Table 14. Distribution of Targets and Programmatic Actions for Habitat by Ecological Management Zone.

[Note: Refer to Volume II: Ecological Management Zone Visions for more information regarding the specific targets and programmatic actions.]

Habitat Vision	Ecological Management Zone[1]													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tidal Perennial Aquatic Habitat	●	●												
Nontidal Perennial Aquatic Habitat	●	●												
Delta Sloughs	●	●												
Midchannel Islands and Shoals	●													
Saline Emergent Wetland		●												
Fresh Emergent Wetland	●													
Seasonal Wetlands	●	●	●	●		●	●	●	●		●	●		●
Riparian and Riverine Aquatic Habitats	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Freshwater Fish Habitats	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Essential Fish Habitat	●	●	●	●	●	●	●	●	●	●	●	●	●	
Inland Dune Scrub Habitat	●													
Perennial Grassland	●	●							●					
Agricultural Lands	●					●	●	●	●	●		●		●

Ecological Management Zones

[1] 1 = Sacramento-San Joaquin Delta
2 = Suisun Marsh/North San Francisco Bay
3 = Sacramento River
4 = North Sacramento Valley
5 = Cottonwood Creek
6 = Colusa Basin
7 = Butte Basin
8 = Feather River/Sutter Basin
9 = American River Basin
10 = Yolo Basin
11 = Eastside Delta Tributaries
12 = San Joaquin River
13 = East San Joaquin Basin
14 = West San Joaquin Basin

Table 15. Comparison of Ecosystem Restoration Program Habitats with Other Community and Classifications Systems.

ERP Habitat	Equivalent Community or Habitat Type under Other Classification Systems		
	MSCS/NCCP Habitat[1]	Wildlife Habitat Relationship[2]	National Wetland Inventory[3]
Tidal perennial aquatic, Delta slough, midchannel island and shoal	Tidal perennial aquatic	Estuarine	Estuarine (aquatic subtypes only)
Riparian and riverine aquatic	Valley riverine aquatic	Riverine	Riverine (aquatic subtypes only)
Riparian and riverine aquatic	Montane riverine aquatic	Riverine	Riverine (aquatic subtypes only)
Riparian and riverine aquatic	Valley/foothill riparian	Valley foothill riparian	Estuarine/scrub-shrub, estuarine/forested, palustrine/scrub-shrub, palustrine/forested
Riparian and riverine aquatic	Montane riparian	Montane riparian	Palustrine/emergent/nontidal/permanent; lacustrine/emergent/permanent; riverine/emergent/permanent
Nontidal perennial aquatic	Lacustrine	Lacustrine	Lacustrine (aquatic subtypes only)
Saline emergent wetland	Saline emergent	Saline emergent wetland	Estuarine/emergent
Fresh emergent wetland, Delta slough, and midchannel island and shoal	Tidal freshwater emergent	Fresh emergent wetland	Palustrine/emergent/tidal
Fresh emergent wetland	Nontidal freshwater permanent emergent	Fresh emergent wetland and wet meadow	Palustrine/emergent/nontidal/permanent; lacustrine/emergent/permanent; riverine/emergent/permanent
Seasonal wetlands	Natural seasonal wetlands	Fresh emergent wetland	Palustrine/emergent/nontidal/seasonal
Seasonal wetlands	Managed seasonal wetland	Fresh emergent wetland	Palustrine/emergent/nontidal/seasonal/artificial
Perennial grassland	Grassland	Annual grassland and perennial-grassland	Upland
Inland dune scrub	Inland dune scrub	None	Upland
Agricultural lands	Upland cropland	Cropland, pasture, and orchard-vineyard	Upland
Freshwater fish habitat	None	None	None
Essential fish habitat	None	None	None

(1) Multi-Species Conservation Strategy, 2000.
(2) Mayer, K. E. and W. F. Laudenslayer. 1988.
(3) Cowardin et al. 1979,

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◆ TIDAL PERENNIAL AQUATIC HABITAT

INTRODUCTION

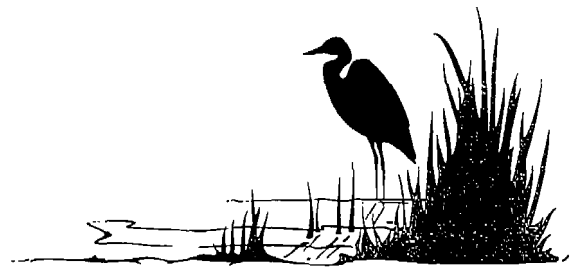
Tidal perennial aquatic habitat consists of the estuary's edge waters, mudflats and other transitional areas between open-water habitats and wetlands. Similar habitats are defined by the Goals Project (1999) as elements of tidal baylands which include mudflats, sandflats, and shellflats. These shallow waters are associated with natural wetland and riparian habitats that are important to fish and wildlife of the Bay-Delta. The substantial loss of historic shallow tidal waters, primarily as a result of reclamation and channel dredging and scouring, has led to the decline of many native fish, wildlife, and plant species in the Bay-Delta. Loss of such habitat has also reduced primary (plant) and secondary (invertebrate) productivity in the Bay-Delta estuary, and has changed important characteristics of the natural foodweb of the system.

TIDAL PERENNIAL AQUATIC HABITAT is defined as deepwater aquatic (greater than 3 meters deep from mean low low tide), shallow aquatic (less than or equal to 3 meters deep from mean low low tide), and unvegetated intertidal (i.e., tideflats) zones of estuarine bays, river channels, and sloughs. Tidal perennial aquatic includes all or portions of the ERP tidal perennial aquatic, tidal and Delta slough, and midchannel island and shoal habitats (Multi-Species Conservation Strategy 2000).

RESOURCE DESCRIPTION

Tidal perennial aquatic habitat is important for many fish, wildlife, and plants. It also supports many biological functions important to the Bay-Delta system. Many animal and plant species, identified as threatened or endangered under the California and federal Endangered Species Acts (ESAs), rely on tidal perennial aquatic habitat during some portion of their life cycle.

Bay-Delta estuary tidal wetlands and associated perennial aquatic habitat are among the most valuable natural resources in the United States. Restoring tidal perennial aquatic habitats is an important ingredient for successfully restoring the



Bay-Delta. Tidal aquatic habitats link wetlands with open-water habitats. Such habitat is used as foraging and resting habitat and escape cover for shorebirds, wading birds, and waterfowl. Resident and migratory fish use tidal perennial aquatic habitats for spawning, rearing, foraging, and escape cover. Young salmon forage in these productive waters and put on critical weight before entering the ocean. Striped bass, delta smelt, splittail, and many native resident Bay-Delta fish use this habitat, especially as rearing areas.

Tidal perennial aquatic habitat plays a primary role in the formation and maintenance of tidal wetlands. As tidal aquatic habitats accumulate sediment vegetation can increase. Over time this vegetation will become wetland and riparian habitat. As these tidal aquatic habitats accumulate sediment and vegetation, they maintain their structure and function, even with gradual rises in sea level.

Stressors that adversely affect the health of tidal perennial aquatic habitats include urban and industrial development, dredging, levees and associated land conversion, wastewater discharges, and land, urban and agricultural runoff.

VISION

The vision for tidal perennial aquatic habitat is to increase the area and improve the quality of connecting waters associated with tidal emergent wetlands and their supporting ecosystem processes to assist in the recovery of special-status fish and plant populations and provide high-quality aquatic habitat for other fish, wildlife, and plant communities dependent on the Bay-Delta.

Restoring tidal perennial aquatic habitat would also result in higher water quality and increase the amount of shallow-water and mudflat habitats; foraging and resting habitats and escape cover for water birds; and rearing and foraging habitats, and escape cover for fish.

Reducing fragmentation of existing tidal perennial aquatic habitat should be a focus of restoration efforts. Many areas of open water in the Bay-Delta are isolated by levees or deeper open-water habitat. Many open-water areas have been converted to managed marshes, saltponds, or agricultural use. Restoring historic habitats would involve reclaiming former tidal habitat by levee removal.

Initial efforts should focus on protecting existing tidal perennial aquatic habitats. These existing habitats offer functions and values that may not be possible to recreate. Former habitats should be linked with existing healthy habitats to enhance natural habitat restoration. Restored habitats should have natural gradients of open water, shallow water, wetland, riparian, and upland habitats to increase the habitat value for a greater diversity of species.

Many leveed lands in the Bay and Delta have subsided and are too low to support shallow tidal perennial aquatic habitat, and thus cannot be readily restored. The greatest subsidence has occurred in the Central and West Delta Ecological Management Unit. A comprehensive long-term program is needed to reverse subsidence. Changes in land use management, and use of suitable dredged materials or other "natural materials" should be implemented to restore land elevations to suitable ranges.

Restoration efforts should focus on those leveed lands that have not yet been subjected to severe subsidence. Prime candidates are existing managed marshes and salt ponds adjacent to San Pablo and Suisun Bays. Leveed agricultural lands and some industrial lands adjacent to Suisun Bay can be readily restored to tidal aquatic habitat. Some of the habitat would be mudflats, while deeper waters would be shallow productive bays not unlike the very productive Honker and Grizzly Bays of Suisun Bay, and much of northern San Pablo Bay.

Link to MSCS Evaluated Species

The MSCS has identified the following species as potentially benefitting from restoration of tidal perennial aquatic habitat in the Bay-Delta system:

MSCS Species Included in the ERP

- steelhead
- delta smelt
- winter-run chinook salmon
- Sacramento splittail
- fall-run chinook salmon
- spring-run chinook salmon
- Sacramento perch
- longfin smelt
- green sturgeon
- California freshwater shrimp.

Other Species Evaluated in the MSCS

- California least tern
- western snowy plover
- American peregrine falcon
- bald eagle
- Aleutian Canada goose
- California brown pelican
- tidewater goby
- California gull
- long-billed curlew
- osprey.

Integration with Other Restoration Programs

Tidal perennial aquatic habitat used here is similar to the Goals Project (1999) descriptions of shallow bay and channel habitat, and tidal flat habitat. It also includes marine and estuarine subtidal areas that are less than 2 m deep at low water and shallow tidally influenced riverine areas (Cowardin 1979).

Many programs and projects aim to protect, restore, and enhance habitats within the San Francisco-San Joaquin Bay-Delta estuary. These include:

- Bay Area Aquatic Habitats Planning Group
- Cache Creek Corridor Restoration Plan
- California Wetland Riparian Geographic Information System Project
- Central Valley Habitat Joint Venture
- Governor's California Wetland Conservation Policy
- Inland Wetlands Conservation Program

- Montezuma Wetlands Project
- National Estuarine Reserve Research System
- North American Waterfowl Management Plan
- North Bay Initiative
- North Bay Wetlands Protection Program
- San Francisco Bay Regional Water Quality Control Board, and San Francisco Bay Conservation and Development Commission - Regional Wetlands Management Plan
- San Francisco Estuary Project
- Suisun Ecological Workgroup of the Interagency Ecological Program
- Tidal Wetlands Species Recovery Plan
- Wetlands Reserve Program
- and Yolo Basin Wetlands Project.

The Ecosystem Restoration Program Plan restoration targets and objectives reflect the goals of many of these programs. For example, the Goals Project (1999) has completed a comprehensive science-based approach to determining where, how much, and what kinds of wetlands should be restored in the Suisun Bay and San Francisco Bay areas. Contributing to each of these program would help to restore critical ecological processes, functions, and habitats and reduce or eliminate stressors.

LINKAGE WITH OTHER ECOSYSTEM ELEMENTS

Tidal perennial aquatic habitat is linked to the following ecosystem elements: (1) ecological processes, (2) habitats, (3) species, and (4) stressors.

Related ecological processes include Delta inflow (Central Valley streamflows) which influences the location of X2; natural sediment supply which influences the maintenance of mudflats, shallow shoals, bottom composition throughout the Delta and Bay; Bay-Delta hydraulic patterns which influence flow patterns in channels and sloughs; and Bay-Delta aquatic foodweb which depends on nutrient input, shallow water interactions, and access to tidal perennial habitat.

Habitats which are closely linked to tidal perennial aquatic habitat include tidal sloughs and channels, saline emergent wetlands, midchannel islands and shoals, and perennial grasslands. Tidal perennial aquatic habitat also provide an important ecological connection between open-water areas and shallow-water, emergent wetlands, and riparian habitats.

Species which depend on tidal perennial aquatic habitat include a large assemblage of marine, estuarine, anadromous, and resident fish, wildlife, and plant species and communities.

Stressors which adversely effect tidal perennial aquatic habitat include levee construction, contaminants, and dredging and sediment disposal.

OBJECTIVE, TARGETS, ACTIONS, AND MEASURES

The Strategic Objective is to restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes.

LONG-TERM OBJECTIVE: Restore tidal perennial aquatic habitats in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to a substantial fraction of their pre-settlement areas, or to a point where all at-risk species that depend on the habitats are no longer at risk.

SHORT-TERM OBJECTIVE: Develop and begin implementation of action plans for restoring large and significant examples of tidal perennial aquatic habitat in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay.

RATIONALE: All major natural habitat types in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay have been reduced to a small fraction of the area they once occupied, resulting in a large number of at-risk plant and animal species and an increased susceptibility of the remaining areas to irreversible degradation (e.g., invasion by non-native species). The reduction trend is continuing and will have to be

reversed if self-sustaining examples of these habitats, and the diverse organisms they support, are to persist into the future. This reversal will require a large number of diverse and localized actions, from levee setbacks to land acquisition to better management of existing sites. The major habitat types to be restored include tidal shallow water habitat, freshwater emergent wetland, channel islands and associated habitats, tidal sloughs, nontidal freshwater emergent wetlands, seasonal upland wetlands, vernal pools and surrounding uplands, riparian forests and associated upland areas, perennial grassland, and inland dune scrub. In order to make restoration actions systematic and cost-effective, specific objectives need to be established for each of the habitat types, as well as subsets of them that have distinctive biological characteristics, and then priorities set within each objective for protection and restoration activities.

STAGE 1 EXPECTATIONS: A classification system for Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay habitats that can be used as a basis for conservation actions will have been developed. Specific, numeric objectives should be formulated for each habitat type, with restoration objectives based on clearly stated conceptual models. Within and among habitat types, conservation and restoration activities should be prioritized. Work should begin on those projects given highest priority within a year of adoption of the strategic plan.

RESTORATION ACTIONS

The general target for restoration of tidal perennial aquatic habitat is to restore 7,000 acres in the Sacramento-San Joaquin Delta Ecological Management Zone and 1,500 acres in the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

The following actions will help achieve this vision:

- restoring land elevations will allow more leveed lands to be returned to tidal shallow water habitat,
- setting backs levees would add aquatic habitat along potential margins of the Bay and Delta, and
- opening or breaching levees would also open unnaturally isolated lands to tidal flows.

MSCS CONSERVATION MEASURES

The Multi-Species Conservation Strategy recommends the following types of conservation measures for species dependant on tidal perennial aquatic habitat.

- Direct ERP actions towards setting back levees in the south Delta to increase shallow water habitat.
- Restore and enhance delta smelt habitat to provide suitable water quality (i.e., low concentrations of pollutants) and substrates for egg attachment (submerged tree roots, branches, rock, and emergent vegetation) to spawning areas in the Delta: Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs, and the Sacramento River in the Delta and tributaries of northern Suisun Bay.
- Protect the Sacramento and San Joaquin river and tributary channels from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversion that result in entrainment and in-channel barriers or tidal gates) for the period February 1 to August 31.
- Protect critical rearing habitat (Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and tributary sloughs, Sacramento River upstream to confluence with Three Mile Slough, and south along the San Joaquin river including Big Break) from high salinity (>2 ppt) and high concentration of pollutants from the beginning of February to the end of August.
- Allow delta smelt unrestricted access to suitable spawning habitat and protect these areas from physical disturbance (e.g., heavy equipment operation) and flow disruption in the period from December to July by maintaining adequate flow and suitable water quality to attract migrating adults in the Sacramento and San Joaquin River channels and their tributaries, including Cache and Montezuma sloughs and their tributaries.
- To the extent consistent with CALFED objectives, channel modification activities should

avoid channel islands, shoals, and shoreline areas with emergent vegetation.

- To the extent consistent with CALFED objectives, no dredging should be conducted within 200 feet of the shoreline and 250 feet of any water 4 feet or less (MLLW) in Suisun Bay and the western Delta (west of the confluence of the Sacramento and San Joaquin rivers.
- To the extent consistent with CALFED objectives, dredging or water side activities should not occur in shallow water (<3 m) areas of the Bay and Delta.
- To the extent consistent with CALFED objectives, construction of waterside rock berms and backfill should be avoided in critical spawning and rearing areas.

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◆ NONTIDAL PERENNIAL AQUATIC HABITAT

INTRODUCTION

Nontidal perennial aquatic habitat in the Bay-Delta estuary is present in certain low-elevation areas. Nontidal perennial aquatic habitat includes portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lake, ponds, oxbows, gravel pits, and flooded islands. Such areas have permanent open water which is no longer subject to tidal influence. The size, quantity, and quality of existing nontidal perennial habitat do not equal the wildlife habitat values of sloughs and backwaters in the estuary before reclamation.

> **NONTIDAL PERENNIAL AQUATIC HABITAT** is defined as lacustrine habitat by the MSCS. This habitat includes portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lake, ponds, oxbows, gravel pits, and flooded islands (Multi-Species Conservation Strategy 2000).

Nontidal perennial aquatic habitats are important for many species of wildlife in the Delta. In many places within the Delta, nontidal aquatic habitat has replaced the native tidal aquatic habitats. Outside the Delta, the substantial loss or degradation of nontidal aquatic habitats associated with Central Valley wetlands has reduced the available habitat area for many native fish and wildlife species. Land reclamation is the major factor that limits the contribution of nontidal perennial aquatic habitats to the health of the Delta.

RESOURCE DESCRIPTION

Historically, most wetlands in the Bay-Delta estuary were tidal. Nontidal perennial aquatic habitats were largely nonexistent. Some historical nontidal perennial habitat was created naturally. Shifts in river alignments occasionally isolated oxbow lakes, and drainage divide ponds in Bay area tidal wetlands were subjected to limited tidal action. Most of the remaining nontidal perennial aquatic habitat areas were established by constructing dikes and levees.

Isolating these areas allowed their conversion for other uses, primarily agricultural. Perennial aquatic habitats on converted lands are primarily located in large agricultural drains, small farm ponds, industrial ponds, ponds managed for waterfowl and other wildlife, and Delta island blowout ponds (created by levee failures that scour island interiors deeply enough to maintain permanent water through seepage).

Existing nontidal open-water areas generally have poor wildlife value. Nontidal perennial aquatic habitats have insufficient shoreline cover for nesting and protection from predators. Adjacent lands are relatively barren (e.g., farmed fields and land next to industrial ponds) and lack cover needed by nesting waterfowl and other species that require adjacent open-water and upland habitats. A notable exception is the unreclaimed blowout ponds around which native vegetation has been allowed to establish (e.g., ponds on Webb Tract).

The loss of permanent open water within historic tidal wetlands substantially reduced habitat for waterfowl, shorebirds, and other wetland wildlife species in the Bay-Delta system. Important ecosystem processes needed to restore and sustain nontidal perennial aquatic habitat include:

- the geologic and hydrologic condition, stream meander, and tidal function necessary to maintain permanent surface water;
- a range of elevations sufficient to support deep-water (greater than 3 feet in depth) and shallow-water areas; and

- adjacent wetland and riparian (streambank) vegetation.

Land use and human disturbance are stressors on nontidal perennial aquatic habitat. Insufficient buffer areas around open water reduce habitat value for wildlife species. These species require quality upland habitats connected to the aquatic habitat and increasing levels of human disturbance that adversely affects wildlife using open-water areas.

The value of open-water habitat to wildlife greatly increases if emergent vegetation is present along shorelines and in shallow-water areas. Adjacent dense upland herbaceous vegetation and riparian woodland further increase the value to wildlife.

VISION

The vision for nontidal perennial aquatic habitat is to increase the area and improve the quality of existing open-water areas to provide high-quality habitat for waterfowl and other water birds.

This vision can be achieved as a component of saline and freshwater emergent wetland restorations. Permanent open-water areas could be restored as a component of nontidal saltwater, and fresh emergent wetland habitat areas. The bottom slope ranges of restored wetland areas will provide the water flow patterns necessary to create a wide variety of permanent open-water areas. Waterfowl brood ponds can be constructed on agricultural lands next to suitable waterfowl nesting habitats.

Restoring nontidal perennial aquatic habitat would improve ecological process and functions of other habitats and wildlife. Adjacent wetland and upland habitats would then have increased ecological value. The open shallow water would provide resting and foraging habitat for waterfowl and other water birds. Wading and shore birds would feed in the open shallow water habitat. These restored habitats may improve the quantity and quality of nesting habitat. Increased nesting habitat would increase the production of waterfowl and other water birds in the estuary.

Restoring nontidal perennial aquatic habitat in sufficient quantity and quality will require reestablishing associated ecosystem processes. Restoring these processes will establish and maintain habitat, reduce or remove stressors, and help restore adjacent habitats.

Restoration efforts should be accomplished through landowners, conservation groups, and land management agencies. The focus of these efforts should be to restore open-water habitats on Delta islands and other former tidelands of the Bay-Delta.

INTEGRATION WITH OTHER RESTORATION PROGRAMS

Nontidal perennial aquatic habitat used here is similar to the Goals Project (1999) description of diked marsh, salt pond, and storage/treatment pond.

Efforts to restore nontidal perennial aquatic habitat would involve cooperation with other wetland restoration and management programs. These include:

- San Francisco Bay Area Wetlands Ecosystem Goals Project,
- Natural Resources Conservation Service's Wetland Reserve Program,
- Wildlife Conservation Board's Inland Wetlands Conservation Program,
- restoration programs administered by Ducks Unlimited and the California Waterfowl Association,
- Central Valley Habitat Joint Venture and North American Waterfowl Management Plan,
- the Suisun Marsh Protection Plan,
- and ongoing management of State and federal wildlife refuges and private duck clubs.

Cooperation will also be sought from agencies or organizations with responsibility or authority for restoring wetland and aquatic habitats, including California Department of Fish and Game, California Department of Water Resources, U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the Delta Protection Commission.