend on a wetland definition that objectively distinguishes wetlands from every other type of habitat.

The State Water Resources Control Board is beginning to develop a scientific definition that covers all kinds of wetlands in the State, one that potentially all State agencies could use.

WHY ARE WETLANDS IMPORTANT?

Wetlands are celebrated world-wide for the many services they provide. They help regulate climate, store surface water, control pollution and flooding, replenish aquifers, promote nutrient cycling, protect shorelines, maintain natural communities of plants and animals, serve as critical nursery areas, and provide opportunities for education and recreation.

No wetland provides all these services, and the level of any service varies among wetlands. The location of a wetland, its size, shape, source of water, ecological characteristics, and how it is managed determine the kinds and levels of service it can provide. For example, many interior wetlands require active management of water levels, often difficult to obtain due to supply demands, which in turn can dramatically affect the level of service. To provide flood control, a wetland must exist within reach of flood waters. To replenish aquifers, wetlands need to retain rain or runoff long enough for it to permeate the ground. Many factors affect the level of service that a wetland provides. Service levels naturally depend on rainfall and flooding. They also depend on how the lands around the wetland are used.

Wetland services have not always been appreciated. Throughout most of recorded world history, wetlands were regarded as wastelands and problem areas to be drained or filled. Wetlands tend to form on flat lands that are easily developed if adequately drained. Most of the wetlands that existed in California at the time of statehood were lost within the following hundred years. Increased protection for wetlands and the growing effort to restore them is due to increased appreciation for their services to society. Below are some additional explanations of the major services that wetlands provide.

SURFACE WATER STORAGE
Wetlands help prevent flooding by temporarily storing water, allowing it to soak into the ground or evaporate. This temporary storage helps reduce peak water flows after rainstorms by slowing runoff into streams, rivers, lakes, and bays.

POLLUTION CONTROL
Wetlands improve water quality by filtering water-borne sediment, nutrients, pesticides, and bacteria. Pollutants are broken down by biological and chemical processes within the wetlands. By trapping sediments, wetlands help protect aquatic resources from excessive sedimentation.

GROUNDWATER RECHARGE
Some wetlands slowly release water into the ground, replenishing aquifers. These aquifers provide water for farms and people, and can extend the period of stream flow from the wet season into the dry season. In many regions of California, having streams flow during spring and summer is essential in meeting the water requirements of wildlife and people.

NUTRIENT CYCLING
Many wetlands are prone to wet and dry cycles that promote the decomposition of organic matter and the recycling of nutrients back into wetland vegetation, the foundation of many food webs.

PROTECT SHORELINE
Wetland vegetation helps protect shorelines and stream banks by increasing their resistance to erosion, dissipating waves and boat wakes, flood protection, and reducing the velocity and turbulence of nearshore currents. This is a highly valued service because it helps protect flood control levees and other shoreline infrastructure which could act as a natural buffer against sea level rise. Some riparian wetlands help reduce flooding of inland systems.

MAINTENANCE OF BIODIVERSITY
Although most of California's historical wetlands have been converted to other land uses, the remaining wetlands comprise a large portion of the state's natural heritage. Because they are a blend of

Wetland Classification

The likely functions and services of a wetland can be predicted based on its location, size, ecological characteristics, water source, and how it is managed. In other words, wetlands can be classified based on these various factors, such that the classes represent different sets of likely functions and services.

The classification system most widely used in the U.S. was developed by the U.S. Fish and Wildlife Service (USFWS) to assess national changes in wetland acreage. The "Cowardin system" is hierarchical and each wetland type has many subtypes. It emphasizes structure and form more than location or function.

The hydrogeomorphic or "HGM" system developed for the U.S. Army Corps of Engineers (USACE) is a hierarchical system that emphasizes water source and geomorphic setting in support of methods to assess wetland functions.

The USFWS has also developed a hierarchical system based on landscape position, landform, water flow path, and water body type that can be used in conjunction with the Cowardin system to help identify likely functions and services.

Efforts are underway to develop a classification system based on California wetlands. It is likely that the system will incorporate aspects of the three federal systems while ensuring that wetland types of special interest to Californians are adequately addressed.

California currently uses the Cowardin system, which has five basic wetland types:

- *Palustrine - Playas, ponds, wet meadows, etc.*
- *Lacustrine - Deepwater lakes and reservoirs*
- *Riverine - Streams, rivers, canals, etc.*
- *Estuarine - Saline and brackish estuaries*
- *Marine - Intertidal beaches and rocky shorelines*

terrestrial and aquatic characteristics, wetlands are biologically diverse and provide critical nursery areas for many species of birds, fish, and invertebrates. They are an essential component in the early life cycle of a large number of species (e.g., one study for the Clean Water Network found that wetlands are essential to three-quarters of the nation's fishery production) and many of the state's identified listed species or species of special concern are found only in wetland habitats. When all California wetlands types are considered together, they support more species of plants and animals than any other type of habitat in the state and are the most important stop-off along the Pacific Flyway for millions of migratory birds. Many of California's wetlands have been identified as "Important Bird Areas" by the National Audubon Society (www.audubon.org). San Francisco Bay has been designated as a site of hemispheric importance, the Grassland Ecological Area and Sacramento Valley as sites of international importance, and the Salton Sea as a site of regional importance for shorebirds under the Western Hemisphere Shorebird Reserve Network (www.whsrn.org). In addition, many California wetland areas are protected under the National Wildlife Refuge System Improvement Act, helping to preserve the diversity the state's wetland biodiversity.

RECREATION AND EDUCATION

Wetlands provide abundant opportunities for hunting, fishing, nature photography, outdoor environmental education, and the enjoyment of open spaces. The ecological diversity and high productivity of wetlands make them one of the most scenic features of any landscape.

CLIMATE CONTROL

Wetlands are considered among the most productive habitats in the world, comparable to rain forests and coral reefs. One recognized benefit of wetlands towards climate control is their ability to transform large amounts of carbon dioxide into plant tissue, then into soil humus, thus helping to control climate change.

Bear Creek, San Gabriel River watershed (Eric Stein, Southern California Coastal Water Research Project)

WHAT WE KNOW ABOUT THE STATE OF THE STATE'S WETLANDS

Over the last 10 years tremendous effort and resources have been invested to acquire, restore, manage, and regulate wetlands in California. Cooperative statewide wetland monitoring programs, developed in tandem with these efforts, are beginning to show a more comprehensive assessment of the state's wetlands. A key component of this success is the development of a toolkit of standardized methods to map and assess the health of wetlands. These standardized tools ease integrated reporting on wetland health across agency policies and programs. Although the State's Monitoring Program is still under development, initial efforts allow new and expanded insight into the State of the State's wetlands.

The state of California's wetlands can be evaluated based on these questions:

- Where California's wetlands located are and how much acreage do we have?
- Are we gaining or losing wetlands over time?
- What are the major factors responsible for poor wetland health?
- How healthy are our wetlands?

What are the tools in California's Wetland Toolkit?

Standard methods to map wetlands and riparian areas (www.wrmp.org, www.socalwetlands.org)

Methods to rapidly assess wetland condition and stressors (www.cramwetlands.org; Collins et al. 2008)

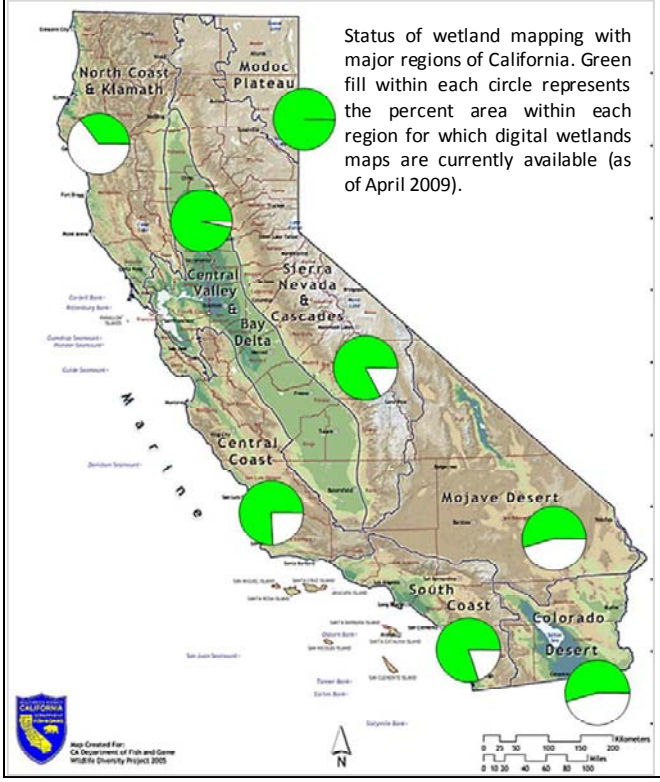
Methods to track the effect of projects permitted by regulatory agencies on wetland acreage and health (www.wetlandtracker.org)

A Web-based portal for the public to access information on wetlands (www.wetlandtracker.org)

While precise estimates of wetland gains and losses are not yet possible, it is clear from regional assessments and studies performed by the state and its partners that urban and agricultural development contributes to shifts in the type of wetlands found on the landscape. A 2007 study of the health of the state's 44,000+ acres of salt marshes showed that 85 percent of the wetland area was in "good" or "very good" condition. Similarly, approximately 60 percent of the miles of riverine riparian habitat in wadeable streams are considered "healthy". However, statewide surveys of salt marsh and wetlands associated with streams show declining health as a function of increased urbanization (Sutula et al. 2008b). Our understanding of the state of California's wetlands will be enhanced when a more robust statewide monitoring program is in place.

WHERE ARE CALIFORNIA'S WETLANDS? HOW MANY ACRES OF WETLANDS DO WE CURRENTLY HAVE?

By current estimates (see inset on Status of Mapping), California has approximately 2.9 million acres of wetlands (Figure 2-1). Approximately 38 percent of the state's wetlands are found in the San Francisco Bay Delta and Central Valley regions. Thirty-six percent are in the Sierra and Modoc Regions of the state, with the remainder (26 percent) occurring in the North, Central, and South Coast and the Colorado and Mojave Desert. Freshwater wetlands are the most abundant in California (Table 2-1), with 60 percent of the total wetland area found in vernal pools, marshes, wet meadows, fens, playas, seeps and springs, bogs, swamps, and shallow ponds. Another 25 percent is associated with lakes, while 15 percent are associated with river channels, intertidal beach, rocky shorelines, and estuaries. California's 251,000 acres of riverine wetlands are associated with 410,000 miles of rivers and streams.



Status of wetland mapping with major regions of California. Green fill within each circle represents the percent area within each region for which digital wetlands maps are currently available (as of April 2009).

Status of Efforts to Map Wetlands:

In response to AB 2286 (2000), the Natural Resources Agency began developing a complete map of wetlands in our state through a partnership with the USFWS National Wetland Inventory (NWI). Currently, digital maps of wetlands that the public can access through NWI are available for 82 percent of the state. Regions that are currently under mapped (at less than 75 percent) are the North Coast-Klamath, Mojave and Colorado Desert Regions. Many of these maps date from the 1980s and are not very detailed, so they do not provide the most current picture and cannot be easily used to determine if wetlands are being gained or lost . The state of California is working to supplement the Statewide Wetlands Inventory with additional mapping methods and other data that will allow us to evaluate the trends in wetland acreage.

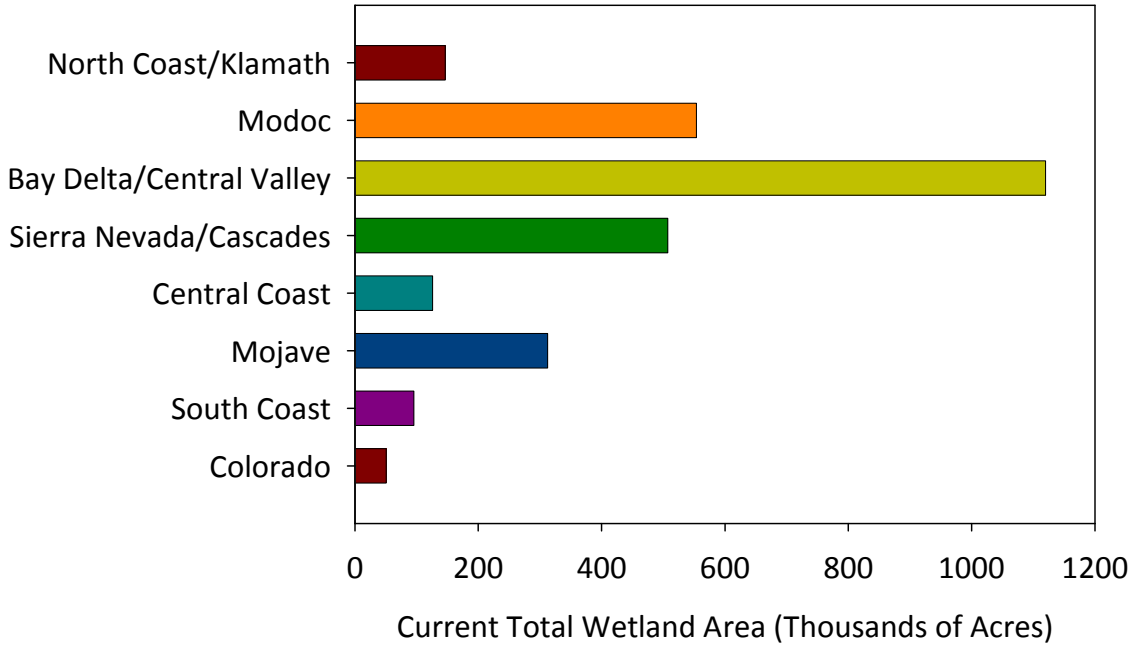


Figure 2-1. Distribution of current wetland acreage by region (Statewide Wetlands Inventory Database, April 2009). Note percent of region mapped above.

Table 2-1. Summary of acreage by wetland type.

Wetland Type	Wetland Area (Acres)
Intertidal beaches and rocky shorelines	10,365
Saline and brackish estuarine wetlands	159,534
Palustrine (Playas, ponds, wet meadows, etc.)	1,751,212
Lacustrine (wetlands associated with lakes and reservoirs)	740,240
Streams, rivers, canals, etc.	251,150
Total	2,912,501

(Data courtesy of T. Dahl., NWI)

ARE WE GAINING OR LOSING WETLANDS OVER TIME?

HISTORICAL AND PRESENT WETLAND EXTENT – THREE CASE STUDIES

California has lost more than 90 percent of wetland acreage that existed at the time of European settlement of California (Dahl 1990). This wetland loss has occurred as land was converted from open space to human uses (e.g., urban and agriculture).

Detailed studies of the historical ecology of wetlands provide valuable information on the nature of changes to wetlands that impact their ability to support plants and animals and provide important services to humans. The historical ecology of wetlands in 10 watersheds across the state is currently being studied, and will provide insight on historic wetland extent, major agents of change, and present wetland extent. Results of three select studies (the Central Valley, San Francisco Estuary, and Napa River) are highlighted here to illustrate the typical patterns of changes that have occurred and how this information can be used to help wetland managers set goals for future wetland restoration and management.

Central Valley

Prior to the Gold Rush of the mid-1800s, the Central Valley contained more than 4 million acres of wetland habitat, most of which were bordered by grassland and riparian habitats. Many wetlands were seasonal and resulted from over-bank flooding of rivers and streams that inundated large areas of the valley during winter and spring. More than 95 percent of historic Central Valley wetlands and 98 percent of all riparian habitats have been destroyed or modified. Today, just over 205,000 acres of managed wetlands now exist in the Central Valley, two thirds of which are in private ownership. The over-bank flooding that once characterized the valley occurs rarely. Dams, levees, and flood bypasses confine these historic flows. Threats to wildlife habitat in the Central Valley continue to grow. Most of the valley's wetlands now rely on the application of water through managed systems. The long-term reliability and affordability of water supplies for these wetlands is uncertain and may be the biggest threat of all, as other water users compete for this limited resource. In addition, as the state's population increases, up to a million acres of irrigated farmland within the valley could be lost along with the associated benefits for waterfowl and other wetland dependent wildlife (Central Valley Joint Venture 2006).

San Francisco Estuary

Over the past 200 years, the amount of wetlands in the San Francisco Estuary has decreased by nearly 99 percent (Goals Project 1999). Most of its historical wetlands were non-saline, and less than 1 percent of that remains. Only about 15 percent of its historical salt marshes remain (Figure 2-2). This wetland loss is a direct consequence of conversions of filling, diking, and draining wetlands for human uses and changes to watershed land use that result in wetland loss.

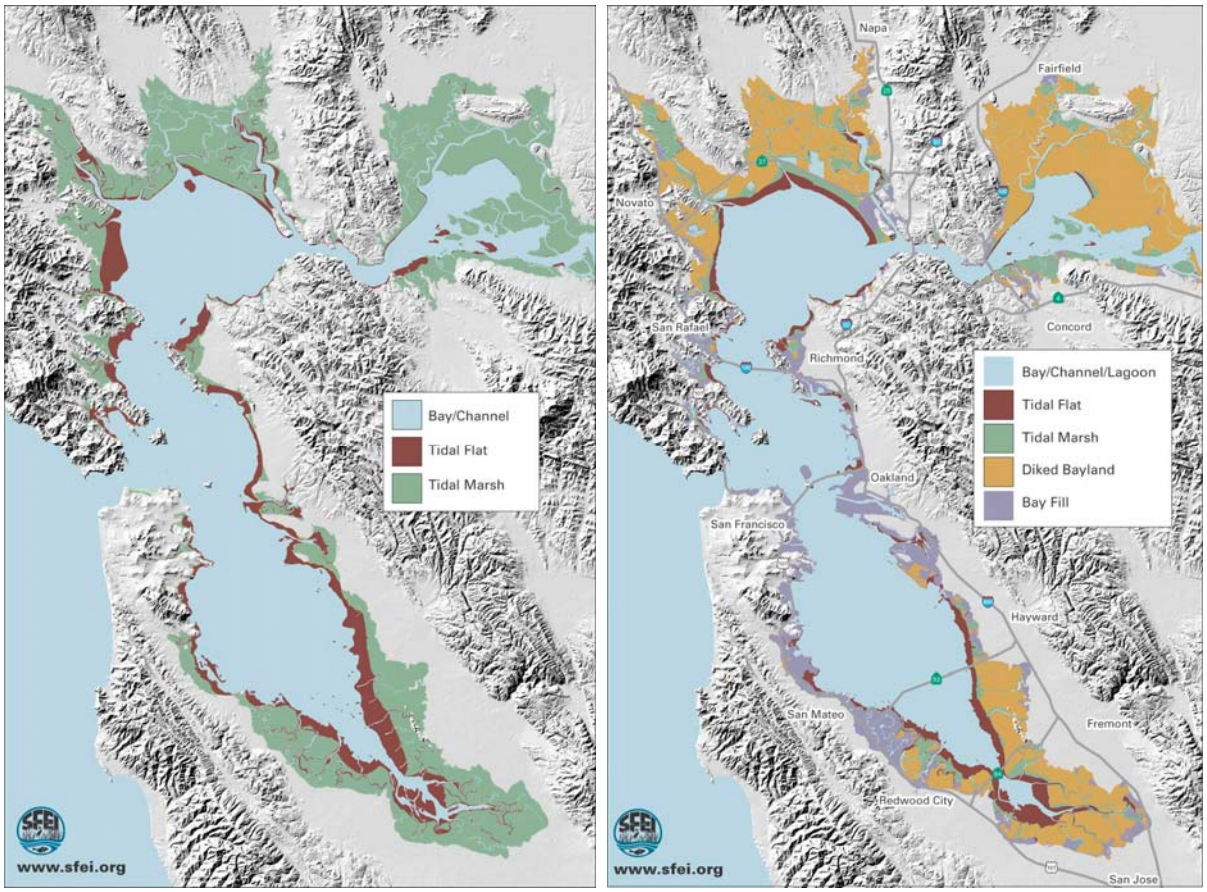


Figure 2-2. Historical (left) and present (right) distribution of tidal wetlands in the San Francisco Estuary downstream of its inland delta.

The San Francisco Baylands Ecosystem Habitat Goals Report established regional goals for restoring the baylands of the San Francisco Estuary (area shown in Figure 2-2), based on an understanding of the historic distribution of habitats and current needs to support a diversity of plants and animals and prized functions (Figure 2-3, Goals Project 1999). These goals are currently being used to guide the restoration of 15,100 acres of salt ponds acquired in the South Bay, restoration or enhancement of numerous wetlands in the North Bay, planning for the management and restoration of Suisun Marsh, and restoration of small wetlands in the urban Central Bay.

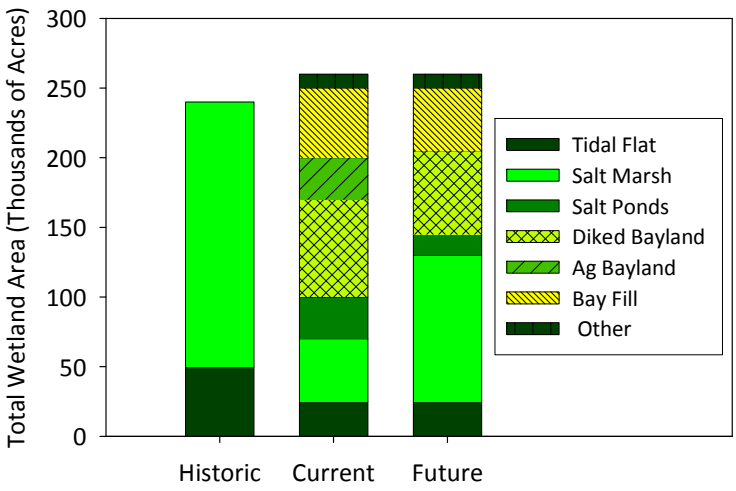


Figure 2-3. Past, present and recommended future habitat acreage for San Francisco Bay (From Goals Project (1999)).

Napa River

At a smaller scale, in the Napa River watershed, historical changes in the abundance of common wetland types reflect two centuries of drainage modification to support agriculture and urbanization. Almost all of the seasonal and perennial depressional wetlands have been drained or filled to make room for urban development, pasture, and vineyards. The amount of wetlands associated with lakes has been greatly increased by the construction of large and small reservoirs for flood control, recreation, irrigation, and other consumptive uses (Figure 2-4). More than 2,000 small reservoirs have been built in the Napa River watershed since the mid 19th century to water livestock and irrigate vineyards. Similar changes have been found in the San Gabriel River watershed in southern California (Stein et al. 2007).

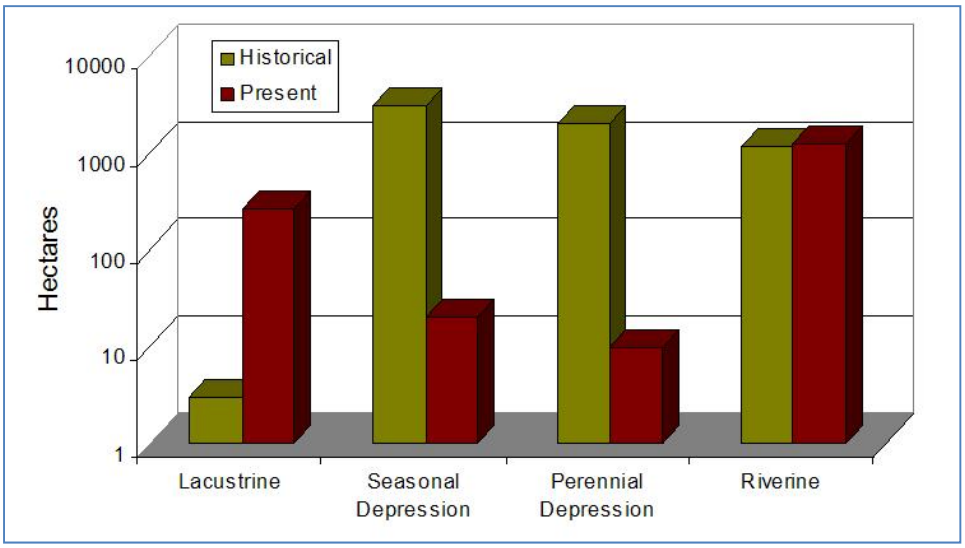


Figure 2-4. Historical and current abundances of selected wetland types in the Napa River watershed. Depressional wetlands are a hydrogeomorphic subclass of Palustrine wetlands. (Ten hectares is equal to roughly 24.7 acres).

RECENT WETLAND GAINS AND LOSSES

Wetland losses and gains can occur through a variety of mechanisms (Table 2-2). A comprehensive assessment of contemporary gains and losses would capture: (1) net change from permitted impacts to wetlands, wetland mitigation, and wetland restoration projects, (2) change in the ambient extent of wetlands through California's Statewide Wetlands Inventory, and (3) change in wetland extent from conservation programs such as the Natural Resources Conservation Service's Wetland Reserve Program (which removes agricultural land from production for the purposes of restoring wetland habitat).

Individual state agencies, including the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards, California State Parks, the California Coastal Commission, the Wildlife Conservation Board (WCB), Department of Water Resources (DWR), and the Department of Fish and Game (DFG), typically track changes in wetland area associated with their programs. In addition many of the California joint ventures (e.g., San Francisco Bay Joint Venture, Central Valley Joint Venture) maintain project and program data bases for their respective regions. However, the lack of a statewide coordinated tracking or data management system makes it difficult to assess overall gains and losses among these programs.

Table 2-2. Major mechanisms through which wetland losses and gains are occurring.

Losses	Gains
• Losses permitted through regulatory programs of Section 404 and 401 of the Clean Water Act, the Porter-Cologne Waste Discharge Requirement Program and the Lake and Streambed Alteration (LSA) Program (implemented by DFG) • Indirect or cumulative impacts of altering urban land use not measured or permitted by regulatory programs (agriculture, downstream impacts on stream and estuaries from development) • Natural forces (climate change, sea level rise, cycles of heavy rainfall and drought, flood, fire) • Invasive species	• Compensatory mitigation (required to mitigate wetland losses through 404, 401, and LSA programs) • Voluntary restoration programs

A general idea of the rates of wetland loss and gain can be gleaned from data on projects permitted through Section 404 of the federal Clean Water Act (CWA). Currently, the USACE maintains the most accurate database of wetland gains and losses associated with implementation of regulatory programs to compensate for wetland loss (see box). Based on records from January 2007 through April 2009, the USACE has recorded 300 to 400 acres per year of impacts to wetlands and other jurisdictional aquatic habitats in California. Compensatory mitigation provides a greater than 1:1 replacement of acreage for impacted habitats, often 3:1.

Requirements for compensatory mitigation do not necessarily imply that mitigation is successfully completed or that the resultant wetlands provide comparable functions and services to those that have been impacted through permitted activities. Difficulties with the wetland compensatory mitigation program have been well documented in a study sponsored by the SWRCB to assess the performance of the federal CWA 404 and state 401 permit programs. The study revealed that most mitigation projects, while meeting their acreage goals, were not meeting their performance goals (Ambrose et al. 2007, Figure 2-5). Ambrose et al. (2007) also

found that only 19 percent of the mitigation wetlands were considered ecologically successful, and 27 percent did not meet the federal definition of wetland. Thus many of the mitigation wetlands represented a type conversion from one wetland class to another or even from wetlands to uplands. Figure 2-5 shows the results of mitigation success as evaluated by four criteria: (1) meeting the acreage requirement for replacing the destroyed wetland, (2) meeting the CWA 401 permit conditions for the project, (3) meeting the mitigation plan conditions, and (4) achieving successful wetland condition.

Compensatory Mitigation?

Section 404 of the federal Clean Water Act, as administered by the USACE, requires any project proposing to impact a wetlands and other jurisdictional aquatic habitat to go through a sequence of avoidance, minimization, and compensation. Proposed impacts to wetlands that cannot be avoided or minimized must be offset by adequate mitigation to compensate for the losses in wetland area and function by creating, restoring, or enhancing other wetland areas. The ratio between area of impacted wetland and area of mitigation is negotiated with the project sponsor. The impacted area and mitigation area can be the same or different kinds of wetland, and they can be near or far from each other. The mitigation might occur in a mitigation bank, where multiple small mitigation areas are aggregated into larger patches of wetland habitat.

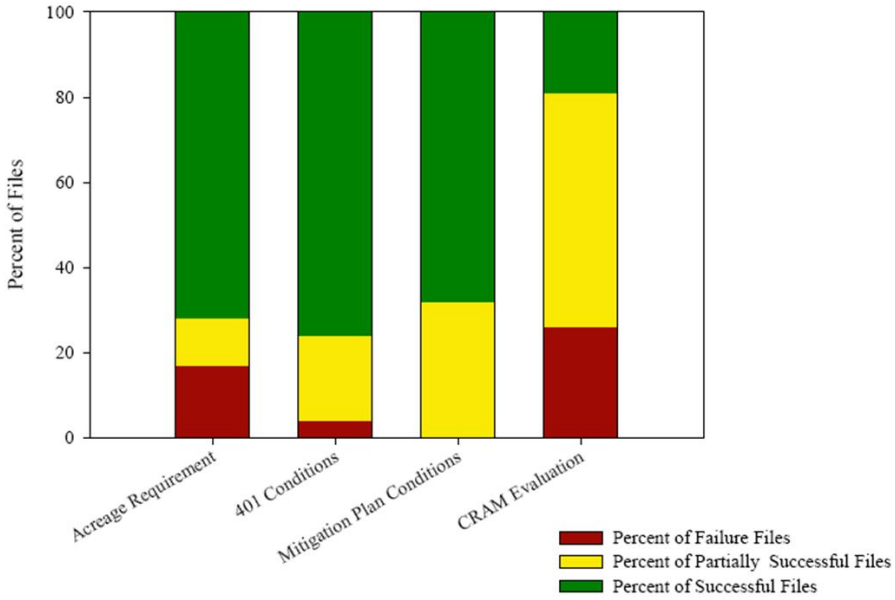


Figure 2-5. Mitigation success by permit file for each evaluation category: acreage requirement, 401 conditions, mitigation plan conditions, and wetland condition (evaluated using CRAM, http://www.cramwetlands.org/).

In general, Ambrose et al. (2007) found that the primary state and federal wetland protection programs have been generating more wetlands of lower quality than the wetlands they allowed to be destroyed. Recommendations to address this problem included improved state and federal mechanisms for tracking, development and adoption of improved performance standards through use of standard methods to assess the functions of the impacted and mitigation wetlands.

Deficiencies in the federal wetland compensatory mitigation program are currently being addressed through a new "mitigation rule" issued jointly by the USACE and U.S. Environmental Protection Agency (USEPA) and by a "state wetland and riparian protection policy" under development by the SWRCB. More information on these programs is provided in the next chapter.

Decker Island Habitat Restoration (Department of Water Resources)

State programs are currently being developed that will provide better data on net wetland gains and losses through: (1) improved tracking of state and federal permitted wetland projects (www.wetlandtracker.org), (2) a more cost-effective approach to monitoring trends in ambient wetland extent through the Statewide Wetlands Inventory (Sutula et al. 2008b, Chapter 3), and (3) better coordination with voluntary wetland conservation programs that restore wetlands and protect existing wetlands through conservation easements.

While many state agencies do require wetland mitigation for projects with wetland impacts, follow-up monitoring and assessment of mitigation success is usually not required. The California Coastal Commission is unique in imposing a standard of long-term monitoring on wetland mitigation projects (most often a minimum of 5 years) and requirements for adaptive management if the project does not meet the established success criteria. In addition, the California Coastal Commission applies a 4:1 mitigation ratio to most projects in recognition of the temporal losses and strong evidence that wetland creation and restoration project failures are common, that adaptive management and eventual results often require more time than envisioned, and that projects are often not timely implemented in relation to when the impact occurs. These approaches could also be implemented by other agencies.

WHAT ARE THE CAUSES OF POOR WETLAND HEALTH?

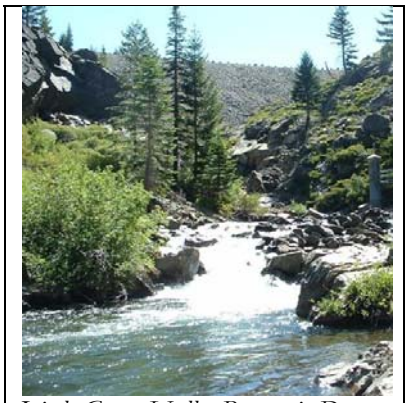
Human activities that result in a reduction in wetland quantity or quality are called wetland stressors. Most wetlands are subject to multiple stressors that exacerbate their negative effects. All stressors are ultimately due to land use practices and can be sorted into five basic groups.

Land Cover Change

Historically, people changed wetlands from one type to another, or changed them into non-wetland areas because the wetlands had originally formed on flat landscapes, such as floodplains and valley floors, which is favored for many land uses. Such change in land cover and habitat has been the leading cause for declines in the distribution and abundance of all wetlands in California and contributes to habitat fragmentation, which can impact hydrology and restrict or impede the movement of species. Many houses and farms are now located on former wetlands, and as a result there has been a 90 percent reduction in wetland acreage in California since the gold rush of 1849. Even today, habitat conversion continues to effect wetlands. A recent study of cumulative impacts to vernal pool landscapes across 29 counties in California, indicates a total of 137,115 acres have been converted from open space or rangeland to some other more intensive land use in the past 30 years (Holland 2009, pers. comm.). In addition, USEPA, Region 9 estimates conservatively that approximately 1,380 acres of wetlands or riparian habitat were filled through unpermitted activities since the mid 1990s (data from 21 cases; P. Jones, pers. comm.).

Hydrological Modification

Unnatural changes in the timing and duration of flooding in a wetland (hydroperiod) can affect its functions and services. The hydroperiod of a wetland is easily modified by upstream impoundments, diversions, or added surface water. Levees, riverbank revetments, spring boxes, dams, and every other unnatural structure directly affect wetlands. Seasonal wetlands are the most vulnerable to changes in water supplies because they tend to be shallow and subject to high rates of evaporation. Slight changes in hydrology can effect large changes in seasonal wetlands.



Little Grass Valley Reservoir Dam, South Fork Feather River (C. Dibble, Department of Fish and Game)

While some interior freshwater wetlands in California still flood naturally, most now rely on managed water supplies for seasonal flooding. These water sources, typically captured in dams and delivered by canal or through stream channels, are in high demand, as they provide water for everything from agriculture and urban use to wetlands and instream flow for fish. Demand for this water increases every year, as does the cost, and many wetland managers now rely on irrigation drain water, wastewater discharges, low priority water contracts, non-binding agreements with water districts, and groundwater pumping.

Biological Invasion

Non-native species that are inadvertently or intentionally introduced by people into a wetland can proliferate. These invasive species compete with and prey upon native species, ultimately displacing them and altering wetland functions and services. Bullfrogs, the Louisiana red crayfish, Brazilian milfoil, invasive cordgrass, bluegill, sunfish, and many other invasive plants and animals are changing the essential functions of California wetlands.

Pollution

The accumulation of anything in a wetland that causes an unacceptable decline in its services can be called pollution. It is not always a manufactured chemical that is dumped, spilled, leaked, or otherwise released by people into the environment. An overabundance of nutrients, sediment, native and non-native vegetation, or even water can pollute a wetland. Many wetlands function as natural filters and tend to have higher concentrations of pollutants than other habitat types.

Climate Change

The world is entering a period of rapid climate change. While there is uncertainty about the future rates of change and how long they will last, California is already experiencing greater year-to-year variability in rainfall and air temperature, higher average temperatures, and less snow pack[2,3]. To the extent that climate change is caused by people, it could be considered a stressor. Regardless of its causes, climate change will likely impact all wetlands in California.

Since wetlands are in-between uplands and completely aquatic areas, slight changes in the availability of water can have large effects on their distribution, size, abundance, and hydroperiod, which in turn can affect every wetland process, function, and service. Wetlands that depend on runoff or groundwater are especially

[2] California Natural Resources Agency 2009

[3] PPIC 2008, Preparing California for a Climate Change http://www.ppic.org/main/publication.asp?i=755

Department of Fish and Game

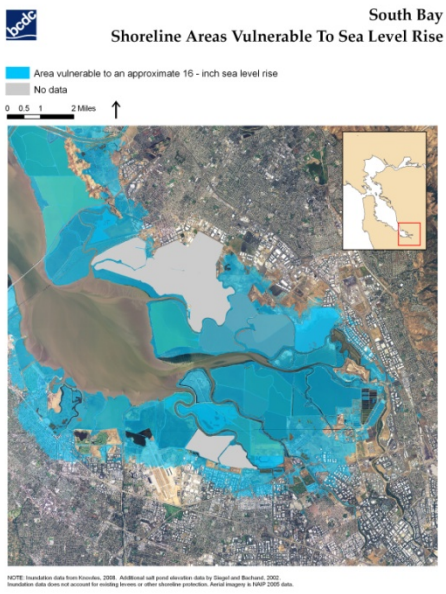
sensitive to changes in rainfall and evaporation. Since the California climate is expected to become drier and warmer, many of these wetlands may become smaller or more ephemeral. Some seasonal wetlands may even disappear. As the rate of sea level rise increases, existing tidal wetlands may disappear. Their fate depends on large supplies of sediment from nearby watersheds and the ability of marshes and tidal flats to migrate inland to offset sea level rise. While some tidal marshes and tidal flats will disappear, others will evolve. The tidal waters will move upstream into rivers and streams, and across the lower limits of coastal valleys. Marshes will form in quiet areas of shallow water where sediments accumulate. Computer modeling using climate data scenarios is being used to virtually raise sea level over topographic maps at different rates to see where marshes might form in effort to help with future planning and allowance for natural progression of uplands to wetlands.

The probable effects of climate change on other kinds of wetlands besides tidal marshes are more difficult to determine. Local changes in rainfall and evaporation are far more difficult to forecast than rates of sea level rise. However, the past can help us see the future. There are well documented historical differences in climate within regions of California, and even within some local watersheds, that exceed the predicted future climate changes. By mapping the historic natural wetlands of the state, the quantity of wetland types that tend to persist under different patterns of rainfall and evaporation can be estimated. This can help us prepare for climate change by adjusting goals and objectives for wetland restoration and conservation. We will still have all of the current types of wetlands that will exist, but that will differ in abundance and exist in different places.

Wetland restoration, enhancement, creation and protection have also been identified as important natural resource adaptation actions to limit the impacts of climate change. Wetlands provide many important ecosystem services, such as habitat for endangered species, shoreline protection, and water quality improvement. The state has recently developed a Climate Change Adaptation Strategy[4] that, among other things, recognizes the importance of and discusses strategies for biodiversity and habitat adaptation. In addition, the Coastal Conservancy recently adopted a climate change policy that identified Living Shorelines as a category of climate change adaptation projects that are encouraged. As envisioned, Living Shorelines will rely on natural habitats such as wetlands, eelgrass or native oysters to reduce erosion on shorelines and lessen the need to have high levees or other structural shoreline protection measures.

[4] http://www.climatechange.ca.gov/adaptation/

If wetland restoration projects can be designed and managed to provide long-lasting reduction of greenhouse gas (GHG) emissions, then these projects could become eligible for a significant new source of funding, through sale of carbon offsets. There is a growing voluntary offset market, with organizations and individuals interested in offsetting their greenhouse gas emissions, providing funding for projects that result in reduction of greenhouse gas emissions. In addition, under various state, regional, international and a pending national cap-and-trade system for reduction of GHG emissions, emitters can or will be able to purchase carbon offsets in order to meet reduction targets. Currently there is a strong emphasis on industrial and agriculture source reduction and capture. Without the critical science and policy work necessary to develop habitat-based sequestration resources, wetland habitat sequestration options may not materialize.



T. Doherty (Bay Conservation and Development Commission)

HOW HEALTHY ARE CALIFORNIA'S WETLANDS?

Answers to this question are just beginning to emerge. The state of California recently completed a study of the health of salt marshes (Sutula et al. 2008) and is conducting an ongoing study of the health of wadeable streams using, among other methods, the California Rapid Assessment Method (CRAM) for wetlands (www.cramwetlands.org). CRAM measures the overall health of a wetland based on the integrity of its marsh plant community (Biotic Structure), Hydrology, Physical Structure and quality and quantity of the buffer that surrounds the wetland (Landscape Context). CRAM also identifies possible causes of poor wetland health by identifying so called "stressors" (Table 2-3). Disturbance from natural forces such as floods, fires, sea level rise, and climate change can also result in poor health and must be taken into consideration when identifying management measures to improve health.

Table 2-3. Types of "stressors" cause poor wetland health.

• Habitat fragmentation • Altered hydrology and flood control structures • Reduced water supply • Altered sediment transport and organic matter loading • Physical barriers to movement of water, sediment, and fauna • Dredging, filling, diking, and ditching • Shoreline hardening, engineered channel, bed, and bank	• Human land use in wetland buffer • Toxic contaminants, nutrient over-enrichment, and pathogenic bacteria • Invasive plants and animals • Excessive human visitation • Predation from feral animals and domestic pets • Compaction and trampling by livestock • Removal of vegetation

Health of Salt Marshes

The study of the health of the state's approximately 44,456 acres of salt marshes (Figure 2-6) demonstrated that overall 85 percent of the wetland area was in "good" to "very good" health (Figure 2-7). Thirty-five percent of the acreage of salt marsh had CRAM scores reflecting very good hydrology and health of the marsh plant community; an even higher percentage (65 percent) was found to have large, intact buffers. Salt marshes within the state were found to be most adversely affected by impacts to their physical structure with 50 percent of the acreage scoring in the "fair" to "poor" in that category.

Martha Sutula (Southern California Coastal Water Research Project)

Figure 2-6. Examples of estuarine wetlands from the South Coast, Central Coast, San Francisco estuary, and North Coast of California.

Salt marsh health generally declined from northern to southern California, consistent with a trend in increasing urbanization from north to south (Table 2-4; Figure 2-7). The most severe human stressors varied by region. Overall, dikes and levees were among the most frequent and most severe stressors identified statewide. These features restrict tidal exchange and reduce the flushing of wetlands, directly impacting the physical structure of a salt marsh and limiting the ability for salt marshes to migrate upslope as sea level rises. Altered rates of sediment deposition also affect physical structure.

Table 2-4. Mean CRAM index scores and significant stressors by region. CRAM index scores represent percent of possible points, ranging from 25 to 100 percent. Blue shaded cells represent scores of very good health; Green cells represent good health; and Yellow cells represent fair health.

CRAM Index or Attribute	North Coast Mean	SF Estuary Mean	Central Coast Mean	South Coast Mean
Overall CRAM Score	82	78	71	67
Most Significant Stressors	Invasive plants, dikes/levees, excessive sediment	Contaminants, dikes/levees, Nonpoint source runoff, predators, ditching	Nonpoint source runoff, contaminants, dikes/levees, trash	Dikes/levees, Nonpoint source runoff, contaminants, trash, excessive sediment

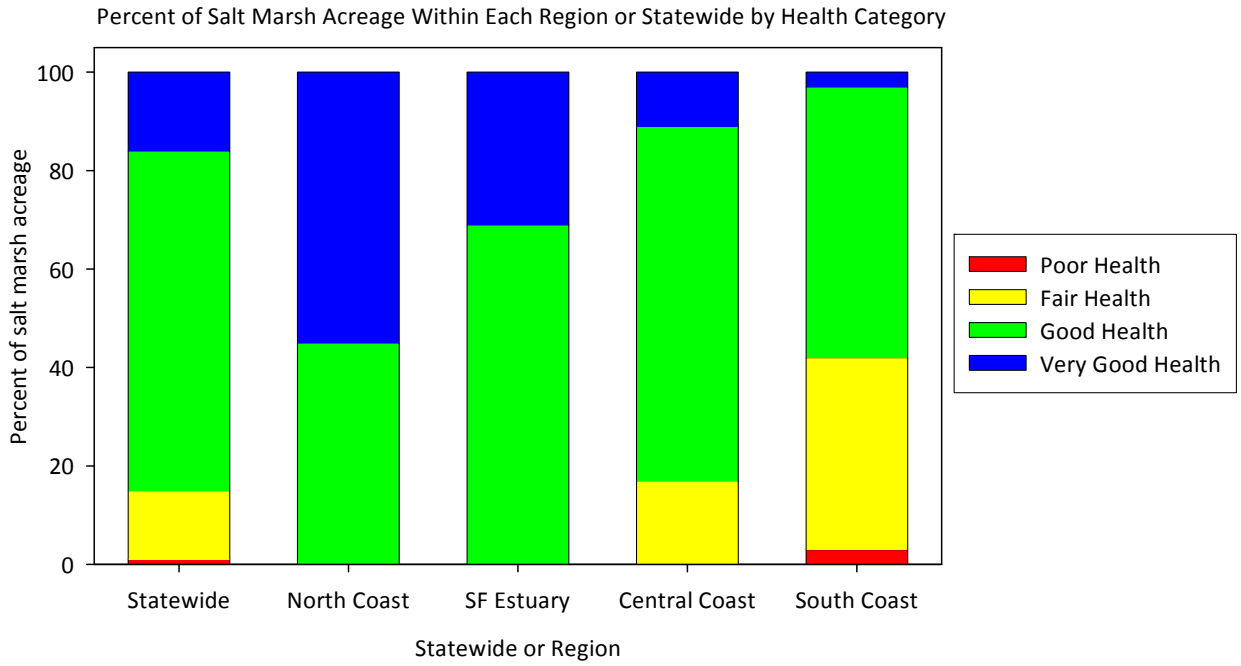


Figure 2-7. Percent of salt marsh acreage by health category, statewide and by region. Measured using CRAM for Wetlands.

Health of Riverine Riparian Habitat in Wadeable Streams

Today, depending on bioregion, riparian habitat covers 2 percent to 15 percent of its historic range in California (Katibah 1984, Dawdy 1989) and riparian vegetation makes up less than 0.5% of the state's total land area, an estimated 145,000 hectares (CDF 2002). Riparian vegetation is critical to the quality of in-stream habitat and aids significantly in maintaining aquatic life by providing shade, food, and nutrients that form the basis of the food chain (Jensen et al. 1993). Riparian vegetation also supplies in-stream habitat when downed trees and willow mats scour pools and form logjams important for fish, amphibians, and aquatic insects.

Starting 2000 the state of California launched a program assessing the chemical and biological integrity of California wadeable streams through the Perennial Stream Assessment (PSA) sponsored by the SWRCB Surface Water Ambient Monitoring Program (SWAMP) and administered by DFG. Recently CRAM was piloted along side of water chemistry, toxicity, and benthic macroinvertebrates to assess the overall health of

the riverine riparian forest associated with streams. These data can be used to compare surveys of riverine riparian habitat in individual watersheds. Three such studies were conducted in the Napa River Watershed, the Morro Bay Watershed, and the San Gabriel River Watershed over the last four years (Sutula et al. 2008b).

Preliminary CRAM data from the PSA show that approximately 60 percent of the state's miles of riverine riparian habitat is in good to very good health (Sutula et al. 2008b). The PSA data provides the opportunity to put results from individual watershed assessments in context (Figure 2-8). The health of the Napa River riparian habitat is near that of the statewide PSA data, with roughly 60 percent of the stream miles assessed having scores in ranges representing "good" to "very good" health. In contrast, Morro Bay watershed riparian habitat was in better health (85 percent of stream miles in "good" to "very good" health), while San Gabriel River watershed riparian habitat is fairing much worse (35 percent in "good" to "very good" health).

Health of Interior Managed Wetlands

The health of managed wetlands in California seems to vary between wet and dry years, and from one manager to the next. Every year, freshwater wetlands in the interior of California are threatened by issues such as the fragmentation of wetlands by roads, canals and powerlines, the encroachment of urban development, the potential for wetlands to methylate mercury, their ability to produce mosquitoes, and perhaps most critically, a need for water in a highly competitive market. Most interior wetlands are managed and privately owned. Many of these private wetlands are monitored on a regular basis by DFG, FWS, or NRCS, while most publicly owned wetlands are managed by the DFG or FWS. All wetland managers, whether private or public, are faced with managing wetlands in a world in which there is rarely sufficient money, staff or water to provide ideal habitat every year.

As an example, the Central Valley Habitat Joint Venture (CVJV) has determined that identifying the management practices pursued by private and public wetland managers, and the consequences of these management choices on wildlife, is one of its highest priorities. As such, the CVJV has launched a program to assess wetland management practices currently used in the Central Valley and develop a rapid assessment methodology to determine wetland health based on those management practices. This work would be used to inform managers on the most effective management strategies, given the constraints of money, staff and water as outlined above. It is hoped that the information gained eventually will be able to be used throughout the state.

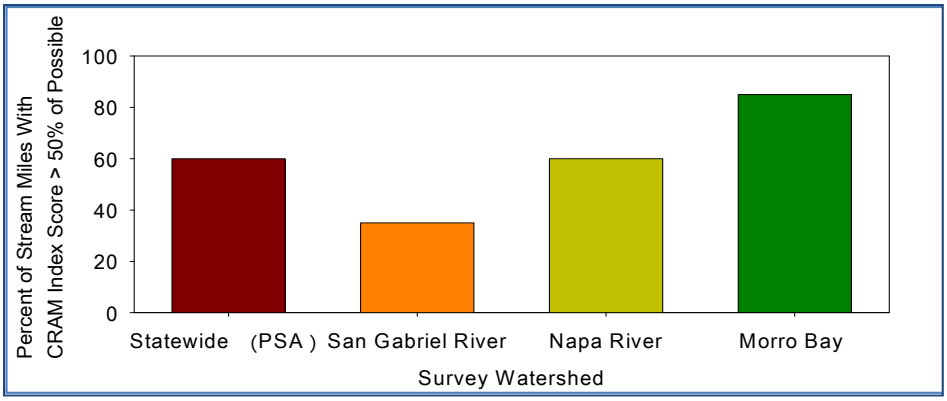


Figure 2-8. Percent of stream miles with riparian habitat in the fair-excellent health scoring range.

PROTECTING AND RESTORING CALIFORNIA WETLANDS

WETLAND REGULATORY PROGRAMS

Wetland protection, restoration, and management in California consist of two general approaches, regulatory and non-regulatory. More than a dozen state and federal regulatory programs involve wetland protection and/or controlling activities in wetlands (Table 3-1).

Table 3-1. State and federal laws that contribute to wetland protection

Federal

- Clean Water Act – Sections 404 and 401
- Rivers and Harbors Act – Section 10
- Food Security Act
- Endangered Species Act
- Migratory Bird Treaty Act
- Coastal Zone Management Act
- National Environmental Policy Act
- National Marine Sanctuaries Act

State

- Porter-Cologne Water Quality Control Act
- Fish and Game Code – Section 1600
- California Coastal Act
- McAteer-Petris Act
- California Endangered Species Act
- California Environmental Quality Act
- California Land Conservation Act

The primary policy tool for protecting wetlands in the United States is Section 404 of the Clean Water Act (CWA), as jointly administered by the USACE and USEPA. This law requires that a project must first avoid all significant, negative wetland impacts. If impacts cannot be avoided, then they must be minimized so that they are not environmentally damaging. If there are any remaining impacts that cannot be avoided or minimized, then they must be mitigated by the creation, restoration, or enhancement of other wetlands. However, several recent Supreme Court decisions have narrowed the scope of the CWA by removing isolated wetlands and ephemeral streams from federal jurisdiction. Isolated wetlands, such as vernal pools

Vernal Pool at Mather Field (Eva Butler, Sacramento Splash)

and seasonal wetlands that have no surface water connector to navigable waters are no longer subject to federal regulation. In addition, ephemeral and headwater streams frequently fall outside of federal jurisdiction under the Clean Water Act. Thus wetland protection under the federal program is diminishing, and this effect is amplified since most projects that cannot avoid destroying wetlands are approved if avoidance, minimization and mitigation are carried out.

Under the CWA section 401, every applicant for a federal permit or license for any activity that may result in a discharge to a water body must obtain State Water Quality Certification (Certification) that the proposed activity will comply with state water quality standards. Certifications are issued by the SWRCB and Regional Water Quality Control Boards (RWQCB) and done in connection with the USACE CWA section 404 permits. Most projects are regulated by the RWQCBs under CWA section 401 or the Porter-Cologne Water Quality Control Act through waste discharge requirements to protect all waters of the state.

The SWRCB is also currently developing a comprehensive wetland and riparian area protection program to, in part, "fill the gap" caused by declining federal protections. The foundation of the program will be the Wetland and Riparian Area Protection Policy (WRAPP). Phase 1 of this policy will provide a standard wetland definition, a consistent state regulatory program for dredge and fill impacts to waters and wetlands, and a standard framework for assessing the ambient condition of wetlands and the performance of wetland policies, programs, and projects. This effort will minimize new costs by implementing the assessment tools through existing state programs. One new element essential to the success of the program is a system of regional data centers for training wetland assessors, compiling assessment data, translating the data into relevant information, and sharing the data and information with the public. WRAPP will likely emphasize public access to accurate and timely information about the status and trends of California wetlands.

DFG regulates alterations to California stream beds. Fish and Game Code Section 1602 requires notification of any proposed activity that will substantially divert or obstruct the natural flow of any river, stream or lake; substantially change or use any material from the bed, channel, or bank of, any river, stream or lake; or deposit or dispose or debris, waste, or other material containing crumbled, flaked or ground pavement where it may pass into any river, stream, or lake.

The notification requirement applies to work undertaken in or near any river, stream, or lake that flows at least intermittently (and associated wetlands). This includes intermittent and ephemeral streams, desert washes, and watercourses with a subsurface flow. If the activity may substantially adversely affect an existing fish or wildlife resource, DFG will enter into an agreement that includes reasonable measures necessary to protect the resource.

Cargill Salt Ponds, South San Francisco Bay (NASA photo obtained from K. Bane, State Coastal Conservancy)

Except in San Francisco Bay, wetlands found in the coastal zone are regulated by the California Coastal Commission. The Coastal Commission, which uses a different legal definition of wetland than the USACE, is the primary agency for protection of wetlands from the impact of coastal development. The Coastal

Commission's primary mission is to plan for and regulate land and water uses in the coastal zone consistent with the policies of the California Coastal Act. Major areas of responsibility of the commission related to wetlands are:

- Water and marine resources and water quality
- Environmentally sensitive habitat areas
- Agriculture
- Dredging, filling, and shoreline structures
- Forestry and soils resources
- Public education

In addition to San Francisco Bay Regional Water Quality Control Board's Certification or waste discharge requirements, San Francisco Bay wetlands within the first 100 feet inland from the shoreline around the Bay are also regulated by the San Francisco Bay Conservation and Development Commission. The responsibilities of the commission related to wetlands focus on:

- Limiting fill of the Bay
- Increasing public access to and along the Bay that is compatible with wildlife protection in the Bay
- Providing for water-oriented uses such as ports, airports, water-related industry, wildlife refuges, and recreation.

PUBLIC AND PRIVATE INVESTMENT IN WETLAND RESTORATION AND PROTECTION

Although regulation is a critical component of California's overall wetland protection strategy, voluntary programs account for the vast majority of wetland gains. Local, state, and federal agencies, in partnership with conservation groups and private landowners, have worked together to develop and increase the capacity for voluntary conservation of California's wetlands. Much of this work has been accomplished through California's six habitat-based joint ventures.

Joint ventures are public/private partnerships that work entirely through voluntary efforts. These joint ventures were originally developed to implement the North American Waterfowl Management Plan, but have since expanded to conserve habitat for all avian species. With North American Wetlands Conservation Act funding now covering all species in wetland ecosystems, joint ventures have begun setting goals for protecting and restoring riparian habitat as well. Each joint venture has a planning document that guides its conservation efforts and identifies goals for habitat conservation. Wetland protection, restoration, and enhancement play a prominent role in each Joint Venture's conservation work as does coordination with other joint ventures (e.g., the Riparian Habitat Joint Venture has provided guidance to both the Central Valley Joint Venture and San Francisco Bay Joint Venture to help establish riparian habitat goals, and also provided planning and implementation guidance to the San Francisco Bay Joint Venture).

California's Six Joint Ventures

- Sonoran Joint Venture – www.sonoranjv.org
- Central Valley Joint Venture –www.centralvalleyjointventure.org
- San Francisco Bay Joint Venture – www.sfbayjv.org
- Pacific Coast Joint Venture – www.pcjv.org
- Intermountain West Joint Venture – www.iwjv.org
- Riparian Habitat Joint Venture - www.rhjv.org

The state, federal, and private partners that comprise each joint venture bring their resources together for wetland conservation, including numerous voluntary conservation programs and diverse partnerships amongst environmentalists, hunters, biologists, and private landowners. Some of the programs focus directly on wetland conservation while others conserve wildlife habitat in general, which may include wetlands. Many of these programs provide direct incentives that protect, restore, or enhance wetlands, thereby supplementing existing wetland regulations. Economic incentives, such as project cost-sharing or conservation easement payments, motivate landowners to proactively take action to protect and restore wetlands. The motivations of landowners to conserve wetlands include providing ecosystem services such as groundwater recharge or floodwater retention and protecting habitat for populations of migratory birds.

Public investment in wetland protection and restoration since 1998 has been facilitated by at least five voter-approved bond measures helping to improve the state's aquatic resources. Proceeds from these bond measures have been combined with other state resources to support the acquisition, protection, and restoration of wetlands across the state. These efforts have been largely administered by two agencies, the State Coastal Conservancy and California's Wildlife Conservation Board. These state monies have been leveraged against federal and local government and private sources. Many of these projects build on earlier efforts by adding to or enhancing previous restoration programs.

California has embarked on aggressive wetland acquisition and restoration programs over the last 10 years, (Table 3-2) with much of the funding coming from voter approved bonds. Many of the state's long-standing wetland restoration priorities have been realized (e.g., Bolsa Chica Wetlands, see box below) or are well underway (e.g., South Bay Salt Ponds, see box below). Continued and expanded investment will be necessary to continue to capitalize on these successes and to meet future challenges. One example is in the Bay Area where inadequate funding was identified as the greatest barrier to re-establishing 100,000 acres of tidal wetlands around San Francisco Bay. In 2008, the California Legislature established the New San Francisco Bay Restoration Authority (BayRA), a regional government agency charged with raising and allocating resources for the restoration, enhancement, protection, and enjoyment of wetlands and wildlife habitat in the San Francisco Bay and along its shoreline[5]. This model has the potential to be replicated by other regions in the state with ecosystem-scale opportunities to protect and restore wetlands.

[5] http;//sfbayrestore.org/index.html

Table 3-2. Identified[6] conservation funding programs

FEDERAL	STATE
U.S. Department of Agriculture Natural Resource Conservation Service	**Natural Resources Agency**
• Environmental Quality Incentives Program	• California River Parkways Program
• Wildlife Habitat Incentives Program	**Department of Fish and Game**
• Wetlands Reserve Program	• Ecosystem Restoration Program
• Grassland Reserve Program	• Waterfowl Habitat Program (Presley Program)
• Farmland and Rangeland Protection Program	• Duck Stamp Program
U.S. Department of Agriculture Farm Service Agency	• Landowner Incentive Program
• Conservation Reserve Enhancement Program	**Wildlife Conservation Board**
• Bottomland Timber Establishment on Wetlands Initiative	• Inland Wetlands Conservation Program
U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation	• Riparian Habitat Conservation Program
• Central Valley Project Improvement Act	• Habitat Enhancement and Restoration Program
U.S. Bureau of Reclamation	• Land Acquisition Program
• USBR Central Valley Conservation Program	**Department of Parks and Recreation**
• Central Valley Wildlife Habitat Augmentation Program	• Riparian Habitat Grants Program
U.S. Fish and Wildlife Service	• Habitat Conservation Fund Grant
• Partners for Fish and Wildlife	**Department of Transportation (Caltrans)**
• Land Acquisition Program	• Environmental Enhancement and Mitigation Program
• Conservation Easement Program	**Department of Conservation**
• North American Wetlands Conservation Act	• California Farmland Conservancy Program
• Neotropical Migratory Bird Conservation Act Grants Program	**State Coastal Conservancy**
• Private Stewardship Grants Program	• Resource Enhancement Program
• National Coastal Wetland Conservation Grant	• San Francisco Bay Area Conservancy Program
• Duck Stamp Program	**San Francisco Bay Restoration Authority**
U.S. Department of Agriculture Forest Service	**Department of Water Resources**
• Partners in Flight	• Urban Streams Restoration Program
U.S. Bureau of Land Management	• Delta Levees Program
• Land Acquisition Program	• Flood Corridor Program
PRIVATE	**PRIVATE**
Ducks Unlimited – Wetland Restoration Program	**National Fish & Wildlife Foundation**
Great Valley Center – LEGACI Program	**David and Lucille Packard Foundation**

[6] Table 3-2 is not inclusive of all conservation funding programs within California.

Table 3-3. Selected wetland restoration programs completed or initiated between 1998 and 2008.

Project	Acreage*
Northern California	
Honey Lake Wildlife Area	3,000
Giacomini Wetlands	610
San Francisco Bay	
South Bay Salt Ponds	15,100
Napa River Salt Marsh	9,450
Hamilton and Bel Marin Keys	2,600
Bair Island	1,460
Napa Plant Site	1,400
Dutch Slough	1,166
Central Valley	
Yolo Bypass Wildlife Area	16,700
Wheatville Farms	1,600
Liberty Farms	1,600
American Basin Farms	600
Central Coast	
Morro Bay Estuary	580
Southern California	
Bolsa Chica Wetlands	1,247
Upper Newport Bay	752
Ballona Wetlands	600
Los Cerritos Wetlands	490
Palo Verde Ecological Reserve	305
San Dieguito Lagoon	150

*Acres listed represent overall project area and are not restricted to area acquired or restored over the past ten years.

Wetland acquisition and restoration projects over the last ten years were built on earlier efforts by adding to or enhancing previous restoration programs. Most of the public investment has been directed toward coastal resources, primarily in San Francisco Bay and Southern California. The San Francisco Bay area has experienced great gains in wetland protection and restoration and is home to the largest individual wetland restoration efforts in the state. Coastal wetlands have suffered great historic losses and continue to be highly vulnerable to future impacts from development, coastal recreation, and sea level rise. Furthermore, land values along the coast are highest, making public investment critical to ensuring long-term protection and management of these resources.

The Central Valley has experienced some of the largest gains in wetland acquisitions and restoration in the state over the last decade. Brought together through the partnerships established by the Central Valley Joint Venture, most of these restoration projects were completed by working through diverse partnerships of farmers, hunters, conservation groups, and local, state, and federal agencies. Wetland conservation in this region of the state is particularly important given that this area is expected to experience some of the greatest development pressure over the next 10 to 20 years and because of its importance to the Pacific Flyway, water fowl, shorebirds, and other waterbirds.

Restored wetland in the Yolo Bypass Wildlife Area (Dave Feliz, DFG)

*The **Yolo Bypass Wildlife Area** was created as the result of a grass roots effort lead by the Yolo Basin Foundation. Funding for land acquisition from the Wildlife Conservation Board has totaled in 16,700 acres and over 7,000 acres of seasonal and permanent wetlands to have been restored. The Wildlife Area is located in the major flood control channel for the Sacramento Valley and provides extensive education and recreational benefits to the community while maintaining the flood control capacity of the Yolo Bypass. Its integration of agriculture into the management of wildlife habitat serves as a model for the Central Valley.*

Bolsa Chica Wetland Restoration

In 2006, construction of the Bolsa Chica Lowlands Restoration Project was completed with the opening of a new tidal inlet. The project area covers about 1,247 acres. This phase restored and enhanced approximately 367 acres to full tidal influence, improved muted tidal circulation to 200 acres, retained 120 acres of seasonal pond habitat, and reserved 252 acres for future restoration. To achieve the biological benefits of tidal restoration, a direct connection to the Pacific Ocean was re-established through the creation of a new tidal inlet cut through Bolsa Chica State Beach and across the Pacific Coast Highway near the Huntington Mesa. The Pacific Coast Highway and adjacent oil field facilities remained in operation during the entire construction period. The project was accomplished with $144 million from Ports of Long Beach and Los Angeles, State Coastal Conservancy, and Wildlife Conservation Board.

Bolsa Chica Wetlands from the base of the bluffs (K. Bane)

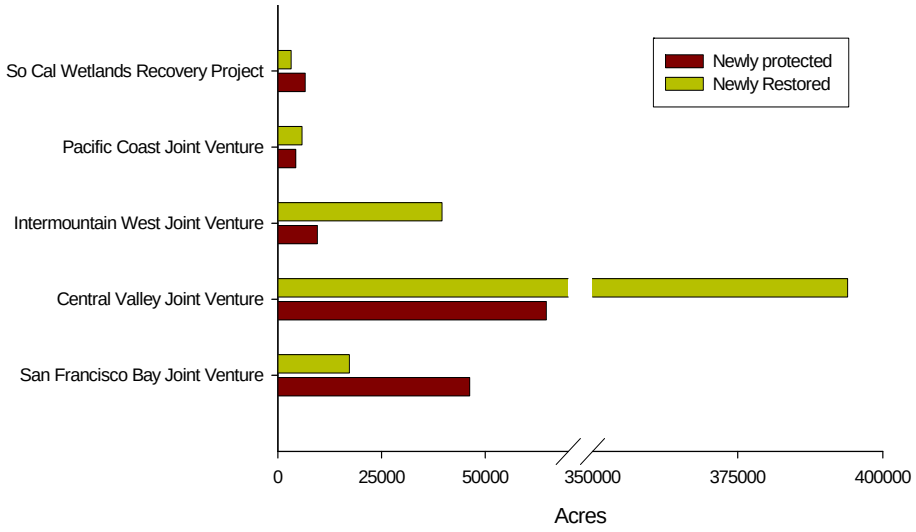
South Bay Salt Ponds Restoration

Over 15,000 acres of South Bay salt ponds were acquired in 2003 by state and federal agencies and private foundations at a cost of $100 million ($72 million from Wildlife Conservation Board, $8 million from USFWS, $20 million from Hewlett, Packard, Moore Foundations and Goldman Fund). Using $15 million of state funds and $5 million of private foundation funds, the State Coastal Conservancy developed, with the landowners (USFWS and DFG) and other stakeholders, a Restoration, Flood Management, and Public Access Plan. Phase 1 implementation is expected to cost approximately $35 million, with funds coming from a variety of local, state and federal agencies, and private foundations. The Conservancy has also entered into an agreement with the USACE and Santa Clara Valley Water District to conduct the South San Francisco Bay Shoreline Feasibility Study, which may lead to construction by the USACE of flood management and ecosystem restoration elements on the Alviso Ponds and adjacent Santa Clara County lands.

Aerial view of the South Bay salt ponds, looking north (obtained from K. Bane, State Coastal Conservancy)

As envisioned in the 1993 State Wetland Conservation Policy, California has used regional implementation strategies to guide investment of billions of bond dollars in wetland conservation and to move wetland regulation away from permitting isolated mitigation sites to regionally planned mitigation. Joint ventures have been particularly successful at acquiring and restoring wetlands in their regions, accounting for over 580,000 acres of wetland acquisition, restoration, and enhancement between 1999 and 2008 (Figure 3-1). The regional nature of these programs allows them to identify local priorities and form community-based partnerships to accomplish their goals. Several regional programs are summarized below.

Figure 3-1. Acres of wetland acquired and restored by various joint ventures between 1999 and 2008.



SAN FRANCISCO BAY EFFORTS

The San Francisco Bay Area Conservancy Program (Bay Program) (www.coastalconservancy.ca.gov/Bay%20Program/bayindex.htm) was established as a program of the State Coastal Conservancy in the late 1990s. The Bay Program conducts projects throughout the nine-county Bay Area, with a focus on protecting open space of regional significance, restoring wildlife habitats, and providing public access and recreational opportunities. The Bay Program has played a significant role in protecting and restoring the San Francisco Bay's wetlands, funding the acquisition of Baylands from willing sellers, planning for habitat restoration and public access on public lands, and implementing restoration and access plans. One recognized success is eradication of invasive *Spartina* resulting in roughly 1000 net acres of removal since 2002. Since 1999, the Bay Program has invested almost $83 million in protecting, restoring, and developing plans and designs for wetlands, which has provided for the leveraging of millions of dollars in state, federal, local, and private funds.

The *Baylands Ecosystem Habitat Goals Report* established a strategy for restoring 100,000 acres of tidal marsh around the Bay. Currently, nearly 40,000 of Baylands have been acquired and are either being restored or planned for restoration. Since its inception in 1996, the San Francisco Bay Joint Venture's (SFBJV) partners have protected, restored, or enhanced over 60,000 acres of a variety of wetland habitat types (Table 3-4).

Table 3-4. SFBJV project acreage summary (courtesy of Sandra Scoggin, SFBJV, March 2009).

Habitat Categories	Activity Categories		
	Protection	Restoration	Enhancement
Bay Habitat	39,323	8,235	5,307
Creek and Lake	3,642	216	33
Seasonal Wetland	3,314	1,800	1,697
Total	46,279	10,251	7,037

SOUTHERN CALIFORNIA WETLANDS RECOVERY PROJECT

The Southern California Wetlands Recovery Project (WRP) (www.scwrp.org) was formed in 1997 to develop and implement a regional strategy to increase the pace and effectiveness of wetland recovery in the Southern California Bight region. The WRP is a broad-based partnership of 19 state and federal agencies working in concert with scientists, local governments, environmental organizations, business leaders, and educators. The geographic scope of the WRP includes coastal wetlands and watersheds from Point Conception (in Santa Barbara County) south to the U.S.-Mexico border. The WRP employs five non-regulatory strategies to recover wetlands: (1) acquisition of property from willing sellers, (2) restoration and enhancement of wetlands where allowed by landowners and land managers, (3) outreach and education about best practices to protect wetlands, (4) securing resources to implement these projects, and (5) coordinating regional monitoring and assessment. The California State Coastal Conservancy manages the WRP and assists local partners in developing and implementing projects.

The WRP is guided by a Regional Strategy which was developed through a multi-year planning process with all of the WRP partners. The Regional Strategy identifies long-term goals and specific implementation strategies to guide wetland recovery efforts within Southern California. To implement the Regional Strategy, the WRP partners develop and adopt a Work Plan that identifies specific priority projects. The Coastal Conservancy, the Wildlife Conservation Board and others use the WRP Work Plan to identify priorities for

grant funds. In addition to the Work Plan, the WRP manages a community-based restoration program that provides funding for projects that build local capacity to plan and implement wetland restoration projects; promote community involvement in wetlands restoration activities; and foster education about wetlands ecosystems. Finally, the WRP is working on developing an integrated regional assessment program to create a standardized method for evaluating the effectiveness of restoration projects. The WRP partners now are working to try to find ways to implement and fund the regional assessment program. Over the past 10 years, more than $430 million has been devoted to the completed Work Plan projects of acquiring 6,603 acres and restoring 2,161 acres of wetlands.

CENTRAL VALLEY JOINT VENTURE

The Central Valley Joint Venture (CVJV) (www.centralvalleyjointventure.org) is a self-directed coalition of 22 state and federal agencies and private conservation organizations with a common goal of providing for the habitat needs of migrating and resident birds in the Central Valley of California. The CVJV was established in 1988 and is one of 18 habitat joint ventures in North America, and one of six active joint Ventures in California, all of which were established under the North American Waterfowl Management Plan (NAWMP). The NAWMP is an international treaty signed by Canada, the United States and Mexico with an initial goal of preserving and restoring wetlands to improve habitat for waterfowl. The NAWMP and the CVJV have since broadened their focus to conserve habitats for other birds, consistent with major national and international bird conservation plans and the North American Bird Conservation Initiative.

The jurisdiction of the CVJV includes the Central Valley, a 400 mile long area, from Red Bluff in the north to Bakersfield in the south, and the surrounding foothills. The Central Valley encompasses the following nine hydrologic basins: Butte, Colusa, Sutter, Yolo, American, Suisun Marsh, Delta, San Joaquin and Tulare. The mission of the CVJV is to work collaboratively through diverse partnerships to protect, restore, and enhance wetlands and associated habitats for waterfowl, shorebirds, waterbirds, and riparian songbirds, in accordance with conservation actions identified in the CVJV's Implementation Plan. The CVJV works to accomplish its mission through the protection, restoration, and enhancement of wetlands and other habitats, along with adequate long-term water supplies, to provide all habitat requirements for the targeted bird groups.

Working both collectively and independently, joint venture partners conduct activities in support of bird conservation goals cooperatively developed by the partnership. These activities include:

- biological planning, conservation design, and prioritization;
- project development and implementation;
- monitoring, evaluation, and applied research activities;
- communications and outreach; and
- fund-raising for projects and activities.

Restoring Wetlands on Agricultural Lands

The U.S. Department of Agriculture's Wetlands Reserve Program, administered by the Natural Resources Conservation Services, is a voluntary program that provides technical and financial assistance to private landowners and tribes to restore, protect, and enhance wetlands in exchange for retiring eligible land from agriculture. Over 1.9 million acres are currently enrolled in the Program nationwide. Since 1998, more than 61,000 acres have been restored and protected in California, a number unmatched by any other single program in the state.

Restored agricultural wetlands in Yolo County (K. Bane)

INLAND WETLAND CONSERVATION PROGRAM

The Wildlife Conservation Board (WCB) (www.wcb.ca.gov) was established by legislation in 1947 to administer a capital outlay program for wildlife conservation and related public recreation. In 1990, a new program, the Inland Wetlands Conservation Program (IWCP), was created within the WCB with a specific mandated goal to carry out the programs of the Central Valley Joint Venture (CVJV). The IWCP works with other CVJV partners to protect, restore, and enhance wetlands and associated habitats in the Central Valley for waterfowl, shorebirds, waterbirds, and riparian songbirds, in accordance with conservation actions identified in the CVJV's Implementation Plan. The program's flexibility allows the WCB to address any of the CVJV objectives, and between 1998 and 2008, has spent nearly $52 million to protect nearly 21,000 acres, restore more than 13,000 acres and enhance more than 28,000 acre of wetlands, uplands and agricultural lands. The WCB continues to protect and restore wetlands outside the Central Valley as part of its general mandate to conserve wildlife habitats.

In 1991, a second program, the California Riparian Habitat Conservation Program, was created within the WCB with a basic mission to develop coordinated conservation efforts aimed at protecting and restoring the state's riparian ecosystems. To achieve these goals the program has adopted the following objectives: assess the current amount and status of riparian habitat throughout the state, prioritize protection needs, develop and fund project-specific strategies to meet these objectives, fund a grants program for riparian habitat conservation, and provide a focal point for statewide riparian habitat conservation efforts. In 1994, the WCB was a founding member of the Riparian Habitat Joint Venture, a diverse partnership of non-governmental organizations and public agencies with common goals to develop a strategic approach to conserving and restoring riparian areas in California, create a forum to provide long-term guidance and technical assistance, and develop and influence riparian policies through outreach and education.

COMPREHENSIVE WETLAND HABITAT PROGRAM

The Department of Fish and Game's Comprehensive Wetland Habitat Program, established in 1990, protects, restores, enhances and helps manage wetland conservation on both DFG-owned and privately owned lands. The program provides funds to restore and enhance wetlands on the DFG's 14 major wetland wildlife areas and to support and maintain these public lands. In its private lands programs, DFG provides technical assistance and financial incentives to assist landowners with enhancing wetlands, native grasslands, and riparian habitat in return for implementing habitat management plans that benefit waterfowl, waterbirds and special status species. In addition and in cooperation with the IWCP, the program acquires conservation easements and restores wetlands on private lands to protect and maintain wetland habitat.

WETLANDS RESERVE PROGRAM

The Wetlands Reserve Program (WRP) is a voluntary program administered by U.S. Department of Agricultural, Natural Resources Conservation Service (NRCS) that provides technical and financial assistance to private landowners and tribes to restore, protect, and enhance wetlands in exchange for retiring eligible land from agriculture. The program offers three enrollment options:

1. *Permanent Easement* is a conservation easement in perpetuity. NRCS pays 100 percent of the easement value and up to 100 percent of the restoration costs.

2. *30-Year Easement* is an easement that expires after 30 years. USDA pays up to 75 percent of the easement value and up to 75 percent of the restoration costs.

3. *Restoration Cost-Share Agreement* is an agreement to restore or enhance the wetland functions and values without placing an easement on the enrolled acres. USDA pays up to 75 percent of the restoration costs.

Table 3-5. NRCS WRP enrollments in California 1999 -2008

Year	Enrolled Acres	Perpetual Easements	30-Year Easements	10-Year Restoration Agreements	Average Per Acre*	Annual Budget
1999	10,027	8,860	679	488	$1,097	$11,000,000
2000	7,163	6,742	125	296	$1,633	$11,700,000
2001	7,493	6,117	22	1,354	$1,780	$13,340,000
2002	8,480	8,353		127	$3,585	$30,400,000
2003	5,749	5,245	342	162	$3,253	$18,700,000
2004	8,367	8,142		225	$1,912	$16,000,000
2005	3,905	3,475	219	211	$3,308	$12,920,000
2006	5,612	1,661	3,889	62	$2,315	$12,991,159
2007	2,326	1,617		709	$3,762	$8,752,011
2008	2,798	1,665	610	523	$2,748	$7,687,830
Average	**6,192**	**5,188**	**589**	**416**	**$2,539**	**$14,349,100**
Totals	**61,921**	**51,878**	**5,886**	**4,158**		**$143,491,000**

Yolo Wildlife Area and the Sacramento Skyline (C. Vouchilas, Department of Fish and Game)

MEETING FUTURE CHALLENGES

A fundamental challenge facing entities entrusted with protecting California's wetlands is the lack of an integrated, comprehensive wetland monitoring and assessment program and the associated data management infrastructure to support it. The actual "state of California's wetlands" will not be fully understood until such a program is in place. An enhanced data management system would not only allow assessment of status and trends, but will facilitate improved coordination among the various entities involved in wetland regulation, management, and protection. Perhaps most importantly, it will improve transparency of wetland programs and information by making it more easily accessible to the public.

The success and progress in wetland conservation over the last decade must be protected by solving an emerging challenge – financing long-term operations and maintenance (O&M) of our wetlands. Absent a long-term commitment to O&M, preserved and restored wetlands will likely degrade as a result of persistent stressors. O&M activities range from delivering and manipulating water levels, to mowing vegetation and dredging and disposing of sediment from protective basins. Since wetlands are dynamic systems, the management needs and costs may vary over time. For example, a new invasive aquatic organism may appear and require immediate eradication (e.g., *Caulerpa taxifolia*). The potential effects of climate change amplify the challenge of and need for securing a sustainable funding source for long-term O&M.

South San Francisco Bay (M. Bittner)

Another important challenge facing California's wetlands is water supply. California's natural hydrology has been altered by dams, diversion projects, flood control levees, and groundwater development. As climate change is expected to reduce water supplies and the demand for water in the state continues to increase, water supply will also increasingly become a challenge facing California wetland conservation. For example, many of California's freshwater wetlands rely on managed water supplies for wetland flooding. Managed water supplies include; irrigation return flows, low priority water contracts, non-binding agreements with water districts, and groundwater pumping. Increased competition to purchase limited water supplies, capacity limitations of existing water delivery systems, increased groundwater pumping costs, and annual long-term water transfers are all challenges California will face in its future wetland conservation efforts.

It is in the public interest to protect the state's investment in not only state-owned lands but also the federal, local, and privately owned wetlands. Some potential solutions include:

- Consider funding O&M in future state bond acts. This could be implemented by allowing contributions to an O&M endowment for any wetland project receiving state funds via direct contract or grant.
- Allowing penalties and fines to go to endowments.
- Securing long-term water supplies to managed wetlands.

Carrizo Plain (C. Vouchilas, Department of Fish and Game)

RECOMMENDATIONS

The state has made substantial progress in identifying, acquiring, restoring and enhancing wetlands, but a significant amount of work remains to be completed. The following recommendations are offered as a vision of the actions needed to continue the successes into the future and to make better assessment of California wetlands.

1. ESTABLISH A MECHANISM IN STATE GOVERNMENT TO COORDINATE STATE WETLAND PROGRAMS AND TO STANDARDIZE WETLAND MONITORING AND ASSESSMENT PROCEDURES

A. FORMALIZE THE INTERAGENCY WETLAND WORKGROUP TO COORDINATE WETLAND MONITORING AND ASSESSMENT IN CALIFORNIA AND TO TAKE STEPS TO IMPLEMENT A CONSISTENT FRAMEWORK FOR WETLAND MONITORING AND ASSESSMENT PROGRAMS THROUGHOUT THE STATE

More than 20 state and federal agencies have some level of regulatory or management responsibility over wetlands. Despite all these programs, no single agency is responsible for overseeing wetland monitoring and assessment in California. The state has the opportunity to build the capacity to monitor and assess wetlands cost effectively by integrating on-going activities conducted across agencies. A new independent monitoring program should not be established; rather, the state's goals for improving the availability and accessibility of wetland information can be achieved by improving and strengthening the relationships among existing programs.

California should establish a comprehensive monitoring program that incorporates elements of mapping and inventory, rapid screening level assessment, and intensive site-specific evaluation. This program should be established with formal input from the state's wetlands conservation community including, but not limited to, joint ventures and NGO's. In addition, monitoring elements should be applied to answer broad environmental questions and site-specific questions related to development projects. This approach allows for comparisons of compatible data for ambient wetland and project-site conditions, and for the evaluation of project (and program) performance in light of overall regional patterns and trends.

This needed cooperation and coordination is already underway through the California Wetland Monitoring Workgroup (supported by the SWRCB and operating as a subcommittee of the SB 1070 Monitoring Council) that has met since early 2008 on better ways to integrate wetland monitoring statewide. This federal, state, and local interagency group should serve as a hub to coordinate monitoring activities, establish priorities, resolve existing inconsistencies, and facilitate communication among agencies and with wetlands conservation stakeholders.

2. ADOPT A COMMON APPROACH FOR WETLAND IDENTIFICATION, MAPPING, AND CLASSIFICATION

A. THE INTERAGENCY WETLANDS WORKGROUP SHOULD WORK TO DEVELOP AND SEEK ADOPTION OF A CONSISTENT STATEWIDE DEFINITION OF WETLANDS AND RIPARIANS AREAS

State agencies use a variety of wetland and riparian area definitions. This not only leads to confusion,

but hinders the ability of agencies to coordinate and share wetland information.

A common wetland definition would reduce regulatory uncertainty for permit applicants. Reducing interagency differences would save money by creating a more consistent regulatory environment and improving integration and data sharing among permit programs. A state wetland definition should include federally defined wetlands, but should also recognize California's unique wetland habitats.

B. THE INTERAGENCY WETLANDS WORKGOUP SHOULD WORK TO DEVELOP A COMMON STATEWIDE CLASSIFICATION SYSTEM FOR WETLANDS AND RIPARIAN AREAS THAT IS TAILORED TO CALIFORNIA'S WETLANDS

The lack of a consistent classification system to characterize the diversity of wetlands makes it difficult for agencies to share data on wetland extent and condition, hinders evaluation of program performance, and results in confusion for the public as to the location, extent, and type of wetland resources.

Ormond Lagoon (obtained from K. Bane, State Coastal Conservancy)

A common classification system would reduce redundancy and allow agencies to better leverage scarce resources. This system is needed to provide more clarity on the status of the state's wetlands and to support assessment of the success of regulatory and management programs. It would also make it easier to communicate information on wetland extent to the public.

C. THE DEPARTMENT OF FISH AND GAME SHOULD BE THE LEAD AGENCY RESPONSIBLE FOR MAINTAINING AND UPDATING WETLAND AND RIPARIAN MAPS AND MAKING THEM READILY AVAILABLE TO THE PUBLIC

Many agencies maintain wetland maps and no mechanism exists for easily sharing this information. Often agencies are unaware of the resources that might be available. This leads to inefficiencies and redundancies.

In 2003, the U.S. Fish and Wildlife Services' National Wetlands Inventory (NWI) and the Natural Resources Agency launched a Statewide Wetlands Inventory. The NWI and its partners have mapped over 80 percent of California's wetlands to date. The Statewide Wetlands Inventory is at a stage that is can be handed off to a state agency for further development. The California Department of Fish and Game's, Biogeographic Data Branch which manages and maintains the Vegetation Classification and Mapping Program, California Natural Diversity Database, and the public site BIOS, should be the repository and manager of wetland and riparian maps. Not only would this improve communication and coordination among agencies, it would also reduce costs by minimizing interagency redundancies. Cost savings would accrue by synthesizing mapping updates that occur through other state and federal programs, such as project-specific mapping, reserve mapping, or status and trends mapping.

3. PROVIDE COMMON TOOLS AND APPROACHES FOR WETLAND MANAGEMENT

A. ESTABLISH STANDARD METHODS TO ASSESS WETLAND CONDITION IN ALL STATE WETLAND PROGRAMS

California has not established consistent wetland assessment methods. In most cases, assessments are based on a combination of staff judgment and limited data gathering. As a result there is a wide disparity of information among state wetland programs, with very limited opportunity for data sharing among agencies or the public.

Methods are now available that provide an opportunity for comparable assessments. One method is the California Rapid Assessment Method (CRAM). Given adequate training, CRAM could be established as a "baseline" monitoring approach for most situations. Use of CRAM across programs would provide a common assessment language that would enhance the state's ability to quantify status and trends in wetland condition and to track project and program performance.

B. IMPROVE COMPENSATORY MITIGATION MONITORING AND ASSESSMENT METHODS

Seal Beach National Wildlife Refuge (E. Stein, Southern California Coastal Water Research Project)

Concerns have been raised about the usefulness of compensatory mitigation under the Clean Water Act section 404 and 401 programs. Similar challenges also burden mitigation monitoring associated with state wetland programs such as those under Porter-Cologne Act and the California Coastal Act. Performance standards vary from agency to agency and as a result, monitoring data is often not consistent or comparable.

New federal regulations for the 404 program call for improved monitoring and performance standards and set forth processes for reviewing and approving wetland and riparian area mitigation projects, including the establishment of wetland banks. These new monitoring and performance standards could also be adopted by state regulatory programs to integrate permitting among agencies.

Consistent assessment methods and performance standards across federal and state agencies will improve interagency coordination and ultimately result in more successful mitigation at less cost to the regulated public.

C. ESTABLISH CALIFORNIA WETLAND REFERENCE SITES TO SUPPORT EVALUATION OF MITIGATION AND RESTORATION PROJECT SUCCESS AND HELP TRACK THE EFFECTS OF CLIMATE CHANGE

Reference wetlands and riparian areas are needed to provide a way to evaluate success of mitigation and restoration projects. Additionally, reference areas are needed to track the effects of climate change.

4. SHARE WETLAND AND RIPARIAN AREA DATA AND INFORMATION WITH THE PUBLIC

A. ESTABLISH AN INTERNET WEB PORTAL FOR MANAGING AND DISSEMINATING DATA ON WETLANDS, RIPARIAN AREAS, AND OTHER ASSOCIATED HABITATS

Agencies typically maintain unique databases for their wetland information. These databases are not standardized and are often not compatible with one another.

A common data management and integration tool would make possible the sharing of information among agencies. An already established data management tool is Wetland Tracker (developed by the San Francisco Estuary Institute). Wetland Tracker could be integrated with the statewide repository of wetland maps and other integrated wetland data bases to provide updates to the wetland map base inventory information. Common data management also allows specific programs to evaluate their data in the context of larger regional and/or ambient data. Such a system should be Web-based and easily accessible to the public.

5. CONSIDER LONG-TERM WETLAND COSTS IN FUTURE BOND MEASURES

A. ENSURE THAT OPERATION AND MAINTENANCE COSTS ARE CONSIDERED FOR NEWLY ACQUIRED OR RESTORED WETLANDS, INCLUDING THE COST OF AQUISTION AND, IF NECESSARY, THE DELIVERY OF WATER

An important recommended future action included in the 1998 *State of the State's Wetlands* report was the need to operate and maintain wetlands that are acquired by California. Recent successes in acquiring and protecting important wetland resources have highlighted the need for ways to operate and maintain these properties. As public land holdings have increased, the need to maintain the wetlands has become more apparent.

California should explore approaches for including operation and maintenance, including water supply reliability and personnel costs, in new wetland projects and existing land holdings.

Del Rey Lagoon (J. Coffin)

6. SUPPORT THE USE OF WETLANDS TO SEQUESTER CARBON

A. ESTABLISH A MARKET FOR WETLAND CARBON OFFSETS AS ONE WAY TO REDUCE THE IMPACTS OF CLIMATE CHANGE IN CALIFORNIA

Restoration of tidal wetlands and managed freshwater wetlands results in carbon sequestration rates (area-for-area) that are similar to or greater than that of many forest habitats (Miller et al. 2008). Establishing a market for wetland carbon offsets could provide a significant new funding mechanism to mitigate greenhouse gas emissions and support adaptation to climate change as well as the benefits of wetlands for fish and wildlife. Additional research is needed to support the science and any policy development for a wetlands carbon offset protocol.

7. INCREASE STATE SUPPORT FOR WETLAND PARTNERSHIPS AND COORDINATION WITH AGRICULTURAL STAKEHOLDERS

A. ENCOURAGE FEDERAL, PUBLIC, AND PRIVATE PARTNERSHIPS TO CONTINUE TO DEVELOP AND MAINTAIN PARTNERSHIPS TO ACHIEVE GAINS IN WETLAND AREA

In the 1998 *State of the State's Wetlands* report, public-private partnerships were found to be the most effective way to achieve gains in wetland area. Today, these partnerships still play a leadership role in acquiring, restoring, and creating wetlands. The six active joint ventures in California play a central role in developing science based goals for wetland restoration, developing and implementing projects, and leveraging limited state and federal funding. Wetland acquisition, restoration and enhancement programs within joint ventures need continued support and funding to help meet wetland goals.

ACTION NEEDED

Improvements must be made to build the capacity of state and regional agencies to monitor and assess wetlands and to maintain our wetland assets. California wetlands conservation, restoration, and management efforts need enhanced coordination, technical support, and sustainable funding. At present these needs far exceed available funding. For example, the State Coastal Conservancy has estimated the cost for major wetland projects planned and designed in San Francisco Bay and Southern California alone to be at least $2 billion.

Many recommendations presented in this report are already being implemented because agencies see the value and improved program efficiency that results from these changes. Monitoring coordination and the development of a Web portal to track wetland monitoring data are well underway. In addition, the SWRCB is moving forward with development of a policy for a consistent statewide wetland regulatory program. Each of these efforts is funded with existing resources.

Other recommendations require new funding. Stable and continuous funding is needed to support operation and maintenance of wetland assets already acquired. When new bond measures and other funding sources are considered for the acquisition of wetlands the costs of operation and maintenance should also be considered.

Finally, private-public partnerships should be the centerpiece of future wetland acquisition and restoration. In the future, wetland conservation will increasingly focus on private lands. Recognizing that private landowners can play a key role in wetland conservation, funding for voluntary incentive programs is needed to continue the proactive stewardship of wetlands. These partnerships can help leverage limited state and federal funding to restore and protect California's wetland heritage.

ACRONYMS

CRAM	California Rapid Assessment Method
CVJV	Central Valley Joint Venture
CWA	Clean Water Act
DFG	Department of Fish and Game
DPR	Department of Parks and Recreation
GHG	Greenhouse gas
HGM	Hydrogeomorphic
IWCP	Inland Wetlands Conservation Program
LSA	Lake and Streambed Alteration Program
NRCS	Natural Resource Conservation Service
O&M	Operations and maintenance
PSA	Perennial Streams Assessment
RWQCB	Regional Water Quality Control Board
SFBJV	San Francisco Bay Joint Venture
SCCWRP	Southern California Coastal Water Research Project
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WCB	Wildlife Conservation Board
WRAPP	State Water Resources Control Board's Wetland and Riparian Area Protection Policy
WRP	Southern California Wetlands Recovery Project

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