# Summary Information

Fishery Foundation of California

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

Amount sought: $411,820

Duration: 36 months

Lead investigator: Mr. Trevor Kennedy, Fishery Foundation of California

# Short Description

This project will build upon ongoing monitoring at two western Delta restorations sites and initiate monitoring at the Twitchell Island Set−Back Levee Restoration Site on the lower San Joaquin River. The objective of the proposed monitoring is to compare fish habitat use within and among the three sites and adjacent river reference areas of the Western Delta.

# Executive Summary

B. EXECUTIVE SUMMARY

Title: Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997

Amount Requested:

Applicant: Fishery Foundation of California (Trevor Kennedy) − Cosumnes@comcast.net

Elk Grove, California, 209−649−8914

Co−sponsors: Delta Levees Subvention Program and Wildlands Inc.

Participants and Collaborators: California State University Hayward, California Department of Fish and Game.

The monitoring proposed would build upon ongoing monitoring at two western Delta restorations sites and initiate monitoring at the Twitchell Island Set−Back Levee Restoration

Site on the lower San Joaquin River. The Twitchell site was constructed from 1999 to 2003 with most of the site reaching some degree of riparian and aquatic maturity in 2004. The objectives of the restoration sites at Kimball Island on the lower San Joaquin River and Decker Island on the lower Sacramento River are to restore tidal marsh and riparian shaded riverine aquatic habitat along marsh channels and the river shorelines of the islands. The objective of the proposed monitoring is to compare fish habitat use within and among the three sites and adjacent river reference areas of the Western Delta. Ongoing monitoring at Kimball and Decker Islands indicates that non−native fishes dominate the fish communities of interior marsh channels, while native fishes are more prevalent near breaches and along river shorelines with extensive cover and shade. The Twitchell Island Set−Back Project has habitat more similar to the breach and vegetated river shoreline habitats of Decker and Kimball islands where native species would be more prevalent. Native fish communities would be expected to change seasonally at Twitchell, consistent with observations at Decker and Kimball. Chinook salmon fry would dominate in winter and early spring. From spring through fall Sacramento splittail, tule perch, Sacramento pikeminnow, hitch, delta smelt, and Sacramento sucker will be prevalent in the catch. Non−natives such as inland silversides, mosquitofish, striped bass, threadfin shad, American shad, and golden shiner will also be seasonally abundant. Interior channels of Decker and Kimball islands become choked with floating aquatic plants especially water hyacinth and Potamogeton sp., and submerged aquatic vegetation especially Parrots Feather. This problem is not expected at the Twitchell site, as it is linear setback project along an existing levee with no connection to the interior of Twitchell Island. The habitat is similar to the breach and river shoreline locations at Decker and Kimball. The Twitchell site has also been designed with considerable rock and large woody material (root wads) to attract spawning delta smelt and other native fishes. We propose to monitor the Twitchell site with a similar array of sampling gear including seines, fyke nets, trawls, gill nets, push nets, and light traps. Both the Kimball and Decker monitoring projects were designed in cooperation with the IEP Resident Fish and Delta Salmon Program Work Teams. These relationships would be carried over to the Twitchell project.

The proposed monitoring project supports the achievement of a number of ERP goals and objectives; foremost amongst these is promoting the cross−program relationship between the Ecosystem Restoration and Levee System Integrity programs with the Twitchell Island Project. There is much hope that the Twitchell project design provides directs benefits of levee stability and habitat enhancement, and indirect benefits to water quality, flood control, and water supply reliability.

## A. Project Description: Project Goals and Scope of Work

### 1. Introduction

The Fishery Foundation of California (FFC) along with its partners Wildlands Inc., California State University Hayward (CSUH), and California Department of Fish and Game (DFG) Stockton request Ecosystem Restoration Program (ERP) grant funds to monitor fish and wildlife use and habitat conditions in the Delta Subventions Program ERP funded Twitchell Island Setback Levee Project. Each of the three parties have been studying Delta fishes over the past several years and hope by teaming together they can focus their efforts on answering important questions on shallow water shoreline habitats in the Delta, specifically those created in recent tidal marsh restoration projects including Decker Island, Twitchell Island, and Kimball Island, all levee mitigation projects. We propose to study the Twitchell Island set-back levee habitat project, which has not been monitored, to determine if it is providing habitat for Delta native fishes. The team proposes to study fish use and habitat in the portion of the Delta bounded by the three sites: Twitchell Island in the southeast on the lower San Joaquin River below the mouth of Old River, Decker Island in the north on the lower Sacramento River downstream of Three-Mile Slough, and Kimball Island in the southwest near the confluence of the two rivers (Figure 1). This triangle encompasses much of the western freshwater Delta known for its importance to delta smelt, splittail, striped bass, and Central Valley Chinook salmon. It also includes the dynamic interface between the lower Sacramento River and the North Delta that is crucial in the protection and restoration of native Delta fishes (May and Brown 2004).

The study compliments other recent and ongoing studies in Suisun Bay and Marsh, the South Delta, and the North Delta. The study would build upon earlier and ongoing region-wide shallow water studies conducted by CALFED (Breach 1 study), DFG (Resident Fish Survey), and USFWS (Beach Seine Survey). The study would focus on meso-scale habitat use[1] by fishes, a scale that best addresses habitat restored or lost to levee maintenance in shallow waters of the Delta including breached tidal marshes and levee shorelines. We hope to identify meso-scale habitat types that are heavily used by native Delta fishes to help guide future Delta levee habitat improvements. On-going survey data from Kimball Island by CSUH and FFC and Decker Island by DFG will be compared directly to results of the proposed ERP funded study at Twitchell Island.

**Kimball Island** is a restored tidal marsh constructed as a mitigation bank from a 100-acre leveed island in 2001. Since completion the interior island channels away from breaches have become congested with water hyacinth and other non-native invasive aquatic plants. Interior sites are those in the interior south side of the island away from the three breaches located on the north side of the island. Interior sites have limited circulation being further from breaches and thus are prone to hyacinth buildup, whereas all breach areas have no buildup of hyacinth. Two years of

[1] Meso-scale habitat is on the scale of tens to hundreds of square meters as opposed to macro-scale habitat (miles) or micro-scale habitat (inches – reflecting immediate habitat fish choose). Meso-habitat can be readily defined and characterized by direct observation at a levee site, and is based on readily definable parameters such as depth, slope, substrate, cover, current, shoreline cover, etc.

monitoring indicate native Delta fish use the vegetated river shorelines and higher energy interior sloughs nearest the breaches, whereas non-native fishes such as crappie, golden shiner, inland silversides, and largemouth bass reside and breed seasonally in the interior southern channels. Future plans call for additional breaching to improve native Delta fish habitat. The site is an ideal adaptive management experimental study area with one to three years of baseline data on fish habitat, fish use, marsh vegetation, and birds.

**Decker Island** is a Special Delta Project within the Subventions Program. Phase I of the project is complete and is similar in some respects to Kimball Island in that it has a breached opening to interior marsh sloughs. Decker Phase II and III consist of additional interior sloughs and are completed or near completion. Located in Solano County, Decker Island is a 470-acre tract surrounded by the Sacramento River to the northwest and Horseshoe Bend (a former meander of the Sacramento River) to the east, south, and west. The ten-acre project site is contained within the 33.2 acres owned by the California Department of Fish and Game, located at the northern tip of the island.

**Twitchell Island** is also a Special Delta Project within the Subventions Program and the CBDA ERP. It includes a setback levee with habitat created between the old and new levee along a small tidal channel with heavy plantings of aquatic and riparian plants as well as a number of large woody material complexes to attract fish. The site is now relatively mature and should be studied to determine if the extensive amounts of habitat are being used by native fishes.

## 2. Problem, Goals, and Objectives

We propose to conduct a study of fish habitat and fish use of Delta levee shorelines and breached islands with the purpose of determining specific habitat conditions that are more conducive to supporting Delta native fishes. The project will help evaluate different fish habitat restoration approaches in the Delta and determine whether existing restoration actions are attaining their objectives. The project will help determine effective designs for future restoration. Specifically the project will focus on determining what habitat conditions are important to native Delta fishes including delta smelt, splittail, and Chinook salmon.

The Twitchell Island Setback Levee Project was funded in 1997 and constructed from 1999 to 2003. The project is a 3000-ft setback levee along the south shore of Twitchell Island on the north shore of the San Joaquin River between the mouth of Old River and Three-Mile Slough (Figure 1). The new levee was built with a new innovative design for soft peat soils behind the old levee. The old levee and the vegetated shaded riverine aquatic channel between the old and new levees were designed to protect the new levee from erosion. The setback extends approximately 200-ft back onto Twitchell Island (Figure 2). The interior channel is connected to the San Joaquin River at multiple “breaches” (Figure 3) and has considerable cover (Figures 4-7). The habitat has matured considerably since construction (Figure 8). It remains to be determined how fish are using the newly formed habitat.

We propose to monitor aquatic habitat conditions and seasonal use by fish of the habitat for three years. The goal of the restoration project is to provide habitat for spawning and rearing native fishes including delta smelt, which spawn and live in this reach of the lower San Joaquin River. Salmon young are also expected to use the new habitat for rearing as they pass through the Delta on their way to the ocean. We propose to compare catch rates at and within the restoration site to catch rates at nearby reference sites and to catch rates from similar monitoring at the Kimball and Decker island restoration sites. Catch rates by habitat types will be compared at all restoration and reference sites. Habitat conditions in terms of water temperature, depths, current velocities, aquatic and riparian vegetation will be compared among all sites within and among restoration sites. A key objective is to evaluate the value of habitats restored for native fishes to provide insights for future designs for Delta habitat restoration, particularly along levee shorelines, and especially as to the importance of these shoreline habitats for Delta native fishes such as delta smelt, splittail, and Chinook salmon.

Finally, we hope to be able to answer the following questions:

- How have the levee setback and biotechnical improvement of channel banks improved habitat conditions for Delta native fish over the prior levee conditions?
- Have we achieved our the goal of the AB 360 levee improvements program of increasing shallow water habitat in the Delta?
- How well are restoration actions attaining their objectives?
- How has the western Delta ecosystem responded to the multiple restoration actions including the Kimball, Decker, and Twitchell projects?
- Have we identified measures of project performance that are good indicators of the ecosystem's response to the habitat restoration actions?

## 3. Justification (including conceptual model and hypotheses)

The basic conceptual model of the set-back levee along the rivers and channels of the Delta is that it provides shallow water, wetland, and riparian habitat needed by fish and wildlife that is not provided by rocked unvegetated levee banks. For the Twitchell Island Setback Levee Project the conceptual model is more specific in that shallow water habitat is more riparian than wetland and the restoration does not involve breached-levee tidal marshes like many of the previous and ongoing restoration projects including those at Kimball and Decker islands, and others such as the sites studied in the CALFED Breach 1 studies. Our project team has found that native fishes are more likely to use high-energy shoreline habitats with considerable riparian cover as opposed to interior tidal marsh habitats on islands that have been breached (Cannon and Kennedy 2004; Rockriver 2004). Habitats with extensive cover offer more protection from predators. This conceptual model is a key component of managing large river habitats within the Sacramento River Bank Protection Program. The general conceptual model is that rocked banks provide poor fish habitat because of the lack of cover from predators (Bugert et al. 1991; Cannon and Kennedy 2003) and that cover is an important determinant of river bank habitat use by fish (Cavallo et al. 2003; Lassettre and Harris 2001; McCain 1992; Peters and Missildine 1998; Piegav 2002).

Much recent science in the Bay and Delta has focused on the role of tidal wetlands as fish habitat (e.g., Breach 1 and 2 studies). Brown (2003) in a recent review of the importance of tidal wetlands to fish in the estuary stated "*There have been few studies of the importance of tidal wetlands to the fishes of the San Francisco Estuary. Therefore, there is a high degree of uncertainty regarding the benefits of tidal wetland restoration for native fishes, including special status species such as delta smelt (Hypomesus transpacificus), chinook salmon (Oncorhynchus tshawytscha), steelhead rainbow trout (O. mykiss) and splittail (Pogonichthys macrolepidotus).*"

Our proposed study focuses on this uncertainty by recognizing the problems with the previous design model (breached islands and conversion to tidal marshes) that was employed at Kimball and Decker Islands, and focusing on a new design model – linear riparian/wetland habitat along leveed Delta shorelines – the Twitchell model. While both models employ shallow water tidal wetland habitat, the footprints and functions are much different. We believe the shoreline tidal marsh of the river channels in the Delta is more consistent with the native habitats of the Delta within which the native fishes evolved. This new model is more a mix of the tidal marsh and river riparian models typically employed in the Bay-Delta and Central Valley rivers, respectively.

This new conceptual model was used in developing the design for the Twitchell project. The basic premise of the model is that corridors of tidal marsh riparian and shaded riverine aquatic habitat along shorelines of rivers, sloughs, and marshes are better for native fish. The Twitchell project employed large numbers of root wads in breach openings to attract fish and specifically spawning delta smelt, because delta smelt are thought to spawn in shallow high energy areas on hard objects such as woody debris. Root wads represent large woody materials prevalent in the riparian river model. The project also employed numerous breaches in the design to maximize circulation in the channels. The model assumes greater circulation improves habitats and benefits native fishes, whereas dead-end marsh channels with low energy favor non-native fishes as well as growth of floating aquatic vegetation such as water hyacinth. The Twitchell design also included extensive amounts of aquatic and riparian vegetation along the shoreline of the setback channel with dense plantings of willows to provide shade to the channel believing again that shade and cover are favorable to native fishes.

The Kimball and Decker projects were designed to provide more tidal marsh habitat with similar emphasis on large woody debris and riparian shade and cover in channels. However, these projects have much greater amounts of tidal marsh and more extensive channels (Figures 9 and 10) that have proven poor habitat for native fishes as well as difficult to maintain because of extensive aquatic plant growth. The Twitchell project with more breaches and only one interior channel parallel to the river (see Figure 2) provides a lesser amount of tidal channels and marsh habitat, but more linear shoreline of riparian SRA habitat per acre of restoration.

Focusing the restoration along the river shoreline also maximizes riverine riparian habitat along Delta channel levee corridors. We believe this is the most cost effective means of restoring Delta habitat as we hypothesize that the Delta native fishes are adapted to shallow water habitats of riverine shorelines and not to tidal marshes. At Kimball Island we have found delta smelt along the river shoreline but not within the interior island tidal marsh channels. Chinook salmon are also far more numerous along the river shorelines. Tule perch and splittail seasonally use the tidal marsh habitats as well as the river shorelines. The Twitchell design incorporates both the river shoreline and tidal channel designs, while emphasizing the river shoreline component.

We hypothesize that both shallow water and cover are important elements of native fish habitat along river shorelines. Steep un-vegetated banks typical of most levee banks in the Delta probably provide poor native fish habitat and likely provide advantages to non-native predatory fish like largemouth bass. Juveniles of many native and non-native fish species seek out shallow water habitat with abundant cover and shade. Many of the non-natives (especially young of centrarchids like largemouth bass, bluegill, redear, and crappie) prefer the backwater lacustrine habitat of the interior marshes, and would not be expected in large numbers along the river shoreline. Based on our experience at Decker and Kimball islands, we expect to find native hitch, pikeminnow, tule perch, and splittail young and adults, as well as Chinook salmon young seasonally in the Twitchell setback channel and breach openings. We also expect delta smelt to be seasonally abundant (fall through spring) in the breach openings. Non-native threadfin shad, striped bass, and silversides may also be seasonally abundant in the channel and breach openings.

Brown (2003) stated that *"increased areas of freshwater tidal wetlands may provide increased rearing and refuge habitat for fry, resulting in greater survival and hence greater production of adult fish"*. We have found in our surveys at Decker and Kimball that native splittail and salmon fry rearing does occur in interior tidal marsh wetlands in winter, but also that extensive rearing of non-native species fry occurs in spring and summer. Splittail and salmon fry also use shoreline marsh habitats extensively, while there is less use by non-natives. Our conceptual model recognizes this tradeoff and reflects our hypothesis that in the long-run linear tidal marsh riparian habitat along levee banks of the Delta will better accommodate the needs of Delta native fishes and limit production of non-native fishes.

Brown describes the standard conceptual model for delta smelt being that juvenile and adults are pelagic and not generally found in shallow water habitats. While our studies agree that delta smelt are not using tidal marshes, we have found significant numbers in shallow shoreline habitats along the rivers. So our conceptual model incorporates delta smelt using the shallow river shorelines for juvenile rearing and adult feeding, and possibly spawning based on Lindberg and Marzuola (1993) who found spawning delta smelt within and near the breach of a flooded island located near the confluence of Cache and Shag sloughs in the northern Delta.

Our conceptual model reflects the results of Kimball Island surveys in 2002-2003 where we found habitat partitioning among the species collected (Figure 11). The analysis indicate three distinct habitat associations: (1) interior island (dead-end) tidal marsh channels, (2) high-energy breach areas, and (3) river shoreline/beaches. The interior island group include golden shiner, largemouth bass, splittail, mosquitofish, silversides, and sunfish (redear, bluegill, and crappie). The breach areas include tule perch, gobies, and pikeminnow. The river shoreline/beaches include striped bass, American shad, threadfin shad, and pikeminnow. This model changes in winter when salmon would dominate the river shoreline habitat and young splittail would dominate the interior island channels.

Our multidisciplinary conceptual model and proposed monitoring program emphasize CALFED's primary question: "How are ecosystem restoration efforts affecting ecosystem processes?" We hypothesize that the restored Twitchell habitat provides cooler summer and warmer winter water temperatures, and greater food availability than adjacent reference sites along un-vegetated, steep-banked, rocked levee shoreline. Our model also recognizes the value to native fishes of higher variability in time and space of many habitat factors in the river shoreline habitats. We hypothesize that invasive species may be less adapted to such seasonal variability. We found that interior island tidal marshes habitats vary much less in comparison to river shoreline habitats. River shorelines have highly variable bank slope, shoreline slope, and vegetation composition. Waves, tides, water depth, and currents also vary considerably. Substrate varies from sand to silt, to rock and large woody material. Some beaches will be shallow and open, possibly meeting the needs of delta smelt, whereas other beaches will have more diverse cover in the form of tules and riparian shade that would benefit splittail, tule perch, pikeminnow, hitch, and juvenile salmon. Overall a diversity of habitats would benefit the whole of the native fish community. Our proposed monitoring program includes measurement of these habitat conditions during sampling and a sampling design that incorporates this variability either with varying gears, or different sampling locations and sampling times.

Brown (2003) identifies many uncertainties with regards to restoring shallow water habitats in the Delta. The greatest problem appears to be lack of data on restored tidal wetlands. We hope to address this concern by collecting several years of data at the Twitchell site to go along with several years of data at the Kimball and Decker sites, with all tied together with data from the regional surveys of IEP including the Delta Resident Fish Survey. The second is the lack of natural reference sites with the physical characteristics desired for restored tidal wetlands. We believe that some of the reference sites at Decker and Kimball and elsewhere in the Western Delta can effectively be considered "natural". Brown also states that further invasions of non-native aquatic plants such as Egeria densa will complicate restoration actions, and provide habitat more suitable for non-native fishes. We believe specific design features of the Twitchell site will preclude colonization of Egeria. Features at Kimball and Decker already do so, but water hyacinth and Eurasion milfoil remain a problem at Kimball, while water hyacinth and Egeria are problems at Decker. We hope to identify features of the three sites that will minimize colonization of nuisance aquatic plants. Some adaptive management of the Kimball and Decker designs may be necessary to alleviate these problems.

Brown also identifies the uncertainties caused by sampling gear biases. We hope to help see through these biases by employing a full array of sampling techniques available to the project team's parent organizations. Each gear we have employed at Kimball and Decker has provided different insights into the composition of the fish communities and their response to habitat conditions.

Finally, Brown and others have identified the ultimate uncertainty of being able to achieve some degree of success at restoring native Delta fishes given great changes in habitat that have occurred and the huge numbers of non-native plants and animals that have invaded the Delta ecosystem. "*As aptly demonstrated by the BREACH study and other comparative investigations, tidal wetlands are extremely complex systems, and the outcome (in terms of achieving stated goals) of any particular wetland restoration effort is difficult to predict. The likelihood that invasive species will successfully exploit restored wetlands is a major concern* (CALFED Science Conference 2000 summary). All we can hope to do in this study is to identify those habitat features that appear to favor the native species over the non-natives, and then focus future restoration on such habitat types and conditions. We can maximize our probability of identifying the important habitat features by adaptively managing each of these three restoration sites, for which we have the support of each of the site owners. We also are committed to making changes in the monitoring program at the three sites to maximize the effectiveness of the overall experiment. In this respect we hope to accomplish Brown's recommendation that uncertainties can be best resolved through large-scale adaptive management experiments. We hope to make the Western Delta triangle between the three sites a large-scale adaptive management experiment with modifications to the three restoration sites and the monitoring program as needed.

## 4. Previously Funded Monitoring

Wildlands has funded two years of monitoring at Kimball Island. The Fishery Foundation of California and CSU Hayward have conducted the monitoring at Kimball Island. DFG has conducted monitoring at Decker Island for two years. Both the Kimball and Decker studies are partially funded for at least the next year. Further photos of the project sites are shown in Figures 12 -17.

At Kimball Island habitat development in aquatic areas of the island has not been stable or as planned. Water hyacinth completely dominates approximately a third of the interior channels. In other portions of the interior island, Parrots Feather and Curlyleaf Pondweed clog many smaller channels and margins of larger channels. It is readily apparent that the abundance of floating aquatic vegetation (FAV) and submerged aquatic vegetation (SAV) has reduced circulation on the island and increased sedimentation rates. Many channels are filling rapidly with vegetative debris as well as fine organic and inorganic silt that is filtered out by the SAV. Sedimentation in these areas of the island channels is much greater (possibly three to four times greater) than the 10 to 40 mm reported by Reed (2002) for nearby tule marshes on breached sites at Sherman, Donlon, and Browns Islands. Reed found breached islands had higher sedimentation rates than reference islands. Reed also found higher rates on the Sacramento River side of the Delta, because the Sacramento carries a greater sediment load than the San Joaquin River. Kimball Island although not directly within the Sacramento channel is within the delta area of the mouth of the Sacramento River channel. Sedimentation rates on Kimball Island may be higher because of its location, as well as having shallower and narrower channels with extensive beds of SAV as compared to beds of tules in developed marsh.

Despite these problems, fish surveys indicate a relatively high percentage of native fish are found in the island's fish community. Native fish including splittail, hitch, pikeminnow, tule perch, Chinook salmon, steelhead, delta smelt, stickleback, and prickly sculpin made up from 15% of the collections in winter, spring, and early summer to only 3 % in late summer and fall. These percentages are relatively high compared to the 1 to 3 percent reported for Suisun Bay and the Delta in other studies (Simenstad et al. 2000 and Moyle et al. 2001). The main reason for the difference is the high percentage of native fish in the river and breach locations. In all seasons native fishes made up less than 1 percent of the fish community at interior island locations, where non-native golden shiner, silversides, and mosquitofish were prevalent. In contrast, Chinook salmon made up approximately half of the beach seine catch at river locations in the winter, and splittail, hitch, pikeminnow, and tule perch made up two-thirds the gillnet catch at breach locations in early summer. Thus the breach and river shoreline areas have more of the "historical ecological function" described by Simenstad et (2000) that are more conducive to native Delta fishes. Cooler water temperatures are one factor that is more conducive to native fishes, perhaps because the island being in the western Delta receives the cooler breezes from the Bay, but also because of the narrow channels of the island's marsh, shaded by native tules and riparian willows. The interior marsh dead-end or slow-moving channels clogged with the FAV water hyacinth and the SAV Parrots Feather watermilfoil is non-natural habitat that favors non-natives like golden shiner, silversides, mosquitofish, largemouth bass, and sunfish. These non-natives dominate the fish community because they reproduce in the interior channels, whereas most of the native fishes spawn primarily in floodplains, rivers, and tributaries. Golden shiner, silversides, and mosquitofish appear to breed prolifically in the interior channels. The island's shallow channels with extensive beds of Parrots Feather appear ideal breeding conditions for these species, as well as largemouth bass and sunfish (mainly crappie). Young largemouth bass were commonly collected in the island's interior in early and late summer, indicating they were spawned on the island probably in late spring. Tule perch and possibly splittail are the only native fish that appear to be reproducing on the island.

Four major aquatic habitat types were identified at the island: (1) large tidal river, (2) large adjacent sloughs, (3) island breaches and adjacent channels, and (4) interior channels. Adjacent slough habitats to the north of the island are relatively wide and deep, and were sampled only with gillnets, which had catches similar to nearby breach locations. Catch and species composition differ considerably among the river, breach, and interior locations. As stated above, river locations seasonally had the most native fish including young splittail, Chinook salmon, and delta smelt; however, the river collections also had high numbers of non-natives including inland silversides, American shad, narrower channels with extensive beds of SAV as compared to beds of tules in developed marsh. In early summer largemouth bass and sunfish (white crappie, black crappie, redear, and bluegill) young were also most prevalent in interior island locations, along with young tule perch and splittail. White catfish and gobies (primarily yellowfin goby) moved into the interior island in late spring and early summer to spawn. Small numbers of threespine stickleback were also found in the interior island in early summer. Adult hitch, pikeminnow, tule perch, splittail, and Sacramento sucker were commonly collected near the breaches, but also at times in the interior island and river locations. Adult largemouth bass and striped bass were also commonly collected at breach and river shoreline locations, and less commonly at the interior island locations. Catch and species composition also varied considerably within location, although our sampling design was insufficient to characterize local habitat conditions that likely contribute to such differences. Limited comparison sampling in heavy cover versus open beach habitat at river locations especially in late summer indicated substantial difference in species composition in these habitats with covered habitats having more native fishes. Fall sampling indicated differences in catch composition that appeared to be related to salinity, as high tide brought in low salinity water (4 ppt) and with it our largest catch of delta smelt (in one fyke and one seine set). This was a unique event in the year of sampling, as the island was generally upstream of the low-salinity zone of the estuary. In the interior of the island, high catch variability is an indication differing habitat and differences in sampling efficiency in the varying habitats. Interior habitats varied in channel width, depth, currents, sediment, SRA cover, and most importantly floating, emergent, and submerged aquatic vegetation. Turbidity, water temperature, and salinity varied little among locations within seasons and specific spring/neap tide period. We were unable to sample channels with heavy infestations of water hyacinth, but did sample immediately adjacent edges. We attempted seining, gill netting, and fyke netting channels with heavy growth of Parrots Feather, but the amount of Parrots Feather affected our ability to sample a consistent protocol. By late summer 2003 many of the channels with high concentrations of Parrots Feather were filling in with fine sediment, making it difficult to sample locations that had been relatively easy to sample in spring and fall 2002. Many shallow dead-end channels were either filled completely with water hyacinth or Parrots Feather. Seine collections indicated that young silversides and golden shiners, along with the ubiquitous mosquitofish dominated this habitat. Deeper dead-end and second order channels held more largemouth bass, sunfish, crappie, tule perch, crayfish, and shrimp. Main flowing channels in the interior provided habitat for these same species as well as the occasional school of adult splittail, adult hitch, adult carp, adult white catfish, and subadult striped bass. The deeper channels near breaches have the most consistent habitat in terms of depth, substrate, and vegetation, but generally varied more in water temperature, turbidity, current, and salinity with tide stage than interior or river locations. Sampling frequency and design, as well as high variability in catch precluded determining the effects of these differences within seasons. Sampling variability also contributed to observed variance in catch within and between gear types. Seines sampled less consistently in the three locations as well as within locations because of different channel configurations and density of aquatic vegetation. Fyke and gill nets sampled differently because of differences in currents, depths, and aquatic vegetation. Native fishes including splittail, tule perch, and Chinook salmon use the interior marsh of the island, but primarily during the cooler months of the year as observed by Simenstad et al (2000). Native resident Delta fishes including splittail, hitch, pikeminnow, tule perch, and Sacramento sucker used high-energy channels especially near breaches in the marsh in all seasons. Native fishes seemed quite content with river and slough shorelines. While we generally agree that introduced fishes will remain the dominant fish in the Delta, we saw indications that improving shoreline habitat with riparian cover can increase use by native fishes. Restoring slough and river shoreline habitat with more linear habitat with extensive riparian cover should benefit native fish populations by providing habitat for sub-adult and adult life stages.

We suggest that native fishes would more heavily use the interior island habitats if there were more breaches to provide greater circulation especially if sloughs carried greater tidal flows across the island in both tidal directions. Essentially this would extend the more heavily used river shoreline habitat across the interior of the island contiguous with tule marsh. The heavy riparian cover along the interior island channels would provide habitat more similar to heavy cover river shoreline habitat where we found high use by native fishes. Having breaches on the riverside of the island would also provide greater access to the interior channels for young delta smelt, splittail, and salmon. Greater circulation also would possibly reduce the extent of water hyacinth and aquatic macrophytes clogging the interior island channels. The water hyacinth problem does greatly reduce the potential of tidal wetland habitats of providing significant habitat for Delta native fishes (Toft 2000). The predominance of silversides, golden shiner, and mosquitofish in the tidal marsh is more a reflection of these species taking advantage of a habitat niche for spawning and early rearing that is relatively underutilized by Delta native species such as pikeminnow, Sacramento sucker, blackfish, hitch, and splittail, which in contrast all make spawning migrations to lower tributaries and Valley floodplains. The main exceptions are the tule perch, which do well bearing their young in the island channels. Yearling and older native species were relatively abundant especially in gillnet sampling that focused on larger fish, which is an indication they use the tidal marshes as juvenile and adult foraging habitats. Pikeminnow at least take advantage of the abundance of non-native forage fish. The other natives take advantage of the high invertebrate production of the tidal marsh.

The physical habitat of the tidal marsh appears more than adequate for the native fishes. We found no evidence that the interior marsh was warmer than the larger river channel. In fact, we found the opposite with the marsh channels being shaded and more likely to cool during the night, whereas the river was a larger heat sink and retained heat energy. The riparian cover and narrow channels within the island greatly reduced solar warming. The problem may simply be the SAV/FAV/EAV along with the non-native fish are too much for the native fish to content with in the tidal marshes.

We agree with Brown (2003) that breached-dike restoration sites should rapidly contribute to the Delta's emergent wetland secondary production. We saw extensive primary production within Kimball Island in the form of SAV/FAV/EAV, benthic filamentous algae, phytoplankton blooms, and riparian plants. Island channels had high secondary production in the form of benthic aquatic invertebrates living in the abundant SAV/FAV/EAV beds. Limited light trap and push net sampling also indicated high zooplankton production. The island wetlands appear to be a sink for riverine and Delta organic and inorganic silts while being a source for Delta organic debris and aquatic organism production.

Brown also suggested that predation may substantially reduce native fish abundance in shallow water habitats. We found no evidence of this on the island and perhaps the opposite as the SAV provided extensive cover for young fishes. We did find larger predatory fishes in near-breach channels and river shoreline habitats. We did not sample the shallow Egeria habitats of the river shoals. The larger size of the subadult and adult native minnows and suckers make them ideal prey for adult striped bass and largemouth bass that are seasonally present in all the island habitats. If anything, the abundance of aquatic vegetation provides cover for the native fishes from the larger predatory non-native fishes. Native minnows were relatively abundant in the high energy, deeper, open channels near breaches that were also frequented by striped bass and largemouth bass, which may be an indication that these two non-native predators are limiting production of native Delta minnows.

Are smaller tidal sloughs better habitat than large sloughs? Our breach sampling indicated a relatively high proportion of native fishes such as splittail, hitch, and pikeminnow use the larger habitats. Our interior island sampling indicates shallow water with riparian cover will be used by young of native splittail, salmon, and tule perch. Thus, we would conclude that sloughs and river shoreline habitats are all potentially important for native fishes. Our study indicates that dead-end tidal marsh habitats are the only habitat that would be detrimental to native fishes by supporting production of non- native predators and competitors such as largemouth bass, sunfish, silversides, mosquitofish, and golden shiner. Moyle et al. (2001) came to a similar conclusion in Suisun Marsh. The larger sloughs have habitat more similar to the river shorelines where native fishes are more abundant.

Overall, we believe the benefits of the new tidal marsh on Kimball Island far outweight any detrimental effects. Furthermore, improvements are possible that would increase benefits. Young native fishes do not heavily use the island tidal channels because the natives spawn principally in Central Valley floodplains and tributaries. Exceptions are tule perch and possibly splittail. The marsh channels are used seasonally by young migrant salmon and splittail. The island channels may be locally important spawning areas for splittail and tule perch whose young were seasonally abundant. Sacramento perch, though extinct from the Delta, are another native fish that could use the marsh for spawning and rearing. The relatively isolated channels of Kimball

Island may make the island a likely candidate for Sacramento perch reintroduction. Juvenile and adult native fishes are relatively abundant as they appear to be taking advantage of the marsh's abundant food sources including young of the non-native golden shiners, mosquitofish, and silversides. Kozel (1971) in his study of the importance of cattail marshes along the Missouri River found that the marshes comprised only a small percentage of the surface area, but were important because they provided a large number of microhabitats and niches, and thus enhanced the diversity and stability of the river ecosystem. He found that many of the native Missouri fishes did use the marshes for reproduction, but also for food and cover, and that abundance of many native fishes was higher in the marshes and river reaches near marshes. He also found that plant, invertebrate, and fish production was higher in the marshes.

DFG has studied the Decker Island site for the past two years (Rockriver 2004). There too introduced fish use the site to a great extent. Interior island channels however have become so clogged with water hyacinth and Egeria that Boating and Waterways has been called on to chemically treat and mechanically remove the plants. Like Kimball Island, the Decker Island site would benefit from increased circulation. The DFG monitoring at Decker Island is also integrated into the regional Delta Resident Fish Study that has been going on since the 1980's (Urquhart 1987).

Generally, we plan to integrate the various methods and analytical tools of the three monitoring programs. We will also continue to work closely with the IEP Program Work Teams on standardizing methods. We plan to continue the multivariate analysis of the data that relates catch of fish of different species and life stages to habitat conditions that were first used by DFG (Urquhart 1987). These techniques have been employed in the Kimball data analysis (see Figure 11).

Performance measures in all three programs will be based on catch by species and life stage with proportion of native and non-natives in the catch being of primary importance. The distribution of native fishes especially delta smelt and Chinook salmon will also be of particular importance.

We do not expect any regulatory implementation issues, because each of the principal investigators maintains the necessary collectors permits, Section 10 take permits, and MOU's with DFG to conduct studies at the three sites and western Delta.

Brown and Michniuk (2004) suggest that the focus of native fish habitat studies in the Delta should be in the North Delta where native fishes are most prevalent. The CALFED ERP Strategic Plan also calls for emphasis on the North Delta. Our proposed study is focused on the Western Delta including the lower Sacramento and San Joaquin River channels and their confluence. We believe these habitat areas are intrinsically at least if not more important than the North Delta because the Western Delta encompasses much of the tidal freshwater habitat of the Delta including that where most of the delta smelt spawn and rear. Western Delta habitat is also very similar to North Delta habitat in that its water sources and habitats are similar. The Western Delta is also an important rearing habitat of Central Valley Chinook salmon. The Western Delta levees are also far more important to protect from failure to protect the Delta water supply from large island flooding. Thus evaluation of the effectiveness of the setback levees at Twitchell Island is important to many of the CALFED objectives.

## 5. Approach and Scope of Work

We propose to monitor the three study sites and adjacent levee habitats seasonally for three years beginning in 2005. Sampling will be conducted using standard techniques including beach seines, fyke nets, gill nets, light traps, minnow traps, plankton nets, and boat-mounted electroshocker. Sampling units will be selected from a wide range of habitat types so that we can compare fish species composition and densities of target species among habitat types. Target habitat types will include rocked bank with no vegetation, rocked bank with vegetative cover, set-back channels, adjacent breached shallow marsh, and various natural shoreline types with vegetative and large woody material cover. Sampling will focus on the three restored sites and adjacent nearby reference areas. Habitat in the three areas will be typed, mapped, catalogued, sampled, and tested for differences. The effect of invasive floating and submerged aquatic vegetation will be investigated as suggested by Feyer and Nobriga (2004).

We propose to add monitoring at the Twitchell site to that being presently funded at Kimball and Decker Islands by Wildlands and DFG, respectively. In addition, we plan to expand reference sites near the three study sites to provide greater regional western Delta coverage. Seines, gillnets, and fyke nets will remain the primary fish sampling gear with seasonal supplementation with plankton push nets, which also sample macroinvertebrates in the water column. Invertebrate and fish plankton will be monitored with light traps. Benthic invertebrates will be sampled with standard dredge samplers. Limited sampling will be possible with the standard Resident Fish Monitoring Program boat and backpack electrofishing gear. All gear and sampling procedures will be as described by IEP Program Work Teams.

The basic sampling design will be quarterly to establish seasonal patterns of fish habitat use and differences in use by life stages. Data will be recorded on standardized field data sheets and entered into standard format electronic files for storage within the IEP database as presently occurs for the Decker Island study.

The sampling design will be a pseudo stratified random sampling design with sampling stratified by location, habitat type, and season. There are three shallow water habitat types: 1) shorelines contiguous to open river channels, 2) high energy slough habitat near breaches adjacent to river channels, and 3) shallow (“deadend”) slough habitat. Each survey type (seine, gillnet, etc.) will sample at least two locations in each of the habitat types at each restoration site and at reference sites each quarter. It will not be possible to sample all gears in all habitat types.

Habitat conditions will be recorded with each fish and invertebrate sample.

- Vegetation - Three categories of vegetation are recognized: emergent vegetation (Scirpus, Typha, Phragmites etc.), submerged vegetation (Egeria, Potamogeton etc.), and floating vegetation (Eichornia). Riparian habitat is recorded in the form of cover and shade.
- Tidal elevation – not only tide stage but whether the location is subtidal or intertidal.
- Bank and Bottom Substrate – sand, silt, rock, shells, woody material.
- Salinity, Water Temperature, and Turbidity – Secchi depth and/or NTU turbidity.
- Water current and wave height.

We plan to follow the guidelines of the Aquatic Monitoring Program (AMP) of the CALFED Science and Interagency Ecological Program by targeting species, habitats, and landscapes. Monitoring will target at-risk species and biological communities and focus on the status of species of concern identified by the ERP and MSCS. Monitoring will also assess quality of specific habitat types relative to their sustainability and ability to support native species and communities. Landscape Monitoring addresses the status of ecological processes, pressures, biological communities, and the extent and distribution of the mosaic of habitats across the landscape. In our case the landscape is the Western Delta, the habitats are the basic three types mentioned earlier, and the species are the native Delta fishes. This approach is designed to provide managers with a maximum of information for making decisions on Delta levees and habitat restoration.

Estimates of relative abundance and emigration will be standardized by area sampled and approximate volume of water sampled based upon the measures of tidal prism and channel area. When the data are appropriate, other statistical techniques will be applied, such as non-parametric or parametric analysis of variance (on log-transformed data) and correlation with different sites. Multivariate descriptors are useful because they are statistically powerful, they integrate multiple species, and they minimize reliance on highly variable single-species data. We will use multivariate statistical analysis programs available as Excel macros (e.g., Winstat). See Figure 11 for an example.

For each sample, all juvenile and adult fish (and macro crustacean species for our proposed macroinvertebrate sampling) will be enumerated and recorded. Native species (and virtually all non-natives) will be identified. Measurements will include standard length for fish, carapace width (in cm) for crabs, and carapace length for shrimp. If more than 30 individuals of any one species are caught during a sample, then the first 30 individuals encountered will be measured; the rest will be counted. All fishes will be released alive after processing except for voucher specimens to document species identifications. The purpose of these data is to identify and quantify fish species present, to test the effects of environmental conditions on their distribution and abundance, and ultimately to study processes of recruitment, growth, reproduction, and migration among marshes.

Measures beyond simple fish counts and length measurements will be made including measures of fish condition such as weight, reproductive condition, presence of external anomalies (e.g., lesions or tumors), stomach contents of predatory fish, and limited scale-growth analysis.

The following is a description of major tasks.

Task 1 – Project Management

FFC will submit semi-annual fiscal and programmatic reports that include: (1) total amount awarded for the entire project; (2) the amount invoiced to the granting agency; (3) the amount invoiced to cost-share partners; (4) a description of activities performed during the six months being reported; (5) the percentage of each task completed; (6) the deliverables produced for the period of the report; (7) problems and delays encountered; and (8) a description of any amendments or modifications to the grant agreement.

Task 2 - Development of Study Plan
A detailed study plan will be developed prior to commencing monitoring. Sampling protocols will be appended to the study plan. Analytical methods will also be prescribed. The Plan will include specific information about methods and techniques, equipment and facilities, data collection, variables to be measured including performance measures, statistical analysis and quality assurance procedures. Specifics as to how hypotheses will be test will be identified.

Task 3 – Survey Sampling
Sampling will be conducted quarterly for three years.

Task 4 – Data Analysis and Reporting
Data reports will be prepared with each quarterly survey. Annual data reports and status papers will be prepared. Final papers will be prepared upon completion of the three years of monitoring. Principal investigators will meet annually with CBDA and IEP management and participate in CALFED Science Conferences and Workshops, and meetings of the Delta Levees Subvention Program.

**Hypothesis Testing Criteria**
We will compare directly the species composition among the sites by sampling gear, season, and habitat type. Criteria include presence of species, species groups, and specific life stages, based on density and catch. Comparison of multivariate analysis of catch and habitat conditions results among sites will be another test of differences.

**Performance Measures**
Performance will be a measure of the degree or extent of use of a site and its habitats. They will include presence of at-risk and nuisance species, catch per unit effort of special status species by life stage, and percent composition by gear type of native Delta species by habitat type. Performance measures will also be developed by habitat type for habitat conditions with water temperature, depth, food availability, and cover being key measures.

These performance measures are designed to provide maximum utility for those making decisions on ecosystem restoration in the Delta by providing direct comparisons with other restoration projects. High seasonal use by Delta native fishes is the most important measure because it is the objective of restoration actions in the Delta.

**Contribution to Bay-Delta Science**
The proposed monitoring program will contribute significantly to our understanding of fish spatial and temporal distribution and abundance patterns in the Western Delta. In addition, the study will provide significant new insight into what factors are important to Delta native and nonnative fishes in their selection and use of habitat. With the focus for many years of surveys being the deeper waters of the Delta channels, the added information from this study will contribute to the limited knowledge of shallow water habitats and their important to Delta native fishes and their ecosystem. The new information will be extremely helpful in designing future

habitat restoration in the Delta and in determining the importance of shallow water habitats for Delta native fishes. We expect to actively participate in Bay-Delta Science activities including IEP Program Work Teams, as well as CALFED science conferences and workshops.

### 6. Feasibility

The project team is highly capable of undertaking and completing the proposed monitoring project as it already conducting surveys at Kimball and Decker Islands as well as other locations in the Delta. DFG and Wildlands will provide their support to ensure these studies get conducted as required by their restoration permits. The addition of Twitchell Island surveys will be cost efficient given the close proximity of the three sites. The project team also has the necessary state and federal monitoring and ESA permits to conduct the proposed studies. Access is very reasonable from both the water and land (via reclamation district levee road).

The project team will work closely with agency representatives of the Levee Subventions Program and the local reclamation district, their engineer Chris Neudeck (and active participant in the Levee Subventions Program), and local landowners who have been integrally involved in the Twitchell Island Setback Levee Project.

### 7. Expected Outcomes and Products

The project will generate a project study plan within three months of project award that will be peer reviewed by IEP Program Work Teams. In addition quarterly data reports and annual status reports will be prepared. A final project report upon completion of the three years of monitoring will be prepared as paper for peer review for submittal to the Bay-Delta Online Science Journal or other peer review science journal. Annual progress reports will be submitted to the IEP Newsletter. Annual reports may make recommendations in the design of the project.

### 8. Data Handling, Storage, and Dissemination

Data will be recorded on standard field data sheets and then transferred to electronic spreadsheet files. Data will also be submitted to IEP database for inclusion in their comprehensive internet accessible database.

### 9. Public Involvement and Outreach

The project team will make periodic presentations to the Delta Levees Subventions Program at scheduled monthly meetings. The project team will also participate in CALFED and IEP meeting and workshops that are open to the public. The project team will also make annual presentations to the local reclamation district and their district engineer. If requested, project team members will make themselves available for tours of the site by CALFED or other programs.

### 10. Work Schedule

The project is scheduled over 12 quarters or three years from award of the contract. Task 1 will be completed in the first three months prior to sampling the first quarter element. Quarterly data reports will be prepared and distributed prior to the next quarter sampling. Annual reports will be completed and distributed prior to initiation of the first quarter of the next years surveys. The final report for the project will be completed and distributed within three months of completion of the last quarter’s survey.

## *B. Applicability to CALFED Bay-Delta Program ERP Goals, the ERP Draft Stage 1 Implementation Plan, and CVPIA Priorities.*

### 1. ERP and CVPIA Priorities

Levee system integrity and flood control are two CALFED objectives along with ecosystem restoration in the Delta. The Twitchell Island Setback Levee project was designed to address all three program objectives. CALFED has stated that "the most significant benefits of peripheral levee construction may be to environmental restoration". The Twitchell Island Setback Levee project design has proven an effective engineering solution to the levee integrity problem. Now we need to determine if the habitat restored in the setback meets the goals of the ERP.

We propose to conduct the study under guidelines and within the context of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP), the San Francisco Estuary Projects Comprehensive Conservation and Management Plan, the North Delta Program, the South Delta Program, Grizzly Island Restoration Program, Dutch Slough Restoration Program, and the Delta Levees Subvention Program.

The proposed study specifically addresses restoration priorities of the DRERIP including the following:

- **Restore habitat corridors in the North Delta, East Delta and along the San Joaquin River.** The proposed project would focus on the Twitchell Island and Kimball Island sites along the lower San Joaquin River and the Decker Island and Brannon Island area at the lower end of the North Delta on the Sacramento River.
- **Restore and rehabilitate floodplain habitat in eastside tributaries and the lower Sacramento and San Joaquin rivers.** The Decker Island and Kimball Island restoration projects have floodplain restoration elements, while the Twitchell site focuses on levee shoreline habitat.
- **Restore habitat that would specifically benefit one or more at-risk species; improve knowledge of optimal strategies for these species**. The three sites are important habitat for delta smelt, splittail, Chinook salmon, and other Delta native species. The focus of the study is determining what habitat features are important for these native species.
- **Implement actions to prevent, control and reduce impacts of non-native invasive species in the Delta.** Habitats that are underutilized by non-native species will be identified.
- **Restore shallow water habitats in the Delta for the benefit of at-risk species.** The project will identify habitat design parameters for shallow water habitats that benefit at-risk species.

The proposed study will also fulfill the need that existing restoration projects including the Twitchell Island Setback Levee Restoration Project be a science-based, adaptive management experiment.

The proposed study will request oversight and coordination through the California Bay Delta Authority (CBDA) Ecosystem Restoration Program (ERP) Technical Working Group, the ERP Adaptive Management Planning Team (AMPT), and the DRERIP process, and be active in assisting in developing indicators and performance measures for these programs.

The proposed project also addresses restoration priorities identified in the ERP Multi-Year Program Plan and Year 4 Work Plan.

1. Restore habitat corridors in the Delta - the monitoring program will contribute to our understanding of habitat requirements in the Sacramento River and San Joaquin corridors of the Delta.
2. Restore and rehabilitate floodplain habitat in the lower rivers – the monitoring program will contribute to our understanding of floodplain habitats in the lower rivers.
3. Restore upland wildlife habitat – the riparian corridors being developed in these restoration projects will provide upland wildlife habitat.
4. Implement actions to prevent, control, and reduce impacts of non-native invasive species in the Delta – the proposed project will provide valuable information on how non-native fishes use Delta habitats.
5. Restore shallow water habitats in the Delta for the benefits of at-risk species – the proposed project will provide valuable information on design parameters for shallow water habitats that would best benefit at-risk species.

The information collected through the monitoring program will be valuable in assessing progress to goals and objectives of the CALFED program related to restoration of habitat of at-risk species. With the information we will be able to determine if habitat corridors along the Delta river channels can be restored to meet the habitat needs of the at-risk species.

## 2. Relationship to Other Ecosystem Restoration Actions Monitoring Programs, or System-wide Ecosystem Benefits

We plan to coordinate integrally with existing monitoring programs including the Delta Resident Fish Survey, the USFWS Seine Survey, general IEP surveys, and other monitoring being conducted at specific sites in the north and central Delta.

The island’s location in the western Delta at the confluence of the Sacramento and San Joaquin Rivers provides an exceptional opportunity to view how plants, fish, and wildlife colonize new tidal marsh habitat. The island is also small enough to allow the Project to be adaptively managed if adjustments in habitat are desired based on results of ongoing monitoring. In this respect the Project fits recommendations by Schmutte (2002), Luoma (2002), and Wise (2002) as a demonstration project or project-based involvement to increase understanding of the Bay-Delta ecosystem to meet the needs of future restoration.

Kimball Island also offers an opportunity to test the hypothesis from recent research in Suisun Marsh that smaller sloughs may provide the best template for designing habitat restoration projects for native fish species (Matern et. al. 2002). The island has a maze of small sloughs connected to breaches that connect to larger sloughs and primary Delta channels (San Joaquin River channel – New York Slough and Broad Slough).

Results from our study will help to resolve uncertainties identified by Brown (2003) about the extent of benefit that native species, particularly special status fishes, will derive from tidal wetland restoration in the Bay-Delta. Specifically, our study at least partially addresses the following issues phrased as questions by Brown:

- Will tidal wetland restoration enhance populations of native fishes?
- Will primary production and other ecological processes in restored tidal wetlands result in net export of organic carbon to adjacent habitats, resulting in enhancement of the food web? If so, what quantities and forms of carbon are being exported?
- Will restored tidal wetlands provide long-term ecosystem benefits that can be sustained in response to ongoing physical processes, including sedimentation and hydrodynamics?

Finally, the Project is also designed to address several objectives of the Delta Native Fish Recovery Plan (USFWS 1996). 1. *Enhance, restore aquatic, and wetland habitat in the Sacramento San Joaquin River estuary.* This project assesses the effectiveness of the restoration toward providing spawning and rearing habitat for splittail, delta smelt, and other Delta native species. 2. *Reduce effects of introduced aquatic species on Delta native fishes.* This project also assesses the potential of the restored habitat to favor non-native species at the expense of Delta native fishes. 3. *Assess recovery management actions and re-assess prioritization of actions.* This project also assesses the effectiveness of restoring shallow water and tidal marsh habitat for Delta native fishes.

## C. Qualifications.

The study team consists of three principal investigators with extensive experience sampling the Delta. Dr. Chris Kitting – estuarine ecologist and professor at CSU Hayward – participant in Kimball Island studies. Andy Rockriver – fisheries biologist DFG Stockton, Decker Island Study Leader. Trevor Kennedy – fishery biologist Fishery Foundation of California (FFC), Kimball Island Study Leader. Dr. Kitting and Mr. Kennedy supervise and conduct the proposed monitoring at Twitchell Island and existing monitoring at Kimball Island with the support of students from the University and field biologists and technicians of the Fishery Foundation. Andy Rockriver will coordinate DFG's monitoring at Decker and support for Twitchell surveys. Andy Rockriver is a staff DFG biologist in the DFG Stockton office where he contributes to IEP and CALFED implementation programs. He has managed the monitoring surveys at Decker Island for the past two years.

The FFC will be the prime contractor for the project with CSUH as a subcontractor. DFG and Wildland's will provide in-kind services in support of monitoring at Decker and Kimball restoration sites, respectively, and for Twitchell activities. The FFC had numerous contracts with CALFED and CVPIA, and has no problems with the administration of those contracts.

**Chris Kitting -** Dr. Kitting is a professor at California State University at Hayward. He has conducted numerous monitoring studies of fish and invertebrates in the Bay-Delta. He conducts a research program with the CSUH Shore Institute that is determining the natural importance and suitable conservation and restoration of shallow-water communities, particularly on San Francisco Bay and Delta Shores. He and his students seek to identify particular, major limitations on shallow-water communities as major determinants of population distributions and abundances, as regions are threatened, conserved, or restored to higher abundances of natural plants and animals. He conducts an annual survey of fish at Brannon Island just to the north of Decker Island, fulfilling a long-term monitoring objective for the site initiated by his former professor, Dr. Sam McGinnis CSUH. Professor Chris Kitting earned his B.S. at University of California and Ph.D. as a Stanford University Graduate Fellow in 1979. After postdoctoral work with Stanford Medical School and Univ. Calif. Santa Barbara, and a faculty position at University of Texas Austin's Marine Science Institute on the Gulf of Mexico, Kitting joined the CSUH Faculty in 1985. At CSUH, he also has taught courses in Statistics, Marine Science, and Geology Departments. He has published over 30 major works on aquatic ecology during his 27 years in academia, emphasizing nursery areas for invertebrates and fishes in shallow vegetation on diverse shores. He has been Principal Investigator on over 16 major external grants at CSUH. He also is a founding Board Member of San Francisco Bay Wildlife Society, Charter member of Ward Creek Alliance, and member of three other watershed organizations. He has long maintained active professional membership in Society of Wetlands Scientists and Estuarine Research Federation Chapters, and over five related international ecological societies, where he presents new talks and posters several times each year at local and international conferences. He recently has served as president in two major scientific societies, and currently serves on two editorial boards of scientific journals. Kitting is a Science Advisor for Bay Area Discovery Museum's new NSF award for "Our Place by the Bay" programs. Kitting and his students have remained active with the Alameda County Clean Water program, which received an EPA National Excellence Award. His CSUH program is active in the Bay-Delta Science Consortium. Kitting has received over 20 major honors since the Ph.D., including nominations for Outstanding Professor Awards.

**Trevor Kennedy -** Trevor Kennedy is the senior fishery biologist and project manager with the Fishery Foundation of California. He has obtained and implemented numerous CVPIA and CALFED grants relating to habitats and fish passage, as well as monitoring in the Bay-Delta and its watershed. He implemented the Kimball Island monitoring program in 2002 and conducted a year of intensive fish monitoring at the site in 2003. He has a B.S. in Fishery Biology from Humboldt State University. He was the Cosumnes River Stream Keeper, where he monitored water rights applications on the Cosumnes River and wrote protests when necessary. He developed and implemented study to determine fish habitat use of newly restored floodplain habitat on TNC Cosumnes River Preserve. Implemented the creation of a watershed level Cosumnes River Scientific advisory group. He was Project Manager, for the Cal Fed funded "Cosumnes River Salmonid Barrier Program" (Accepted Nov. 1998) and numerous CVPIA study programs in Central Valley rivers. He implemented a study to determine fish use of newly restored tidal marsh habitat on Kimball Island.

## *D. Cost.*

1. **Budget—**The proposed monitoring budget is by year and each year could be funded separately. Specific elements of the study design, though not broken out because of multitasking and cost sharing, could be reduced or eliminated with some cost savings.

2. **Cost sharing—**Wildlands, DWR, and DFG are funding significant elements of the monitoring program at Kimball and Decker islands, and are willing to adjust their study scopes to be more compatible with the proposed study. These funding sources will most likely continue for the three years of the proposed study. The proposed study budget is intended to focus new funds on

Twitchell site and western Delta reference site monitoring, with only limited commitment to expanding monitoring at Kimball and Decker as necessary.  More details on the commitments of these cost-sharing partners will be determined once the specific study needs and commitment of the ERP are identified.

3. **Long-term funding strategy –** Long-term monitoring at the three restoration sites may or may not be needed depending on the results of the proposed studies.  Some long term monitoring of the regional survey elements, specifically shallow water surveys, may be picked up as part of the IEP Delta surveys or an expansion of the DFG Delta Resident Fish Survey.

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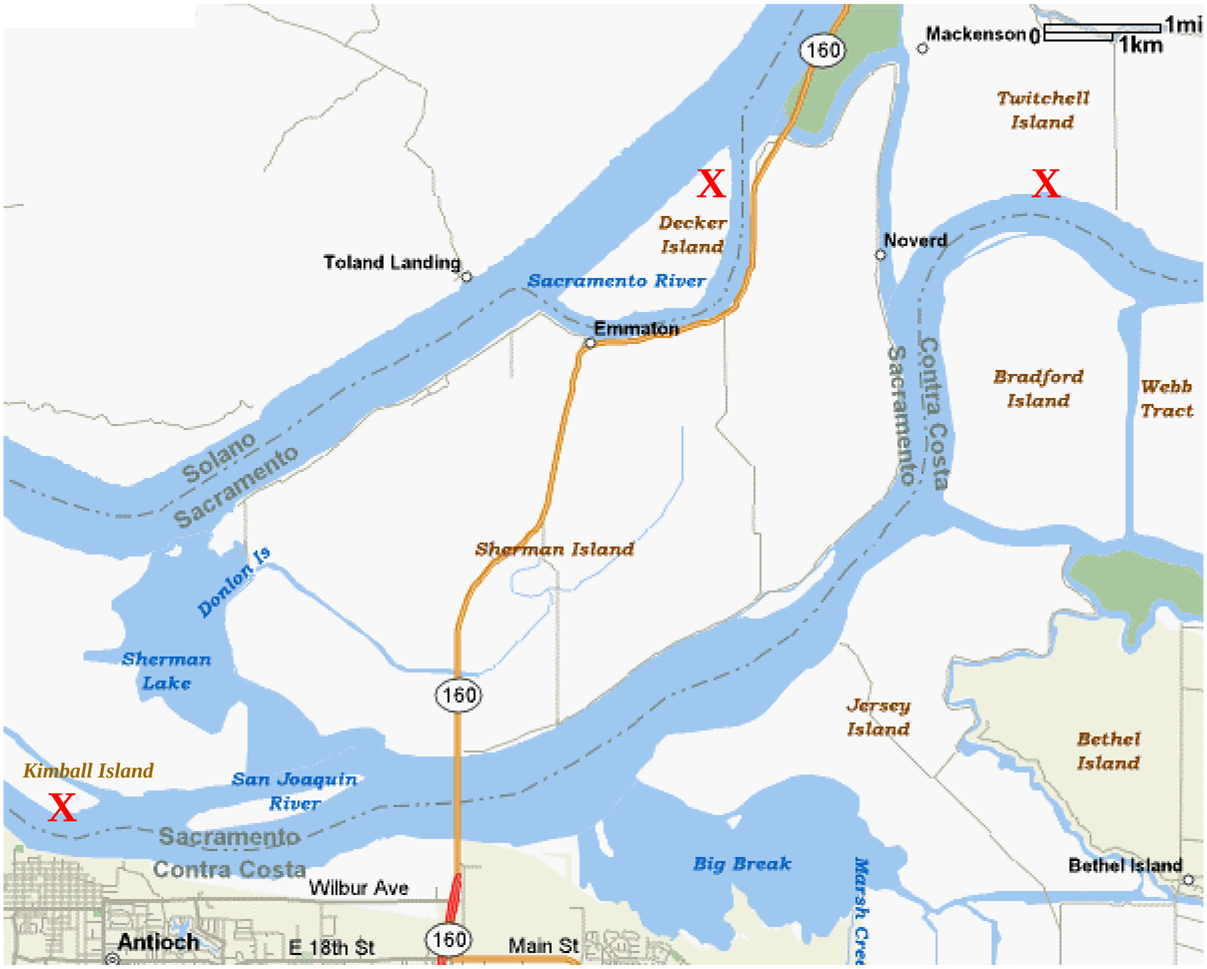



Figure 1. Location of three restoration sites in the Western Delta at Kimball, Decker, and Twitchell Islands.

Figure 2. Twitchell Island Setback Levee Project on south shore of Twitchell Island on the lower San Joaquin River channel in the western Delta 2002.

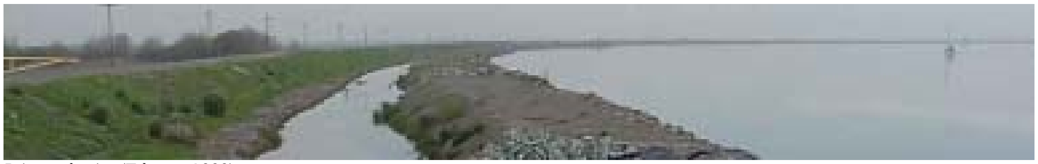
Figure 3. Breach in old levee at Twitchell Island Setback Levee project in spring 2004. Channel between old levee and set back levee is at left. The breach and old levee have been rocked to limit erosion while riparian vegetation takes hold.

Figure 4.  New breaches and habitat are forming where outer levee is eroding (spring 2004).


Figure 5.  Twitchell project breach with root wads placed for fish cover habitat and erosion control (spring 2004).

Figure 6. Interior channel between old and new levee at Twitchell project. In spring 2004 channel had become heavily vegetated with aquatic and riparian plants.

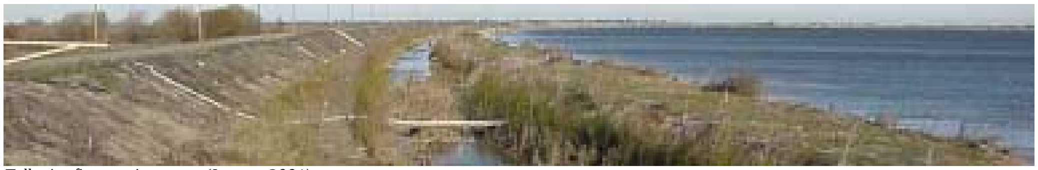
Figure 7. Interior channel in spring 2004 is well vegetated with considerable cover on both sides.



*Prior to planting (February 2000)*

*Installing woody vegetation on old levee (March 2000)*

*During growing season (September 2000)*



*Following first growing season (January 2001)*

Figure 8. Early stages of restoration in 2000 and 2001 at Twitchell Island Setback Levee project.

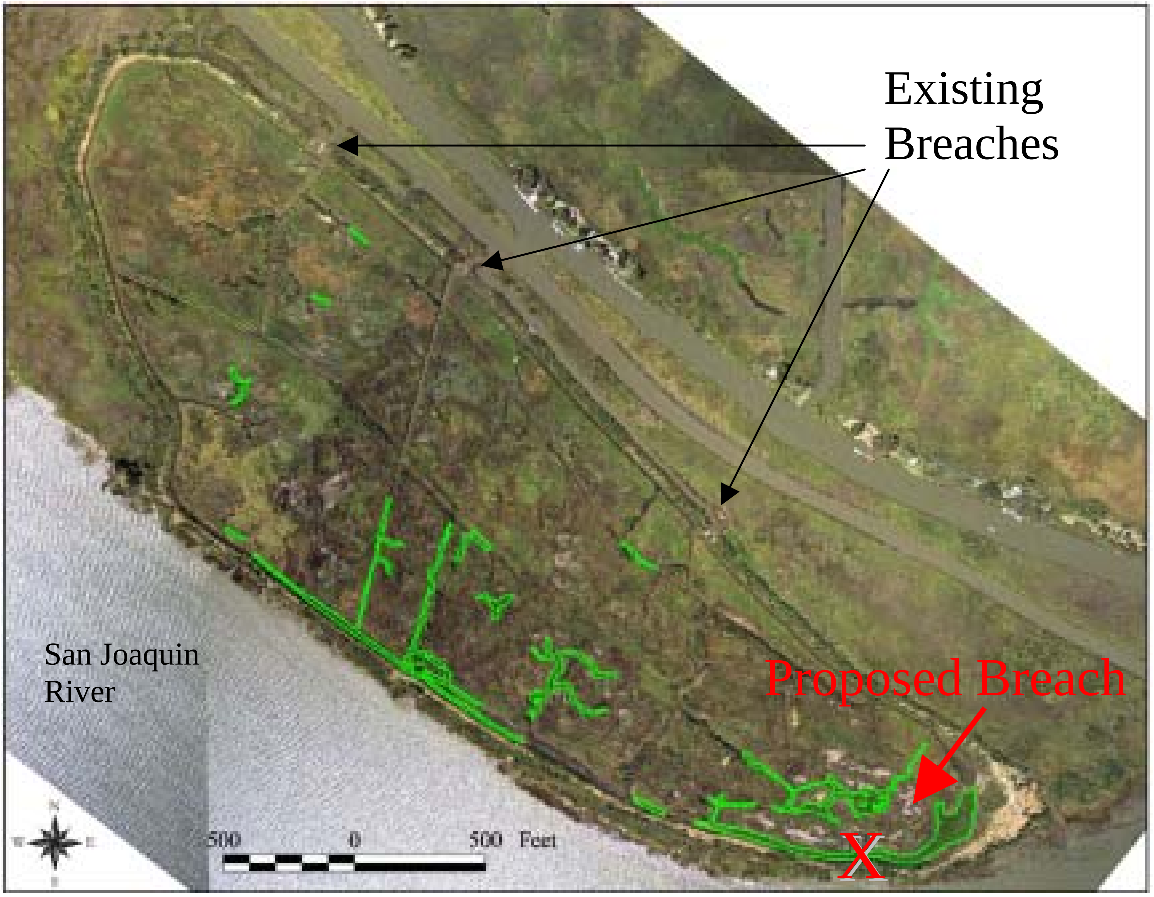



**Figure 9. Aerial photo of Kimball Island with three breaches located on a slough off the lower San Joaquin River - Fall 2003. Island channels have relative high tidal energy near these breaches and lower energy further from the breaches. Native fishes are more prevalent nearer the breaches, while non-natives dominate the interior channels further from the breaches. Water hyacinth (outlined in bright green) also is a problem further from the breaches, clogging channels and limiting fish use. Additional breaches on the river may increase interior channel circulation and reduce the extent of water hyacinth. The interior channels on**

Figure 10. Aerial photograph with superimposed design of Decker Island breached wetland project. The design is similar to Kimball Island project in that it has limited opening to the river and consider length of interior channels. Like Kimball the interior channels of Decker have become clogged with water hyacinth and where the fish community is dominated by non-native species.

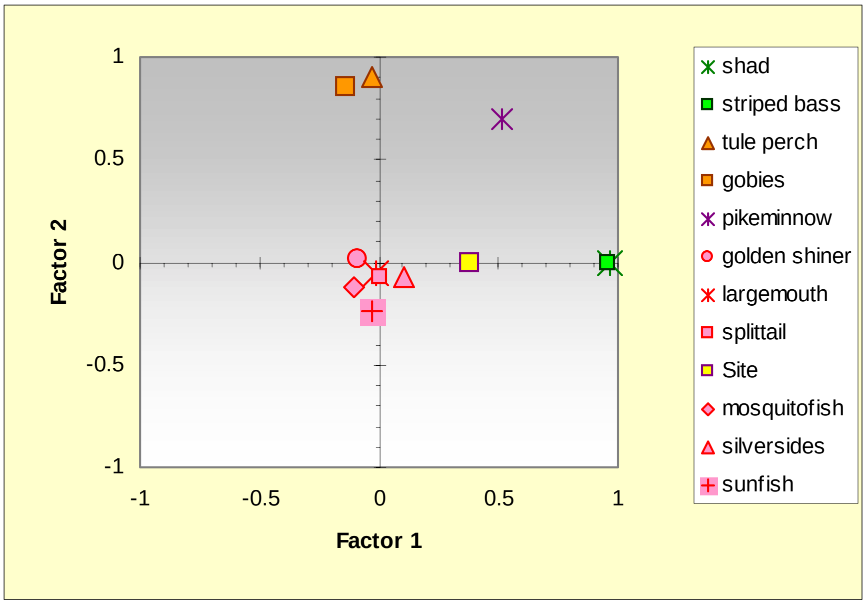



Figure 11. Multivariate analysis output for spring-summer beach seine sampling at Kimball Island 2003. Habitat factors separated species groups. Factor 1 was high energy river shoreline. Factor 2 was deep breach channels.

Figure 12.  Kimball Island breach where fyke and gillnets are employed.

Figure 13.  Kimball Island river shoreline beach sampling site with 50-ft seine.

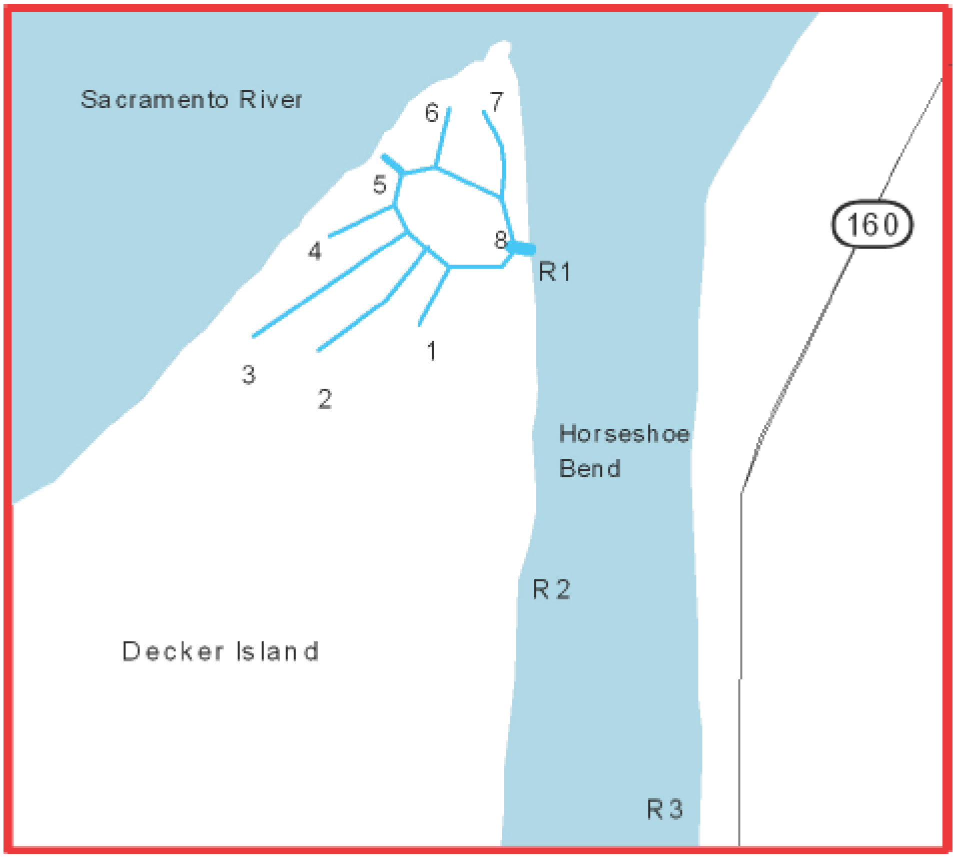



Figure 14. Decker Island sampling areas within the restoration area (stations 1-8) and at adjacent reference areas in Horseshoe Bend.

Figure 15. Potential beach seine site on Decker Island at Horseshoe Bend.


Figure 16. Early stage planting on Decker Island interior tidal slough.

Figure 17. Potential sampling site in channel between old and new levee at Twitchell Island restoration site. All gear types could be employed at this site.

# Tasks And Deliverables

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

| Task ID | Task Name | Start Month | End Month | Deliverables |
|---|---|---|---|---|
| 1 | Project Management | 1 | 36 | encompasses all QAQC activities, database management, and quarterly and annual reporting. It also allows for the project manager to spend 40 hours per quarter in the field for QAQC and training puropses. |
| 2 | Development of Study Plan | 1 | 2 | A detailed study plan will be developed prior to commencing monitoring. Sampling protocols will be appended to the study plan. Analytical methods will also be prescribed. The Plan will include specific information about methods and techniques, equipment and facilities, data collection, variables to be measured including performance measures, statistical analysis and quality assurance procedures. Specifics as to how hypotheses will be test will be identified. |
| 3 | Survey Sampling | 2 | 36 | Sampling will be conducted quarterly for three years. |

# Comments

If you have comments about budget justification that do not fit elsewhere, enter them here.

# Budget Summary

## Project Totals

| Labor | Benefits | Travel | Supplies And Expendables | Services And Consultants | Equipment | Lands And Rights Of Way | Other Direct Costs | Direct Total | Indirect Costs | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **$117,800** | **$41,230** | **$19,038** | **$6,605** | **$187,308** | **$2,400** | **$0** | **$0** | **$374,381** | **$37,439** | **$411,820** |

Do you have cost share partners already identified?
**Yes.**

If yes, list partners and amount contributed by each:

**Wildlands and DFG each contribute $50,000 annually to the study of Kimball and Decker islands, respectively.**

Do you have potential cost share partners?
**Yes.**

If yes, list partners and amount contributed by each:

**DWR Delta Levees Program may contribute to this effort.**

Are you specifically seeking non−federal cost share funds through this solicitation?
**No.**

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

## Year 1 ( Months 1 To 12 )

| Task | Labor | Benefits | Travel | Supplies And Expendables | Services And Consultants | Equipment | Lands And Rights Of Way | Other Direct Costs | Direct Total | Indirect Costs | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1: project management (12 months) | 4000 | 1400 | 170 | 300 | 6000 | 0 | 0 | 0 | $11,870 | 1187 | $13,057 |
| 2: Development of Study Plan (2 months) | 2000 | 700 | 0 | 0 | 2700 | 0 | 0 | 0 | $5,400 | 540 | $5,940 |
| 3: Survey Sampling (11 months) | 34600 | 12110 | 6176 | 4550 | 59836 | 2400 | 0 | 0 | $119,672 | 11967 | $131,639 |
| **Totals** | **$40,600** | **$14,210** | **$6,346** | **$4,850** | **$68,536** | **$2,400** | **$0** | **$0** | **$136,942** | **$13,694** | **$150,636** |

## Year 2 ( Months 13 To 24 )

| Task | Labor | Benefits | Travel | Supplies And Expendables | Services And Consultants | Equipment | Lands And Rights Of Way | Other Direct Costs | Direct Total | Indirect Costs | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1: project management (12 months) | 4000 | 1400 | 170 | 300 | 6000 | 0 | 0 | 0 | $11,870 | 1187 | $13,057 |
| 3: Survey Sampling (12 months) | 34600 | 12110 | 6176 | 550 | 53386 | 0 | 0 | 0 | $106,822 | 10682 | $117,504 |
| **Totals** | **$38,600** | **$13,510** | **$6,346** | **$850** | **$59,386** | **$0** | **$0** | **$0** | **$118,692** | **$11,869** | **$130,561** |

# Year 3 ( Months 25 To 36 )

| Task | Labor | Benefits | Travel | Supplies And Expendables | Services And Consultants | Equipment | Lands And Rights Of Way | Other Direct Costs | Direct Total | Indirect Costs | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1: project management (12 months) | 4000 | 1400 | 170 | 300 | 6000 | 0 | 0 | 0 | $11,870 | 1187 | $13,057 |
| 3: Survey Sampling (12 months) | 34600 | 12110 | 6176 | 605 | 53386 | 0 | 0 | 0 | $106,877 | 10689 | $117,566 |
| **Totals** | **$38,600** | **$13,510** | **$6,346** | **$905** | **$59,386** | **$0** | **$0** | **$0** | **$118,747** | **$11,876** | **$130,623** |

# Budget Justification

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

## Labor

**The following outlines annual task by task summaries of estimated hours and associated rates for each task. Annual efforts for each task are the same for each year. Task 1 (project management) encompasses all QAQC activities, database management, and quarterly and annual reporting. It also allows for the project manager attend key meetings with stakeholder groups.**

**Task 2 (Development of Study Design) will last two months. The project manager will work closely with stakeholders, agency representatives, and the subcontractor to develop a clear, hypothesis driven study design. This task will take 40 hours.**

**Task 3 (Survey Sampling) will be conducted for two week every quarter for a total of 40 days per year. As the survey locations are remote, survey crews will work 10 hours per day to complete the project objectives for a total of 400 hours per year.**

**Year 1**

**Task 1(project management) Project manager 50hr−80hours**

**Task 2(Development of Study Design) Project manager 50/hr−40 hours**

**Task 3(Survey Sampling) Project manager 50/hr−300 hours Senior Biologist 20/hr−400 hours Biologist 17/hr−400 hours Field Tech 1 12/hr−400 hours**

**Year 2**

**Task 1(project management) Project manager 50hr−80hours**

**Task 3(Survey Sampling) Project manager 50/hr–300 hours Senior Biologist 20/hr–400 hours Biologist 17/hr–400 hours Field Tech 1 12/hr–400 hours**

**Year 3**

**Task 1(project management) Project manager 50hr–80hours**

**Task 3(Survey Sampling) Project manager 50/hr–300 hours Senior Biologist 20/hr–400 hours Biologist 17/hr–400 hours Field Tech 1 12/hr–400 hours**

## Benefits

**Employee benefits are charged at 35% and cover Workers Compensation, Unemployment, Social Security, and disability insurance.**

## Travel

**FFC field techs and biologists will travel to the project sites from either Stockton, CA or Sacramento, CA. Distances required for this project have been established for all employees during past delta monitoring activities and were used in estimating total mileage by task. The current rate of $0.34/mile was used in calculating reimbursement totals.**

**Year 1**

**Task 1(Project management) 500 miles @$0.34/mile– $170**

**Task 3(Survey Sampling) 7680 miles @$0.34/mile– $2611 Boat rental: 40 days@$100/day $4,000**

**Year 2**

**Task 1(Project management) 500 miles @$0.34/mile– $170**

**Task 3(Survey Sampling) 7680 miles @$0.34/mile– $2611 Boat rental: 40 days@$100/day $4,000**

**Year 3**

**Task 1(Project management) 500 miles @$0.34/mile– $170**

**Task 3(Survey Sampling) 7680 miles @$0.34/mile– $2611 Boat rental: 40 days@$100/day $4,000**

## Supplies And Expendables

**Supplies and expendables include office supplies, document generation, and general field supplies such as field notebooks, rite in the rain paper, thermometers, beach seines, gill nets, light traps, water quality meter maintenance, waders, etc. The majority of these costs will be accrued in year 1. The amounts are based on expenses accrued during similar past monitoring activities. Rates are adjusted upward annually by 10% assuming an increase in costs.**

**Year 1**

**Task 1(project management) Office supplies, document production–$300**

**Task 3(survey sampling) General field supplies, beash seines, gillnets, light traps–$4550**

**Year 2**

**Task 1(project management) Office supplies, document production–$330**

**Task 3(survey sampling) General field supplies –$550**

**Year 3**

**Task 1(project management) Office supplies, document production–$363**

**Task 3(survey sampling) General field supplies –$605**

## Services And Consultants

**The following outlines annual task by task summaries of estimated hours and associated rates for each task for Chris Kitting of California State University Hayward and his field crews. Dr Kitting via California State University Hayward will be a sub−contractor to the FFC in this cooperative effort. Travel, miscellaneous office and field supplies, and equipment for Dr Kitting and his survey crews are included in the total sub−contracor cost. Annual efforts for each task are the same for each year.**

**Task 1 (project management) encompasses all of his efforts in QAQC activities, database management, and quarterly and annual reporting. It also allows for the project manager attend key meetings with stakeholder groups.**

**Task 2 (Development of Study Design) will last two months. Dr.Kitting will work closely with stakeholders, agency representatives in unison with the FFC to develop a clear, hypothesis driven study design. This task will take 40 hours.**

**Task 3 (Survey Sampling) will be conducted for two week every quarter for a total of 40 days per year. As the survey locations are remote, Dr Kitting and his survey crews will work 10 hours per day to complete the project objectives for a total of 400 hours per year.**

**Year 1**

**Task 1(project management) Project manager 75hr−80hours**

**Task 2(Development of Study Design) Project manager 75/hr−40 hours**

**Task 3(Survey Sampling) Project manager 75/hr−300 hours Senior Biologist 30/hr−400 hours Biologist 25.5/hr−400 hours Field Tech 1 18/hr−400 hours**

**Year 2**

**Task 1(project management) Project manager 75hr−80hours**

**Task 3(Survey Sampling) Project manager 75/hr−300 hours Senior Biologist 30/hr−400 hours Biologist 25.5/hr−400 hours Field Tech 1 18/hr−400 hours**

**Year 3**

**Task 1(project management) Project manager 75hr−80hours**

**Task 3(Survey Sampling) Project manager 75/hr−300 hours Senior Biologist 30/hr−400 hours Biologist 25.5/hr−400 hours Field Tech 1 18/hr−400 hours**

## Equipment

**Two fyke nets will be purchased at a cost of $1,200 per unit.**

## Lands And Rights Of Way

**none**

## Other Direct Costs

**none**

## Indirect Costs/Overhead

**The Indrect cost rate is 10% and includes costs associated with general office requirements such as rent, phones, computors, furniture, and office staff.**

## Comments

# Environmental Compliance

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

## CEQA Compliance

Which type of CEQA documentation do you anticipate?
**X** none
**−** negative declaration or mitigated negative declaration
**−** EIR
**−** categorical exemption

If you are using a categorical exemption, choose all of the applicable classes below.
**−** Class 1. Operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The types of "existing facilities" itemized above are not intended to be all−inclusive of the types of projects which might fall within Class 1. The key consideration is whether the project involves negligible or no expansion of an existing use.
**−** Class 2. Replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.
**−** Class 3. Construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
**−** Class 4. Minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
**−** Class 6. Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies. These may be strictly for information

gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.
– Class 11. Construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

Identify the lead agency.

Is the CEQA environmental impact assessment complete?

If the CEQA environmental impact assessment process is complete, provide the following information about the resulting document.

**Document Name**

**State Clearinghouse Number**

If the CEQA environmental impact assessment process is not complete, describe the plan for completing draft and/or final CEQA documents.

# NEPA Compliance

Which type of NEPA documentation do you anticipate?
**X** none
– environmental assessment/FONSI
– EIS
– categorical exclusion

Identify the lead agency or agencies.

If the NEPA environmental impact assessment process is complete, provide the name of the resulting document.

If the NEPA environmental impact assessment process is not complete, describe the plan for completing draft and/or final NEPA documents.

Successful applicants must tier their project's permitting from the CALFED Record of Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

| **Local Permits And Approvals** | **Required?** | **Obtained?** | **Permit Number (If Applicable)** |
|---|---|---|---|
| **conditional Use Permit** | – | – | |
| **variance** | – | – | |
| **Subdivision Map Act** | – | – | |
| **grading Permit** | – | – | |
| **general Plan Amendment** | – | – | |
| **specific Plan Approval** | – | – | |
| **rezone** | – | – | |
| **Williamson Act Contract Cancellation** | – | – | |
| **other** | – | – | |

| **State Permits And Approvals** | **Required?** | **Obtained?** | **Permit Number (If Applicable)** |
|---|---|---|---|
| **scientific Collecting Permit** | – | X | 801102–02 |
| **CESA Compliance: 2081** | – | – | |
| **CESA Complance: NCCP** | – | – | |
| **1602** | – | – | |
| **CWA 401 Certification** | – | – | |
| **Bay Conservation And Development Commission Permit** | – | – | |
| **reclamation Board Approval** | – | – | |
| **Delta Protection Commission Notification** | – | – | |
| **state Lands Commission Lease Or Permit** | – | – | |

| | | | |
|---|---|---|---|
| action Specific Implementation Plan | – | – | |
| other | – | – | |

| Federal Permits And Approvals | Required? | Obtained? | Permit Number (If Applicable) |
|---|---|---|---|
| ESA Compliance Section 7 Consultation | – | – | |
| ESA Compliance Section 10 Permit | – | – | |
| Rivers And Harbors Act | – | – | |
| CWA 404 | – | – | |
| other | – | – | |

| Permission To Access Property | Required? | Obtained? | Permit Number (If Applicable) |
|---|---|---|---|
| permission To Access City, County Or Other Local Agency Land<br>Agency Name<br><br>California Department Of Water Resources | – | X | |
| permission To Access State Land<br>Agency Name | – | – | |
| permission To Access Federal Land<br>Agency Name | – | – | |
| permission To Access Private Land<br>Landowner Name<br><br>Wildlands Inc | – | X | |

If you have comments about any of these questions, enter them here.

**Both entities are active participants in the monitoring activities.**

# Land Use

*Monitoring Study of Western Delta Aquatic Habitat Restoration Sites including Twitchell Island Restoration Site – K250/1997*

Does the project involve land acquisition, either in fee or through easements, to secure sites for monitoring?
**X** No.
**–** Yes.

How many acres will be acquired by fee?

How many acres will be acquired by easement?

Describe the entity or organization that will manage the property and provide operations and maintenance services.

Is there an existing plan describing how the land and water will be managed?
**X** No.
**–** Yes.

Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?
**X** No.
**–** Yes.

Describe briefly the provisions made to secure this access.

Do the actions in the proposal involve physical changes in the current land use?
**X** No.
**–** Yes.

Describe the current zoning, including the zoning designation and the principal permitted uses permitted in the zone.

Describe the general plan land use element designation, including the purpose and uses allowed in the designation.

Describe relevant provisions in other general plan elements affecting the site, if any.

Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?

**X** No.

**−** Yes.

| Land Designation | Acres | Currently In Production? |
|---|---|---|
| **Prime Farmland** | | − |
| **Farmland Of Statewide Importance** | | − |
| **Unique Farmland** | | − |
| **Farmland Of Local Importance** | | − |

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?

**X** No.

**−** Yes.

Is the land affected by the project currently under a Williamson Act contract?

**X** No.

**−** Yes.

Why is the land use proposed consistent with the contract's terms?

Describe any additional comments you have about the projects land use.