

Bolsa Chica Lowland Restoration Project

Biological Monitoring and Followup Plan

Fish and Wildlife Service
November 2001





INTRODUCTION

The Bolsa Chica restoration project is similar in type (tidal restoration) and dimension to the Batiquitos Lagoon restoration which was completed in 1996 and has an ongoing 10-year biological monitoring program. Biological monitoring at Bolsa Chica will be conducted in a manner similar, but not identical, to the Batiquitos Lagoon monitoring. The Bolsa Chica monitoring plan has dropped some sampling methods and reduced the number of sampling locations based upon an evaluation of the results of the Batiquitos Lagoon monitoring and the reduced physical complexity of the Bolsa Chica restoration area when compared to Batiquitos Lagoon.

The purpose of the Bolsa Chica wetlands long-term ecological monitoring program is to document the habitat improvements for fish and wildlife, the success of revegetation efforts, and the use of the site by endangered species. In addition, there are several specific monitoring programs to insure that the restoration is built according to the approved plans, the inlet is properly maintained, that constructed nesting areas have adequate maintenance, that any impacts to sensitive plant species are offset, and that construction impacts to Belding's savannah sparrow are minimized.

The ecological monitoring objectives are:

- Facilitate evaluation of the effectiveness of the restoration to provide habitat for fish and wildlife;
- Document changes in the ecology of the wetlands environment over time;
- Provide timely identification of any problems with the physical, or biological development of the restored area;
- Assist in providing a technical basis for resource management of the restored wetland by documenting maintenance needs and enhancement opportunities.

Some parts of this plan may be subject to a Request for Proposal process for consultant services with a negotiated contract and scope of work to be established following completion of construction. However, the agency which assumes long-term management and maintenance responsibility may elect to implement this plan employing its own experts and institutional expertise. The Batiquitos Lagoon plan was approved by the California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers (COE), Environmental Protection Agency (EPA) and California Coastal Commission (CCC). This Bolsa Chica monitoring program, which has the concurrence of the above Bolsa Chica Lowland Restoration Project Steering Committee agencies, is provided to CCC as part of our project proposal in support of our commitment to the public to execute the best possible restoration project.

The program will emphasize monitoring the biological elements of the lagoon. Some physical elements will be monitored to provide supporting information for the biological assessments. Sampling programs are designed to document the condition of vegetation, benthos, fish, birds, and special status species as well as the state of the physical environment on which they depend.

Biological monitoring will be conducted during the 2nd, 5th, and 10th years after completion of construction. Listed species will be monitored each year. Biological sampling will be conducted at fixed intervals as specified in this program. The reasons for the various sampling frequencies are explained in the discussions of individual program elements.

Sampling along permanent transects established at strategic locations will support multiple monitoring elements. To the extent possible, physical and biological variables will be measured at the same general location in order to suggest causal relationships among the variables. The information will be summarized in an annual report prepared by the responsible agency for the regulatory agencies (COE and CCC), as well as the other proponent agencies (NMFS, CDFG, SLC, Coastal Conservancy, USFWS, and EPA).

This monitoring program was prepared in consultation with state and federal regulatory agencies responsible for maintaining, protecting, and enhancing natural resources (CDFG, NMFS, and USFWS). The program is consistent with agency guidelines for environmental monitoring..

ECOLOGICAL MONITORING

WATER QUALITY

The water quality in Bolsa Chica full tidal basin will influence the timing and course of biological developments after project construction (e.g., plant colonization,, fish utilization, benthic colonization). Data on water quality will be taken quarterly at the two locations sampled for benthos and fish. Sampling will be conducted during the same period as fish sampling. If poor water quality conditions are noted, more intensive sampling may be employed to determine the extent and duration of these conditions.

Dissolved oxygen, temperature, chlorophyll a, and conductivity will be measured with a Hydrolab Surveyor, or equivalent, and turbidity will be recorded with a Seatech transmissometer, or equivalent. At each site, measurements will be made at the surface, mid-depth, and near bottom in the channel and also at surface and near bottom over the shallow subtidal during high tide and low tide to characterize the environmental extremes of the lagoon.

The results of quarterly water quality surveys will be summarized and presented in a form that allows comparisons of locations and over time. The results can also be used in multivariate correlations of environmental conditions with biological parameters.

SOILS

Soil and sediment conditions in the lagoon might be changed in the course of dredging and by the influence of tidal flushing. A knowledge of soil conditions will help determine which factors might be controlling plant community diversity and productivity and which types of plant communities are likely to develop in the future.

Soil (sediment) samples will be taken at the time of vegetative sampling along each of the three vegetation transects within the elevational range where vegetation is expected to colonize. Within the elevational ranges for different expected floral assemblages along the transect, three randomly selected locations will be sampled. Soil texture and organic content samples will be collected with a near-surface coring device of at least 100 gram capacity. Salinity/conductivity and pH samples will be taken at depths of 5 centimeters and 15 centimeters with a 12-cubic centimeter syringe that is open at the distal end. These are routine sampling procedures used in contemporary studies of West Coast wetlands. The analyses of soil texture, organic content, salinity/conductivity, and pH will be conducted by using standard laboratory (ASTM) procedures.

VEGETATION

The composition and extent of vegetation will be documented by transect sampling and aerial photography. Aerial photography will record wide-scale patterns of plant community distribution. Transect sampling will provide data on species composition with elevation and on cover of plant communities. Over time, these combined techniques should reveal the pattern of lagoon revegetation following construction.

A minimum of three replicate permanent transects will be established in each of habitats (cordgrass, Rabbit Island intertidal, muted tidal pickleweed, and full tidal pickleweed) and will span the elevational range encompassing the possible growth of marsh plants (3.5 feet MLLW to extreme high tide level). Elevations along the transects will be surveyed during the first year (to ± 0.1 foot) and referenced to a local benchmark. Each transect will be designated with poles located along its length. The transects will be located in areas that represent zones where coastal salt marsh vegetation is expected to respond to the predicted tidal regime.

Before and during construction, two vegetation transects in the proposed muted tidal area will also be examined twice, during spring and early summer, for the purpose of documenting the interim water management measures there. The interim water management in the muted tidal area will be conducted to assure that Belding's savannah sparrows that may be displaced from the tidal basin during construction will have optimal nesting conditions in the muted tidal area, but before the muted tidal influence is functioning. This sampling will start with the first breeding season following final approval of the project plan (e.g. spring of 2002). Soil saturation, measures of pickleweed growth, other plant species will be determined along these transects.

Species composition and percent cover will be determined by the point-intercept method using a sample quadrat of appropriate area. A stratified random sampling design will be used. Within uniform intervals along each transect, replicate samples will be taken at randomly determined points within 5 meters on either side of the transect. The intercept frame will be placed on the ground, and plants hit by pins in the frame (or equivalent points) will be identified to species. The sampling area will also be photographed with the frame in place to provide a permanent record. Within appropriate habitats, height measurements will also be taken of a random sample of *Spartina* and *Salicornia* plants. In addition, all plant species present within a 1-meter swath on either side of the transect will be recorded.

Reintroduction of eelgrass, *Zostera marina*, and cordgrass, *Spartina foliosa*, into the completed full tidal basin will occur, in order to begin establishment of these high habitat value coastal wetland species. The intended reintroduction method for cordgrass would be that successfully employed by the Corps of Engineers at Newport Slough. For eelgrass, the method used for eelgrass reintroduction at Batiquitos Lagoon or Talbert Marsh would be used at Bolsa Chica. Additional, more frequent monitoring of pilot planting areas for cordgrass and eelgrass following planting will occur. The contractor responsible for the revegetation component of the enhancement effort will have responsibility for meeting survival criteria for one year following transplantation. The long-term monitoring program will determine, document, and report on the location and size of the stands of these reintroduced plants. At representative locations, vegetative cover will be estimated for both species and turion density will be estimated for eelgrass. These surveys, as well as the fish sampling, would also aid in the early detection of highly undesirable, aquatic, invasive species, such as *Caulerpa taxifolia*, the notorious “killer algae”.

The establishment of new acreage of coastal salt marsh will be determined in the aerial photographic analysis. Aerial photographs will be taken during each monitoring year during early summer (May and June). This is when wetland habitat can best be delineated because it remains green while upland vegetation has begun to senesce and turn brown. The photographs will be taken at as low a tide as possible given a high sun angle. False-color infrared photographs will be produced at a scale of 1:4800. Aerial photography will be done at the same time as transect sampling so that transect data can provide ground truth.

Based on the aerial photograph, a vegetation map will be prepared at 1:300 scale. The map will cover all vegetated areas within the full tidal basin. Vegetative communities will be mapped using the Holland classification system developed by the CDFG. Acreage of each habitat type will be determined.

Other observations that will be recorded during the yearly survey include:

- Invasion by any non-native species considered to be nuisance or pest species such as giant reed or pampas grass;
- Die-offs of native vegetative communities that might be attributed to disease, anomalous oceanographic conditions, or insect damage;
- Shifts in species abundance, such as replacement of coastal salt marsh by freshwater

- species or the presence of new species such as increases in cordgrass or eelgrass;
- General growth and expansion patterns in the vegetative transplant areas.

FISH

A variety of sampling methods will be used to determine the abundance and composition of burrowing, demersal, and pelagic fish assemblages in the lagoon. The approach is based on agency-approved monitoring programs for wetlands enhancement projects at Upper Newport Bay, Anaheim Bay, and Batiquitos Lagoon.

Fish will be sampled quarterly at high tide during specified monitoring years at two sites in the Bolsa Chica full tidal basin. Samples will be collected from slope and subtidal areas at opposite ends of the tidal basin by using otter trawls, or bag seines, as appropriate, and enclosures in the muted tidal area. Other sampling methods, such as gill nets may be employed during the monitoring, as needed, to document specific subgroups of lagoon fish. The sampling locations will be selected after construction plans are final, but they are expected to be near two of the benthos sampling sites discussed below. Sampling will begin one year after completion of construction (beginning of year 2) to characterize post-construction conditions. The fish surveys will be conducted between mid- and high tide during daylight hours.

Demersal fish, including juvenile California halibut, will be collected by otter trawl. A 3.8-meter otter trawl with 2.0-centimeter mesh in the wings and 0.8-centimeter mesh in the cod end will be towed by a small boat along the mid-channel area at each station. Two replicate 5-minute otter trawls will be made during each survey. Differential GPS will be used to measure the length of the trawl area so that catch densities can be calculated.

A bag seine (15.2 meters x 1.8 meters with 0.3-centimeter mesh net in the bag and 0.6-centimeter mesh in the wings) will be used to capture large and small demersal and pelagic fish. This device is particularly effective for sampling nearshore schooling fish (the type the California least tern feeds on). Two replicate hauls covering approximately 220 m² each would be made at each station. The bag seine will be set parallel to shore at a depth of 1.8 meters and hauled to shore by hand or winch.

A square enclosure (1 meter x 1 meter x 1 meter) will be used to sample burrow-inhabiting fishes, especially gobies, in the muted tidal area. The square enclosure is made of heavy duck material fastened to a frame of 2.5-centimeter PVC pipe. The enclosure is set on the bottom in 1 meter of water at three randomly chosen positions at each station and spiked with rotenone or quinaldine to kill or immobilize the fish. Fish are collected from the interior of the enclosure by thorough search for 10 minutes with a 1 millimeter mesh, long-handled dip net.

A gill net may be used to catch large, fast-moving pelagic fish. At each station, a mixed-panel monofilament gill net would be placed in the channel perpendicular to the axis of tidal flow for one hour. The monofilament gill net would be 45.6 meters x 2.4 meters with six panels (two

panels with 1.3- to 2.5-centimeter mesh, two panels with 2.5- to 5.1-centimeter mesh, and two panels with 6.4 to 7.6-centimeter mesh). Because gill nets could also capture diving ducks and other waterfowl, use of this fish-sampling method would be kept to a minimum and attended while in place.

Samples will be processed in the field to the extent possible. All fish (or subsamples of large catches) will be counted, measured, and weighed, then returned, if alive, to the water unless identification to species is not possible. Subsampling, when necessary, will follow standard procedures for each sampling technique. Fish samples not measured in the field will be preserved in 10 percent formalin and returned to a laboratory for analysis.

The fish catches will be expressed as fish per square meter for trawl and seine results. Parametric statistics will be used to summarize abundance, size, and biomass of fish populations and to describe differences over time. The establishment and recovery of the fish community will be well described and quantified and will be comparable to the similar work done at other completed restoration projects, such as Anaheim Bay and Batiquitos Lagoon.

BENTHOS

The objective of benthos monitoring is to characterize the marine invertebrate food resources for birds and for fish, including those of recreational or commercial importance (e.g. California halibut). The results will also provide an index of general habitat quality.

Benthic invertebrates will be sampled twice each year, in December/January and June/July. This schedule will encompass the extremes of seasonal variation for benthic communities and will document food availability for winter migrating birds and summer fish communities. Benthic samples will be taken near the two locations sampled for fish (one near the inlet end of the tidal basin, one in the north or closed end of the tidal basin) and at one nearby vegetated area at the closed end of the tidal basin. The benthic survey will be conducted during low tide to facilitate collection of intertidal and subtidal samples.

Infaunal samples will be collected with a hand-operated corer 15 centimeters in diameter by 10 centimeters deep (approximately 1.5-liter volume). At each station, three core samples will be collected in the intertidal zone (approximately 2 to 4 feet MLLW), and an equal number will be collected in the subtidal zone (below -1.6 feet MLLW). Cores will be collected within 10 meters of the designated sampling station. A random number table will be used to select the six locations (direction and then distance along the radius) for core samples within each tidal zone. In order to reduce within-zone variability, each sample may be a composite of several cores. A subsample (100-gram capacity) will be taken from each core or composite and washed through a 0.5-millimeter screen. The remaining portion of each sample will be washed through a 1.0-millimeter screen. Both portions will be preserved in seawater-formalin for subsequent taxonomic and biomass analysis.

Macrobenthic organisms living on the sediment surface (for example, the California hornsnail *Cerithidea californica* and grapsid crabs) are not effectively sampled by cores. Relatively sedentary epifauna will be censused visually by counting animals within randomly-placed quadrats. Six replicate quadrats will be censused at each station. The size of the quadrat will be appropriate to the abundances of the species present. The more motile epifauna will be counted in belt transects. Representative subsamples of epifauna in the quadrats will be collected for biomass determination.

Infauna retained by the 1.0-millimeter screen will be sorted into major faunal groups (crustacea, polychaetes, oligochaetes, molluscs, echinoderms, insects, and others) and weighed to determine wet-weight biomass. This level of taxonomic discrimination is sufficient to establish the food resource for birds and bottom-feeding fish. The total food resource represented by infauna in each basin will be calculated on the basis of the densities in the core samples. The subsample of organisms retained by the 0.5-millimeter screen will also be identified and weighed to establish the proportion of infaunal biomass made up by smaller organisms. All samples will be archived, however, and will be available for more detailed evaluation in the future. Epifaunal invertebrates will be identified to species, and their abundance will be expressed as estimated number per square meter. Parametric statistics will be used to summarize the abundance and biomass of major infaunal groups and to describe differences over time. The establishment and recovery of the benthic invertebrate community would be well described and quantified and be comparable to the similar work done at other completed restoration projects, such as Anaheim Bay and Batiquitos Lagoon.

BIRDS

Counts of all birds throughout the Bolsa Chica lowland will be conducted monthly throughout each monitoring year. The survey will involve systematic coverage of the lowland during daylight hours. As a way of partitioning the data base into manageable units, previous surveys divided Bolsa Chica into study subareas (Cell numbers). Surveying the study areas standardizes the coverage and allows for direct comparisons of avifauna within each study area on each survey date. This same procedure will be followed in the long-term monitoring program to ensure compatibility of data, with appropriate modification of the cell numbering system where cell features have been removed by construction of the tidal basin. In addition, each study area will be divided into habitat types. These types will correspond to the habitat types described in this Final EIR/EIS and those used in the vegetation mapping.

The avifauna of the wetland system will be counted over a tidal cycle during each observational period. Several surveyors, experienced ornithologists equipped with spotting scopes, binoculars, field guides, and data entry forms, will systematically survey the study areas. All birds seen or heard will be counted, and the activity (feeding, resting, flying, courting) will be recorded along with the habitat being used. Wind speed and cloud cover will be noted periodically during the survey (surveys will be canceled if wind speed exceeds approximately 10 knots because the effect of strong wind on bird behavior would make the resultant data not comparable with the

other surveys). Each observational period will be conducted over a tidal cycle (or approximately 6 hours) and will be conducted from low to high tide. During the survey, staff gauge readings will be recorded at hourly intervals to relate to habitat distribution.

The data from each survey will be used to describe the composition of the bird community by habitat and through time. Each year of data will be compared with other years and with data from other coastal wetlands, as available. Avifaunal abundance will be summarized by habitat type, activity patterns will be described, and use of the Bolsa Chica wetlands by key groups of birds (herons/egrets, raptors, dabbling ducks, shorebirds, grebes and diving ducks; and gulls, terns, and skimmers) will be discussed.

Data analysis will evaluate differences in population density among habitats in the lagoon, between Bolsa Chica and other coastal wetlands, and at Bolsa Chica over time. The comparisons will be supported by basic parametric techniques such as t-tests.

SPECIES OF SPECIAL CONCERN

Biological monitoring for nesting listed Threatened or Endangered species will be conducted annually, not just during years 2, 5, and 10. The monitoring method will be the same as has been developed for each species pursuant to a statewide monitoring program or the same method as has been conducted at Bolsa Chica for several years pre-project. The purpose of this monitoring is primarily to assess reproductive success and/or problems, and to determine the adequacy or need for management actions.

The special-status species in Batiquitos Lagoon that will be monitored each year are the Federal and State listed Endangered California least tern (*Sterna antillarum browni*) and light-footed clapper rail (*Rallus longirostris levipes*), Federal Threatened western snowy plover (*Charadrius alexandrinus nivosus*), and the State Endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*). These listed species will receive special attention because they have long histories of breeding at Bolsa Chica or, as in the case of the clapper rail, are expected to eventually breed there. The breeding conditions for the least tern at Bolsa Chica will be improved by the large expansion of nesting sites, since they are currently crowded by larger, denser nesting birds, such as Caspian tern, elegant tern, and black skimmer, on the small existing islands. The constructed nesting areas will also benefit western snowy plover as they can use similar nesting areas as the least tern, and these nesting areas will be available even in severely wet years when the unvegetated flats of the seasonal pond area are under water. Reintroduction of tidal conditions for cordgrass will eventually create breeding conditions for the highly endangered clapper rail.

A Statewide breeding census of the least tern has been conducted annually under the guidance of CDFG and USFWS. Least tern breeding site monitoring is somewhat standardized: nesting colony inspections of nests and tern breeding activity twice a week between middle April to late August, by a qualified permitted monitor. Additional observations may be made from a suitable distance outside the nesting colony to avoid disturbance. Other pertinent observations will also

be made (e.g., evidence of disturbance by humans, predators, other nesting birds). This census program, at a minimum, determines the breeding population at the site, number of nests, and number of fledglings, or breeding success, each year during and after project construction.

Monitoring of western snowy plover breeding activity at Bolsa Chica has been conducted by USFWS for 5 years pre-project in accordance with methods described in the reports. This survey method would continue during and after project construction. This survey method determines the snowy plover breeding population, number of nests, number of chicks and fledglings produced. Snowy plovers and least terns may nest together on the constructed nesting areas, as happened at Batiquitos Lagoon. Such nesting activity by least tern or snowy plover during construction will be protected from harm by maintaining an appropriate buffer between the nesting location and construction activity.

The clapper rail is not expected to breed at Bolsa Chica until the cordgrass reintroduction has been successful. However, its presence will still be sought in accordance with the annual census that has been conducted for many years.

Counts and observations of Belding's savannah sparrows will be completed each year during and post-project with the same methods as have been used at Bolsa Chica for many years. Field observations will concentrate on high coastal salt marsh pickleweed communities. A walk-through survey will be conducted annually between early April through July. Singing males, resting females, and other evidence of breeding or breeding territories will be mapped. Other pertinent observations will also be recorded.

PERFORMANCE MONITORING

“Built-to-Plan Monitoring”

The restoration plan for Bolsa Chica calls for dredging to create a subtidal area (about 175 acres) within a larger tidal basin (360 acres) and construction of nesting areas, reintroduction of eelgrass, cordgrass. Existing low-lying habitats will be restored to tidal action by creation of a new ocean inlet and a large tidal prism (converting seasonal flats and nontidal pickleweed into about 172 acres of intertidal mudflats and salt marsh habitats). Therefore, the post-project “built-to-plan” survey at the end of construction will be a bathymetry survey. The design criteria are the performance standards. The tidal basin bottom will be surveyed following construction to verify that design criteria (e.g., channel dimensions, side slopes, nesting site locations) have been achieved. This survey will be conducted by an independent contractor (not the construction contractor) under the guidance of the responsible agency. If the performance standards are not met the construction contractor will be responsible for remediation in order to meet those standards.

INLET MONITORING

Bathymetry

The results of this survey will describe starting-point conditions. Changes in bathymetry inside the inlet, in the area of the flood shoal formation, can detrimentally influence the performance of the habitat restoration. (Flood shoal enlargement can mute the low end of the tidal range such that intertidal mudflat or low elevation salt marsh habitats are eliminated.) The information gathered is intended to be sufficient to detect the onset of significant alteration of the tidal regime in the basin and the concomitant need for maintenance dredging. The bathymetric monitoring during the first 10 years is designed to evaluate the predicted maintenance dredging schedules.

Absolute horizontal and vertical elevations will be established to accuracies of ± 0.1 foot referenced to U.S. Coast and Geodetic survey marker controls or other agency controls that will be referred back to the U.S. Coast and Geodetic survey markers. All work will be performed in accordance with professional hydrographic survey and profiling practices. Subsequent, long-term bathymetric monitoring may be conducted on a schedule that reflects the likelihood of significant bathymetric change in the flood shoal management area.

For the flood shoal area, bathymetric monitoring will be conducted twice annually in years 1, 2, and 3, and once each during years 5 and 10. Because the consequences of inlet stricture or closure can have significant effects on the habitat in the lagoon, this monitoring schedule is intensive just after lagoon construction to provide an assessment of flood delta formation rates. The surveys will be conducted from a small boat equipped with a survey-quality fathometer and a positioning system, or by wading surveys at low tide, or by using a combination of both, or by other techniques that will provide the vertical and horizontal accuracy required.

Profile plots will be produced for each survey. Cross sectional plots of flood shoal profiles from each survey will be compared to the post-construction bathymetry map.

Tidal Monitoring

Information on water levels in the lagoon will be used in conjunction with bathymetric data to evaluate and to make management decisions such as the need for maintenance dredging. The tidal monitoring will be conducted continuously in years 1 through 3 and during years 5 and 10. Water levels will be recorded by tide gauges located in the flood shoal maintenance area. The gauges will be placed away from the inlet channel to provide representative measurements. Tide gauges will be left in place to cover neap, mean, and spring tidal conditions and determine seasonal variations and affect of specific storm events.

Tidal curves will be generated from tide gauge data for each survey, and the information will be summarized for each period. Water level variations over time will be correlated with bathymetric data to correlate with desired habitat acreage and to determine if the tidal ebb and flow is impeded or inlet blockage is indicated. A tidal muting of the average low tide elevations

(Mean Low Water) in the order of 0.5 feet would indicate that the flood shoal maintenance dredging was warranted.

MONITORING AND MAINTENANCE OF CONSTRUCTED NESTING AREAS

The three new constructed nesting areas (and the two existing small islands in the State Ecological Reserve) will require annual evaluation of the surfaces in order to determine whether they remain optimal for nesting snowy plovers and least terns. To provide a site attractive to nesting Least Terns, the site should be relatively free of vegetation prior to the breeding season. All nesting sites should be inspected in January. If vegetation coverage exceeds 5%, vegetation must be removed. The presence of some low profile native vegetation that provides cover for chicks is acceptable. The amount of effort required to remove vegetation will depend on the extent of coverage. Removal of excess vegetation would be carried out by scraping, dragging, hand weeding, and sometimes appropriate herbicides, before middle March, when plover nesting begins. Snowy plovers nest on the flats once the accumulated winter rainfall has evaporated or drained away. Management of water levels by pumping or water control culverts may be necessary in some years to assure that unvegetated flats are available for snowy plover nesting in the seasonal pond area of the lowland. Controlled access and regular maintenance of the security fences, to preclude the damaging influence of human trespass, but especially feral cats and dogs, are also essential.

During breeding season for these birds, regular surveillance for predation losses or other disturbances to these sensitive species is essential and will be conducted. Predator management (to guard against listed species breeding failure) has been conducted by USFWS and/or CDFG at Bolsa Chica for years, and will continue. At Bolsa Chica, the principle predators of the listed species, particularly terns and plovers, have been other birds, such as crows and American kestrel. Qualified predator management specialists will conduct appropriate predator removal activities in coordination with the site manager/monitor.

ENHANCEMENT OF BELDING'S SAVANNAH SPARROW HABITAT

The regular state-wide censusing of breeding Belding's savannah sparrow indicates that salt marsh areas with full or muted tidal influence, such as Mugu Lagoon, Anaheim Bay, Upper Newport Bay, Sweetwater Marsh, and Tijuana Slough support more breeding pairs than non-tidal salt marsh areas, such as Bolsa Chica. Also, while the pre-project data is weaker than the after-project data, Belding's savannah sparrow was apparently benefitted by the 1978 muted tidal restoration of Inner Bolsa Chica. At any rate, the restoration of muted tidal influence to the proposed muted tidal area of Bolsa Chica is intended to mimic the results obtained by the muted tidal restoration of Inner Bolsa Chica, invigorating the existing pickleweed and the associated salt marsh/aquatic community.

During the three years of project construction and, thus, before tidal influence could be restored, Belding's savannah sparrow would be incrementally and permanently displaced from parts of the construction areas of the tidal basin. It is probably that many of these birds will relocate to available suboptimal pickleweed habitats. However, in order to increase the likelihood that displaced breeding birds have a suitable place to which to relocate, interim water management will be conducted in the future muted tidal area.

Currently, during wet years, the oil company pumps water out of Bolsa Chica to maintain safe access to the operating oil wells. The primary goal of interim management of water levels in the future muted tidal area is to increase the value of nontidal pickleweed for Belding's savannah sparrow by mimicking Inner Bolsa Bay pickleweed habitats, but without actual tidal influence. Water level manipulation will be adjusted to create similar patterns of soil saturation and pickleweed habitat in the future muted tidal area. In order to control the water level within the future muted tidal area during this interim water management period, closure of selected culverts to prevent drainage from the cells may be necessary. Water management will consist of pumping or draining accumulated rainfall out of some cells if water levels are judged by the biologist to be too high. During dry periods, seawater will be pumped into these areas.

During construction, this water management would be conducted by the construction contractor, at the direction of the USFWS project manager and biologist. Once the construction is complete and the muted tidal area is connected to the tidal basin, the regular but muted ebb and flow of the tides will enhance this pickleweed dominated area for nesting Belding's savannah sparrow, and pumping would not be necessary.

The above mentioned vegetation transects within the proposed muted tidal area, observed during this interim water management period, along with the censusing of Belding's savannah sparrow breeding activity, will be used to help modulate the water management action to the best benefit of the bird. (Also, inadvertent creation of a mosquito production area would be avoided.) An adaptive management approach to interim water management is intended and this interim water management may begin as soon as final project approvals are obtained, to allow for some habitat improvements before construction must be initiated in the full tidal basin.

SENSITIVE PLANTS

Coastal woolyheads, *Nemacaulis denudata* var. *denudata*, a rare, annual, dune plant, continues to survive in a few tens of square feet on Rabbit Island and in remnant dunes next to the Pacific Coast Highway and the CDFG loop trail. USFWS surveyed the project area for this plant in 1997 and again in 2001. Nonnative iceplant now carpets much of Rabbit Island and has already excluded woolyheads from those areas which would become intertidal salt marsh after completion of the project. Without any action, woolyheads will have been completely eradicated from the project area by iceplant encroachment. Therefore, measures to enhance woolyheads within the project area should be viewed as enhancement, rather than mitigation. It is intended that iceplant will need to be removed from the higher elevations of Rabbit Island to restore

conditions appropriate for the reseeding of woolyheads. Seed collection from extant plants onsite and reintroduction to the sandy areas where iceplant has been removed is the expected method. Other methods, such as greenhouse cultivation and seed harvesting, would only be considered if necessary. Establishment of woolyheads in a native dune plant community on the non-tidal portion of Rabbit Island would enhance conditions for this rare plant. This effort would span several years and would be overseen by a qualified botanist.

INLET MAINTENANCE

Flood shoal maintenance dredging is essential to maintaining the habitat distribution of the restored tidal basin. If the flood shoal were allowed to enlarge to the point where the inlet ceased to function, the tidal habitats within the tidal basin would become severely degraded, because the moderating and invigorating influence of the ocean waters would be curtailed. In the extreme, anoxic conditions (oxygen depletion and overheating) could cause the death of most aquatic organisms trapped inside a closed tidal basin. The restored wetland must not be allowed to close. Sand accumulation in the flood shoal can begin to mute the full tidal range before there is the threat of closure.

The tidal hydraulic modeling done during preliminary engineering indicates that flood shoal maintenance dredging would occur approximately every two years and is a necessary aspect of maintaining the flow of sand along the beach outside the inlet. Using the flood shoal bathymetric and tidal monitoring results will allow an adaptive management of the flood shoal dredging. Thus, the flood shoal may be dredged in order to place the sand out on a section of beach that the beach monitoring indicates is in need of the sand. The flood shoal may be dredged if the tidal regime inside the tidal basin becomes significantly impaired. If neither of these “triggers” is applicable, the flood shoal maintenance dredging interval may be extended until one or the other of them does apply. A maintenance endowment (currently amounting to \$6.3 million) was established when the project began in 1997 and will be used to conduct the flood shoal maintenance dredging.