CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

Project Information

1. **Proposal Title:**

   CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

2. **Proposal applicants:**

   THOMAS LEEMAN, Environmental Science Associates
   JULES EVANS, PRIVATE CONSULTANT
   ERICH FISCHER, ENVIRONMENTAL SCIENCE ASSOCIATES
   NIALL McCARTEN, ENVIRONMENTAL SCIENCE ASSOCIATES
   CHRIS ROGERS, ENVIRONMENTAL SCIENCE ASSOCIATES
   BRIAN PITTMAN, ENVIRONMENTAL SCIENCE ASSOCIATES

3. **Corresponding Contact Person:**

   THOMAS LEEMAN
   ENVIRONMENTAL SCIENCE ASSOCIATES
   700 UNIVERSITY AVENUE, SUITE 130 SACRAMENTO, CA 95825
   916 564-4500
   tleeman@esassoc.com

4. **Project Keywords:**

   Endangered Species
   Habitat Restoration, Wetland
   Wildlife Ecology

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

At-Risk Species Assessments

8. **Type of applicant:**

   Private for profit

9. **Location - GIS coordinates:**

   Latitude: 38.127

   Longitude: -122.261

   Datum: NAD83

   Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

   1. MARE ISLAND MARSH, APPROXIMATELY 1 MILE WEST OF THE MOUTH OF THE NAPA RIVER. 2. WHITE SLOUGH, ON THE EASTERN SHORE OF THE NAPA RIVER, EXTENDING NORTH FROM THE HIGHWAY 37 BRIDGE OVER MARE ISLAND STRAIT. 3. COON ISLAND, APPROXIMATELY 9.5 MILES UPSTREAM FROM THE MOUTH OF THE NAPA RIVER.

10. **Location - Ecozone:**

    2.2 Napa River, 2.5 San Pablo Bay

11. **Location - County:**

    Napa, Solano

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    7th

15. **Location:**

    California State Senate District Number: 2

    California Assembly District Number: 7

16. **How many years of funding are you requesting?**

    3 years

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

       If no, list single overhead rate and total requested funds:

       Single Overhead Rate: 0%

       Total Requested Funds: $244,822

    b) Do you have cost share partners already identified?

       No

    c) Do you have potential cost share partners?

       No

    d) Are you specifically seeking non-federal cost share funds through this solicitation?

       No

       If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

    No

    Have you previously received funding from CALFED for other projects not listed above?

    No

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

    No

    Have you previously received funding from CVPIA for other projects not listed above?

    No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

    No

Please list suggested reviewers for your proposal. (optional)

JOY ALBERSTSON	**US FISH AND WILDLIFE SERVICE**	**916/414-6600**	**joy_albertson.fws.gov**
CARL WILCOX	**CA DEPARTMENT OF FISH AND GAME**	**707/944-5525**	**cwilcox@dfg.ca.gov**

21. **Comments:**

Environmental Compliance Checklist

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      THIS IS A RESEARCH PROJECT THAT DOES NOT MEET THE DEFINITION OF "PROJECT" UNDER CEQA OR NEPA.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

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

Scientific Collecting Permit Required

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land. Agency Name:	
Permission to access state land. Agency Name: CA DEPARTMENT OF FISH AND GAME	Required
Permission to access federal land. Agency Name: US NAVY	Required
Permission to access private land. Landowner Name:	

6. **Comments.**

Land Use Checklist

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   Yes

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   THIS IS A RESEARCH PROJECT ONLY.

4. **Comments.**

Conflict of Interest Checklist

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

THOMAS LEEMAN, Environmental Science Associates
JULES EVANS, PRIVATE CONSULTANT
ERICH FISCHER, ENVIRONMENTAL SCIENCE ASSOCIATES
NIALL McCARTEN, ENVIRONMENTAL SCIENCE ASSOCIATES
CHRIS ROGERS, ENVIRONMENTAL SCIENCE ASSOCIATES
BRIAN PITTMAN, ENVIRONMENTAL SCIENCE ASSOCIATES

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

JULES EVENS AVOCET RESEARCH

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

FRANK WERNETTE CALIFORNIA DEPARTMENT OF FISH AND GAME

LAURIE BRIDEN CALIFORNIA DEPARTMENT OF FISH AND GAME

JOHN GUSTAFSON CALIFORNIA DEPARTMENT OF FISH AND GAME

Comments:

Budget Summary

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	DEVELOP HABITAT SUITABILITY MODEL	548	42,180		2,550	4,250	22,218	1,500		72698.0		72698.00
		548	42180.00	0.00	2550.00	4250.00	22218.00	1500.00	0.00	72698.00	0.00	72698.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	DEVELOP HABITAT SUITABILITY MODEL	952	67,160		3,150	4,200	23,144	1,950		99604.0		99604.00
2	DETERMINE SPATIAL REQUIREMENTS	288	21,120			250		5,000		26370.0		26370.00
		1240	88280.00	0.00	3150.00	4450.00	23144.00	6950.00	0.00	125974.00	0.00	125974.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
2	DETERMINE SPATIAL REQUIREMENTS	312	23,040			500				23540.0		23540.00
3	EVALUATE RESTORATION PRIORITIES	280	21,360			1,250				22610.0		22610.00
		592	44400.00	0.00	0.00	1750.00	0.00	0.00	0.00	46150.00	0.00	46150.00

Grand Total=244822.00

Comments.

Budget Justification

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

Direct Labor Hours. Provide estimated hours proposed for each individual.

ENVIRONMENTAL SCIENCE ASSOCIATES: THOMAS LEEMAN: 700 ERICH FISCHER: 272 NIALL McCARTEN: 80 STAFF BOTANIST: 320 STAFF BIOLOGIST: 848 ADMINISTRATIVE STAFF: 128

Salary. Provide estimated rate of compensation proposed for each individual.

ENVIRONMENTAL SCIENCE ASSOCIATES: THOMAS LEEMAN: 85 ERICH FISCHER: 95 NIALL McCARTEN: 115 STAFF BOTANIST: 60 STAFF BIOLOGIST: 60 ADMINISTRATIVE STAFF: 65

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

BENEFITS ARE INCLUDED IN HOURLY RATES

Travel. Provide purpose and estimate costs for all non-local travel.

ALL TRAVEL COSTS WILL BE INCURRED DURING FIELDWORK, AND WILL RESULT FROM TRAVEL BETWEEN ENVIRONMENTAL SCIENCE ASSOCIATES (ESA's) REGIONAL OFFICES AND THE STUDY SITES. COSTS ARE ESTIMATED AT $150 PER DAY, AND WE ESTIMATE 38 TRIPS TO THE SITES.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

OFFICE: 4,200 LABORATORY: 750 COMPUTING: 3,500 FIELD: 2,000

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

CLAPPER RAIL SURVEYS AT $100/HR.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

NONE.

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

THOMAS LEEMAN WILL SPEND APPROXIMATELY 12 PERCENT OF HIS $59,500 BUDGET TO COORDINATE FIELD WORK WITH AVOCET RESEARCH AND ESA STAFF, ENSURE THAT SCHEDULES ARE MET AND TECHNICAL REPORTS ARE PRODUCED, REVIEWED, AND SUBMITTED. HE WILL BE RESPONSIBLE FOR COORDINATING WITH STATE AND FEDERAL AGENCIES AND ENSURING THAT ALL NECESSARY PERMITS ARE OBTAINED.

Other Direct Costs. Provide any other direct costs not already covered.

NONE.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

NOT APPLICABLE.

Executive Summary

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

THIS PROJECT WILL DEVELOP A HABITAT SUITABILITY MODEL BASED ON HABITAT AND LANDSCAPE RELATIONSHIPS OF THE CALIFORNIA CLAPPER RAIL (RALLUS LONGIROSTRIS OBSOLETUS) IN THE NORTH BAY REGION (INCLUDING SAN PABLO BAY AND SUISUN BAY). THIS MODEL IS MEANT TO ASSIST IN RESTORATION EFFORTS ACROSS THE NORTH BAY BY IDENTIFYING AREAS THAT ARE IMPORTANT FOR MAINTAINING CALIFORNIA CLAPPER RAIL BREEDING POPULATIONS. THE MODEL ALSO MAY BE USED TO TARGET AREAS WHERE SPECIES REINTRODUCTIONS WILL HAVE A HIGHER LIKELIHOOD FOR SUCCESS. BY MODELING HABITAT AT A LARGE SCALE, WE WILL TAKE THE FIRST STEP TOWARD DEVELOPING A REGIONAL MANAGEMENT PLAN FOR CALIFORNIA CLAPPER RAIL HABITAT RESTORATION. CONSEQUENTLY, THIS STUDY WILL PAVE THE WAY FOR A COMPREHENSIVE RECOVERY EFFORT. TO ACHIEVE THIS GOAL, WE WILL EXAMINE SEVERAL ENVIRONMENTAL AND LANDSCAPE FACTORS CONSIDERED SIGNIFICANT TO SPECIES CONSERVATION INCLUDING, BUT NOT LIMITED TO, VEGETATION PARAMETERS, CHANNELIZATION, SOIL AND SUBSTRATE PHYSICAL AND CHEMICAL CHARACTERISTICS, AND PREDATOR ACCESS ROUTES (E.G., ROADS AND LEVEES). THE MODEL WILL BE DEVELOPED USING DATA COLLECTED DURING THE BREEDING SEASON IN MARSHES ADJACENT TO THE NAPA RIVER AND ON MARE ISLAND. THE MODEL WILL BE TESTED IN OTHER REGIONS OF THE NORTH BAY. ONCE FINALIZED, LAND MANAGERS AND RESOURCE AGENCIES MAY USE THE MODEL TO TARGET RESTORATION EFFORTS SPATIALLY, THEREBY PROVIDING A FOUNDATION TO BUILD REGIONAL CONSERVATION AND RESTORATION MANAGEMENT PLANS.

Proposal

Environmental Science Associates

CALIFORNIA CLAPPER RAIL - DEVELOPMENT OF A GEOGRAPHIC INFORMATION SYSTEM-BASED HABITAT SUITABILITY MODEL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

THOMAS LEEMAN, Environmental Science Associates
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BRIAN PITTMAN, ENVIRONMENTAL SCIENCE ASSOCIATES

DEVELOPMENT OF A GIS-BASED HABITAT SUITABILITY MODEL FOR CALIFORNIA CLAPPER RAIL TO GUIDE RESTORATION EFFORTS IN THE NORTH BAY REGION

A. Project Description

This project will develop a habitat suitability model based on habitat and landscape relationships of the California clapper rail (*Rallus longirostris obsoletus*) (CCRA) in the North Bay region (including San Pablo Bay and Suisun Bay). This model is intended to assist restoration efforts across the North Bay by identifying areas that are important for maintaining CCRA breeding populations. The model also may be used to target areas where species re-introductions will have a higher likelihood for success. By modeling habitat on a large scale, we will take the first step towards developing a regional management plan for CCRA habitat restoration. Consequently, this study will pave the way for a comprehensive recovery effort.

To achieve this goal, we will examine several environmental and landscape factors considered significant to species conservation including, but not limited to, vegetation parameters, channelization, soil and substrate physical and chemical characteristics, and predator access routes (e.g., roads and levees). The model will be developed using data collected during the breeding season in marshes adjacent to the Napa River and on Mare Island. The model will be tested in other regions of the North Bay. Once finalized, land managers and resource agencies may use the model to target restoration efforts spatially, thereby providing a foundation to build regional conservation and restoration management plans.

1. Problem

Background.

CCRA is a state and federally listed endangered species that is almost entirely restricted to saline and brackish marshes in south San Francisco Bay and the Suisun Marsh/North San Francisco Bay Ecological Zone. The two primary reasons for the decline and listing of this species are market hunting until the early 20th Century and habitat loss through the conversion of tidal wetlands. A secondary reason for the decline is the fragmentation and restriction of habitat, which provides predators access to much of the remaining habitat. Restoration of salt marsh habitat and additional research on habitat requirements are key components of the U.S. Fish and Wildlife Service (USFWS) recovery plan for CCRA (USFWS 1984).

San Pablo Bay is within the historic range of the CCRA, and Grinnell and Miller reported the recolonization of former habitat in the bay by 1944 (Department of Water Resources [DWR] 1994). Gill (1979) reported that San Pablo Bay supported 38% of the CCRA population, and he suggested that the Napa Marsh population is likely a range expansion made possible by increased salinity resulting from substantial decreases in freshwater inflow to the marsh. Suisun Marsh is not considered part of the historic range of CCRA, and the first detections of CCRA in the marsh only occurred in 1978.

The area of historic tidal marsh in San Pablo and Suisun Bays was reduced by 73% and 19%, respectively, by 1984 (USFWS 1984). Much of the remaining marsh has lost its original structure. Historically, wide marshes gently transitioned from the high marsh zone into adjacent grasslands. Many of the remaining fragments are either narrow strips bordering dikes, or they have been back-filled and have lost their high marsh zone and adjacent upland vegetation. Many of these remaining marshes also have lost their intricate network of secondary tidal channels, thus reducing their value to many wildlife species (USFWS 1984).

Goals and Hypotheses.

There are two primary goals of the project: 1) identify habitat relationships between CCRA and various habitat features in the North Bay region, and 2) develop a geographic information system (GIS)-based habitat capability model that may be used to guide restoration efforts in the region. We hypothesize that CCRA use of habitats is non-random and is correlated to measurable characteristics of the habitat. We further hypothesize that significant habitat relationships may be modeled at the landscape level and that in doing so, potentially suitable habitat may be identified through combining the results of the landscape modeling with occurrence information from existing populations. Methods to test these hypotheses are provided in Section 3.

Study Area.

We chose three locations within and adjacent to the Napa River in San Pablo Bay: Mare Island, White Slough, and Coon Island, all of which are known to contain populations of CCRA (Collins et al. 1994). These locations were selected for this effort because they represent what is believed to be relatively suitable salt marsh habitat that still receives tidal influence; the Coon Island population also may represent a recent range expansion following conversion of the marsh from mainly freshwater to brackish conditions. Furthermore, there is existing data from surveys previously performed in these marshes (Collins et al. 1994).

Previous and related studies.

Lewis and Garrison (1983) developed a habitat suitability index (HSI) for CCRA, irrespective of subspecies. The model used univariate analysis of three habitat variables to determine if a study area would meet the requirements for CCRA: percent of shoreline of persistent emergent and scrub/shrub mangrove wetlands that is bordered by tidal flats or exposed tidal channels; percentage of area covered by persistent emergent and/or scrub/shrub mangrove wetlands; and percent of emergent and scrub/shrub mangrove wetland within 15 meters of tidally influenced bodies of water. These variables were selected based on published species requirements. This HSI was developed to compare areas for relative value to clapper rails. The applicability of this HSI to CCRA has not been tested, and subsequent research indicates that additional variables may influence CCRA occupancy of habitat.

As part of an on-going analysis of the potential impacts of climate change on CCRA habitat, a CCRA habitat model has been developed for tidal marsh in the San Francisco Bay (U.S. Department of the Interior [USDI] 2001). A GIS database of South San Francisco Bay also was assembled and will be used to model the effect of sea-level change on CCRA habitat. The results of the habitat and GIS models are not available at this time.

Foin et al. (1997) evaluated recovery strategies for CCRA within the San Francisco estuarine system. The focus of their analysis was on saline marshes in San Francisco Bay and eastern Marin County. They found that several measures of channelization, height of *Salicornia*, density of *Spartina*, and macroinvertebrate abundance were significant in predicting occupied breeding territories. However, they acknowledged the lack of information about the flexibility of habitat selection by CCRA, as evidenced by CCRA use of brackish marshes.

Foin and Brenchley-Jackson (1991) developed a simulation model to evaluate the potential recovery of light-footed clapper rails in southern California. Their goal was to provide insight into the viable components of a rail habitat improvement plan. They showed that light-footed clapper rails are more abundant in *Spartina* marshes than would be expected under random conditions and that no marshes with abundant *Spartina* lacked light-footed clapper rails. They concluded that "…a greater benefit to rails may result from concentrating on habitat improvement in those estuaries that have the greatest potential for *Spartina* production rather than the dispersion of expenditures upon all existing wetlands, many of which may have limited potential for rail population expansion." The authors admit that the model's predictions, while reasonable, are uncertain and could be improved. Simply managing for one feature, *Spartina*, may not be the solution to recovery of the light-footed clapper rail. They also state that a "second generation of landscape models taking spatial factors into account would also be desirable."

Collins et al. (1994) demonstrated a disturbing decline in the number of CCRA in the northern reaches of the San Francisco estuary. They suggest that the primary reasons for this decline are increased predation and declining fecundity, due mainly to habitat loss and fragmentation. The distribution of CCRA in their study area was discontinuous and patchy. In addition, the habitat was restricted and fragmented. CCRA was most dense in areas where habitat patches were at least 100 hectares in size.

2. Justification

A conceptual model that integrates adaptive management concepts (as outlined in Chapter 2 of the Draft Stage 1 Implementation Plan) is provided in Figure 1. Our study clearly falls in the category of research and it will generate data that will be useful in identifying habitat polygons that are a high priority for restoration. We will address the issue of species recovery and associated habitat restoration by using habitat modeling at the landscape scale.

The need to conserve and recover endangered species at the landscape level is well-recognized (Burkey 1989, Fahrig and Merriam 1985, Merriam and Lanoue 1990, Noss and Harris 1986, Shaffer 1990). Furthermore, the CALFED Natural Community Conservation Plan (NCCP) species goal for the CCRA is to contribute to its recovery by implementing some of the actions deemed necessary to recover the species populations within the MSCS focus area. The USFWS joint Recovery Plan for CCRA and salt marsh harvest mouse states that "(p)rotecting these species will require the protection and enhancement of existing marshes, the restoration of former habitat, and additional research on their habitat requirements and population trends, especially in San Pablo Bay and Suisun Marsh" (USFWS 1984). One of the specific conservation needs is the development of management plans that include specific management

guidance. A key component to developing management guidance is to determine the habitat requirements of CCRA in tidal and brackish marshes. The HIS model will directly address these issues for CCRA in the North Region.

3. Approach

Study Design.

We will attain the goals and objectives of this project by answering a series of key questions (Table 1). These questions will be answered through field research and computer assisted modeling as a series of specific tasks. At the end of each task we will evaluate teh data and products in a progress report that analyzes what problems were encountered, how they were addressed, and what modifications were made to the study design to better achieve the goals and objectives.

Task 1.0 - Develop Habitat Suitability Model

As discussed in Section 1, several habitat relationships need further research to gain a better understanding of how CCRA distribution is influenced by habitat and landscape variables. Under this task, we will develop an HSI model that considers these relationships and determines what significant variables have the greatest influence on CCRA occurrence. The model will be constructed using data collected at three locations within and adjacent to the Napa River in San Pablo Bay: Mare Island, White Slough, and Coon Island, which are known to contain populations of CCRA (Collins et al. 1994). These locations were selected for this effort because they represent what is believed to be relatively suitable salt marsh habitat that still receives tidal influence; the Coon Island population also may represent a recent range expansion following conversion of the marsh from mainly freshwater to brackish conditions.

Task 1.1 - Collect Baseline Data

We will collect data from both existing sources (literature, databases, and field notes) and field surveys.

A. Acquire and Review Existing Databases and Species Literature. We will query relevant databases to obtain occurrence data for CCRA in the North Bay region. We have derived occurrence data for CCRA from the California Natural Diversity Database (CNDDB). We will supplement this data by obtaining data from public agencies, independent consultants, universities, and other sources. Public agencies that will be contacted include DWR, California Department of Fish and Game (DFG), and USFWS. This data will then be entered into the databases created in Subtask B (below).

B. Construct Project Databases. We will create three separate databases for model development. The first will track records for the region and relevant species literature. The second will be used to track field data collected under Subtask C. Lastly, a GIS database will be created for spatial information to display data and overlay with other GIS databases, such as the CNDDB, DWR data, and Environmental Science Associates'

(ESA) internal GIS data sets. All databases will be updated regularly throughout the project as new information is collected.

Aerial photography for the study area will be reviewed. Vegetation and habitats will be classified using Wildlife Habitat Relationships and California Native Plant Society classification systems (other classification systems may be used where appropriate, such as the USFWS wetland classification system). Habitat polygons will be incorporated into the GIS database, which will include other data layers, such as roads, topography, land ownership, hydrology, and soils.

C. Conduct Field Surveys.

Species Sampling. CCRA populations will be sampled by passive and active surveys at three locations in and adjacent to the Napa River. These sampling sites have been chosen on the basis of containing populations large enough to result in an adequate number of detections and to represent a salinity gradient. Survey locations will be established throughout each of these habitat units. These locations will be spaced approximately 200 meters apart and we will attempt to replicate the previous survey points used in each marsh. Six surveys will be conducted at each site during the breeding season (between January 15 and March 15) for two consecutive years. All data will be entered into an electronic database to be used in model construction (see Task 1.2). Field surveys will be conducted by Jules Evens, who holds a current USFWS permit for studies of the CCRA.

Vegetation Sampling and Other Variables. We will sample vegetation in the study area using a grid that overlays the grids used in CCRA sampling. We will measure and classify vegetation according to species, percent cover, and strata. Other physical variables, such as distance to open water, salinity, soil type, redox potential continuity, and channel characteristics also will be measured or categorized. All data will be collected on standardized field forms or data recorders, to be later transferred to the appropriate database.

Task 1.2 - Identify Significant Variables

Once databases have been created, we will analyze the data using several statistical techniques. Although the exact methods for statistical analysis may change as a result of how data is collected and stratified, we are expecting to conduct a canonical correlation analysis (COR) to determine species-environment correlation for several variables. We will use CANOCO (ter Braak 1987-1992) for our analysis. Once completed, further multiple regression analysis may be warranted to define interrelationships. Significant variables identified under this step will then be used to construct the HSI model (see below). Based on past research (Foin et al. 1997, Lewis and Garrison 1983), significant environmental variables may include:

- Height of *Salicornia* (or other vegetation)
- Percent cover of *Spartina*
- Average channel depth
- Length of second and third order channels

- Depth of channel bank overhang
- Salinity
- Polygon size of salt marsh and upland habitats

Task 1.3 - Develop HSI Model

We will develop an HIS model based on the statistical analysis conducted in Task 1.2. The model will emphasize quantitative relationships between key environmental variables and species occurrence. We anticipate that the HSI model will separate habitat into four categories: high capability, medium capability, low capability, and unsuitable habitat. These categories correspond to probabilities of species occurrence, and may then be used to identify potentially significant areas of CCRA activity. The habitat relationships developed in the model will then be used in conjunction with the data generated in Task 2 to develop a GIS model. The GIS model will have the ability to graphically display this mathematically based model, thereby clearly displaying spatial relationships between habitat polygons.

Task 2.0 - Determine Spatial Relationships

Task 2.1 – Develop GIS Model

Using the HSI model created under Task 1.0, we will develop a GIS model in ArcInfo (and the associated extension ArcGrid) to map suitable habitat in the Napa River study areas. While the type of data collected will ultimately affect specific model design and methods, we anticipate constructing a script in Arc Macro Language (AML) to derive new data set from the GIS data library constructed in Task 1.1. The script will be constructed as a series of reselects, joins, and dissolves that are based on the variables identified in the HSI model. For example, we may reselect from the vegetation layer all *Salicornia* polygons with greater than 50% cover and join those polygons with a layer of 2^{nd} and 3^{rd} order channels that are buffered at regular distances. The polygons will then be dissolved to form a new data set (i.e., polygons with high pickleweed cover and with **x** distance of 2^{nd} and 3^{rd} order channels). This process will be repeated for all variables include in the HSI model and for each habitat capability category. Figure 3 gives a graphical representation of this process.

Task 2.2 - Evaluate Model

Once the GIS model has been developed, we will evaluate the model under two environments. Our first statistical test will be to overlay the habitat capability layers constructed for the study marshes over the occurrence data collected by Jules Evens. Should the model show a poor degree of correspondence with this data, we will reevaluate the parameters used in the model to determine if variables should have been weighted differently or if interrelationships were misinterpreted. Once the model is shown to be statistically accurate, we will conduct targeted surveys in the marsh to further validate the model. These surveys will target each of the habitat categories (high, medium, low, and non-) to determine their level accuracy. This also may provide information on what may be expected in terms of population density within each of the habitat categories.

Once the model has been evaluated, we will recompile the GIS script to run it in a different region. Although selection of a specific test region in the North Bay will be dependent on a number of factors (primarily the availability of suitable data), we anticipate that the Suisun Marsh may prove to be an excellent candidate for testing. Suisun Marsh has a complete GIS data set associated with it, and occurrence data will be collected during the winter of 2001-2002. Similar to the exercise performed for Petaluma Marsh, we will overlay the derived habitat capability layers over occurrence data to determine the degree of overlap.

Task 2.3 - Identify Gaps in Habitat Distribution

As a final task to determine spatial distribution interrelationships, we will conduct a qualitative analysis to identify potential gaps in habitat distribution within the study area and selected test area. This information will be used to conduct Task 4.0.

Task 3.0 - Evaluate Restoration Priorities

Task 3.1 - Correlate Model to Habitat and Population Distribution

We hypothesize that CCRA density may be significantly related to both habitat quality and distribution. While the modeling may not ultimately provide a clear answer to this question, we do anticipate that the following scenario may develop:

1. (A) In areas of high or medium capability habitat within a matrix of medium capability habitat, CCRA density is high. (B) In addition, in areas of suitable habitat within a matrix of low to unsuitable habitat, CCRA density is low. These relationships may indicate that the spatial distribution of habitat has a direct correspondence to the ability of CCRA to occupy an area during the breeding season.

2. In addition to scenario 1(A) being true, it is found that in areas of high capability habitat within a matrix of low capability or unsuitable habitat CCRA density is high. (B) It also is found that in areas absent of high capability habitat within a matrix of medium or low capability habitat, CCRA density is low. This may indicate that CCRA density is influenced more by habitat suitability and not by other factors such as metapopulation dynamics.

Each of the above scenarios has different implications for conservation and restoration. Under scenario 1, linkages to other habitat polygons will be emphasized. Under scenario 2, maintaining large polygons of high capability habitat will be emphasized. Should a relationship be identified, we will use the results of this analysis in formulating recommendation for Task 3.2.

Task 3.2 - Prioritize Habitat Polygons for Restoration

Once we have determined the relationship between CCRA density and habitat distribution (if any), we will identify specific polygons within the study area and the test area that should be targeted for restoration. Depending on the results obtained under Task 3.1, this task may target the matrix (i.e., dispersal habitat) for restoration, or it may target high capability habitat and associated upland refugia, or a combination of both to varying levels. The end goal of this

project is to provide a model that may be applied to multiple North Bay regions and will yield consistent results in terms of identifying restoration priorities.

4. Feasibility

Approach. Our approach considers two factors important to CCRA conservation and recovery in a cost-effective, timely manner: 1) determining the habitat characteristics correlated with CCRA density, and 2) identifying spatially priorities for restoration projects that are most likely to benefit the species. Our three-year study period and budget is projected to sufficiently allow for delays due to weather conditions or the need to acquire additional data.

Some tasks (particularly Task 3.0) will be dependent on the success of the model. Therefore, the nature of this task may change significantly to reflect the results obtained under Task 2.0. For example, some environmental variables not previously considered significant may prove to be so, thereby driving the model in unexpected directions. To account for this, we will closely monitor our progress as tasks are completed to determine if overall goals or objectives are in need of revision to better address specific conservation issues.

Required Permits and Agreements - Jules Evens, who holds a current USFWS permit for studies of CCRA as well as a Memorandum of Understanding (MOU) with DFG, will conduct all field surveys for this species. Mr. Evens is a CCRA specialist who is recognized as a regional expert on the species, and has extensive knowledge of the project area.

Sampling will be conducted within White Slough and Coon Island, which are managed by the DFG, and Mare Island, which is under the jurisdiction of the U.S. Navy. We have had initial discussions with DFG on this project, and will coordinate closely with DFG staff. Mr. Evens has a professional relationship with the U.S. Navy and has conducted surveys on Mare Island in the past; we anticipate the cooperation of the U.S. Navy with this effort.

5. Performance Measures

We will monitor performance throughout the projects by monitoring the achievement of specific milestones. For each of the tasks described in Section 2.0, we will have milestones that must be completed prior to initiating subsequent tasks. At each milestone, we will evaluate the products and data acquired in a report to determine how much progress towards the goals and objectives is being made. Throughout the process, we will consult with the USFWS, DFG, and associate researchers to ensure that data and methodologies are kept current.

6. Data Handling and Storage

A complete set of originals and copies of all data collected will be maintained by ESA. Data will be stored in Microsoft Access and ArcInfo format. Because of the sensitive nature of this data, it will only be available through contacting the appropriate resource agency (USFWS or DFG). Field survey data on federal and state-listed and other special-status plants and wildlife collected under authorized permits will be entered into the required federal forms for the USFWS and Field Survey Forms for the CNDDB. Copies of all data collected will be included in biological

baseline studies and monitoring reports. This data will be closely shared with the DFG and U.S. Navy for their use.

Data is exportable via Excel files to database systems maintained by ESA and DFG. Reports will be provided in one or more of the following forms as preferred: hard copy; Microsoft Word, PDF, and/or HTML files on CD-ROM; e-mail attachment; web accessible files.

7. Expected Products / Outcomes

We anticipate the following reports and products:

- Habitat Model Technical Report
- GIS Script in AML (or similar scripting language)
- Occurrence Data/Maps for Study Area
- Habitat Capability GIS Data Sets for the Napa River marshes and test area
- Restoration Priorities Maps and Management Recommendations

Most products will be available in both hard copy and electronic (pdf) formats.

8. Work Schedule

The proposed project will be completed in three years, and is summarized in Table 2. The proposed schedule takes into consideration potential problems with data collection techniques, participation by various local, state, and federal agencies, and minor changes in climate. The proposed activities are designed to include activities that can occur during different seasons. If one or more years are drier than normal, we will adjust the study to measure the biological and habitat variables that can be measured under drought conditions. The model and associated restoration recommendations will be written to address the conditions under which the documents were developed.

B. Applicability To CALFED ERP And Science Program Goals And Implementation Plan And CVPIA Priorities

1. ERP, Science Program and CVPIA Priorities

CALFED MSCS Milestones

Suisun Marsh and North San Francisco Bay Habitat Milestones - Acquire land needed for tidal restoration and complete the steps to restore wetlands to tidal action. This project will assist in focusing the limited resources available for saline emergent wetland restoration towards the habitat with the greatest potential to be effectively restored. This project also will identify the most important components missing for land acquired for restoration.

CALFED NCCP

Species Goal for CCRA - Contribute to the recovery of CCRA by implementing some of the actions deemed necessary to recover the species populations within the MSCS focus area. The USFWS joint Recovery Plan for CCRA and salt marsh harvest mouse states that "(p)rotecting these species will require the protection and enhancement of existing marshes, the restoration of former habitat, and additional research on their habitat requirements and population trends, especially in San Pablo Bay and Suisun Marsh" (USFWS 1984). One of the specific conservation needs is the development of management plans that include specific management guidance. A key component to developing management guidance is to determine the habitat requirements of CCRA in tidal and brackish marshes.

ERP Strategic Goals and Objectives

Goal 1 - Achieve Recovery of At-Risk Native Species Dependent on the Delta and Suisun Bay as the First Step Toward Establishing Large, Self-Sustaining Populations of These Species. There is considerable uncertainty about how best to facilitate the recovery of these species. ERP actions must address the immediate needs of At-risk species as well as gain additional information about how they respond to modifications to ecosystem functions and processes. We need to maximize opportunities that improve our understanding of the best methods for restoring At-risk species and their habitat.

Goal 4 - Protect and/or Restore Functional Habitat Types in The Bay-Delta Estuary and Its Watershed for Ecological and Public Values such as Supporting Species and Biotic Communities, Ecological Processes, Recreation, Scientific Research and Aesthetics. Though the importance of restoring additional habitats is not debated, there are difficult choices ahead regarding the relative importance of restoring different habitat types on regional and local scales, and there is a pressing need to develop better tools to make these decisions.

Regional Goals and Objectives

BR-1 - Restore Wetlands in Critical Areas Throughout the Bay, Either via New Projects or Improvements That Add or Help Sustain Existing Projects. The proposed project will facilitate restoration of several wetland types emphasized by this goal, including tidal marsh and tidally muted marsh.

BR-2 - Restore Uplands in Key Areas of Suisun Marsh and San Pablo Bay. This project may identify the need to protect and restore upland habitat for CCRA escape cover, thereby prioritizing restoration in these locations.

CALFED Science Program Goals

Restoration is a new science and uncertainty exists about how to most effectively restore communities and ecological function, what communities might result from restoration efforts, and how to sustain restoration. The long-term goal of the CALFED Science Program is to progressively build a body of knowledge that will continually improve the effectiveness of

restoration actions and that will allow the CALFED Science Program to track restoration progress. The priorities of the Science Program include:

- *Develop Performance Measures* - Scientific studies are needed to demonstrate and establish performance measure monitoring.

- *Build Population Models for At-Risk Species* - This requires knowledge of life history, environmental requirements and biology of At-risk species, and ultimately developing reliable models of population processes.

- *Establish Integrated Science Programs in Complicated Field Settings* - It is the goal of the Science Program to establish intensive site-, multisite-, or watershed-specific interdisciplinary programs in every region.

- *Advance the Scientific Basis of Regulatory Activities* - The present state of knowledge is imperfect and uncertainties exist in the science that is applied. It is critical to continually address, explain, and advance the knowledge that can be applied to management, with the goal of adapting regulatory activities as the knowledge changes. Addressing the uncertainties in the science used for management is an important goal of the Science Program.

- *Take Advantage of Existing Data* - Projects are encouraged that develop questions that can be addressed by interpreting existing data and that can build from that data to develop indicators and better understanding of processes, species and communities.

CVPIA Goals

Contribute to the State of California's Interim and Long-Term Efforts to Protect the San Francisco Bay and Sacramento-San Joaquin Delta Estuary. The Central Valley Project Conservation Program implements projects to protect, restore, and enhance federal threatened or endangered species, other special status species, and their habitat in areas directly or indirectly affected by the CVP.

2. Relationship to Other Ecosystem Restoration Projects

The proposed project will provide a foundation for restoration projects in the North Bay that wish to consider the specific habitat requirements of CCRA. Several large restoration projects (some that are required for mitigation under NEPA/CEQA) are planned for the region, and this project may be used in those planning efforts to ensure that this species specific habitat needs are taken into account.

3. Requests for Next-Phase Finding

Not Applicable.

4. Previous Recipients of CALFED Program CVPIA Funding

Not Applicable.

5. System-Wide Ecosystem Benefits

The proposed model may be used throughout the North Bay Region, with potential application in Suisun Marsh. The model may also help address current management issues that surround this species, such as the lack of specific, quantifiable management recommendations. The model may ultimately be used to identify potential recovery options at the landscape level through modeling habitat throughout the North Bay Region and Suisun Marsh.

6. Additional Information for Proposals Containing Land Acquisitions

Not Applicable.

C. Qualifications

Thomas Leeman is a wildlife biologist and ornithologist with ESA. He received his B.S. in Biology from UCDavis and his M.S. in Natural Resources (wildlife emphasis) from Humboldt State University. He has 10 years' experience coordinating and conducting field studies in wetland, upland and riverine habitats. Mr. Leeman will act as the Project Manager for the overall project, ensure coordination with federal and state agencies, and maintain communication with Avocet Research. He will ensure that all goals and objectives are met.

Jules Evens is a principal of Avocet Research Associates and a Research Associate with Point Reyes Bird Observatory and Audubon Canyon Ranch. He has conducted research in San Francisco Bay since the early 1980s with special focus on CCRA and California black rail. Mr. Evens has authored or co-authored numerous journal articles in peer-reviewed journals, and technical reports for state and federal agencies, on CCRA. He holds a CCRA USFWS Permit #TE786728-1.

Erich Fischer is a senior wildlife biologist with ESA who serves as a Project Manager and Technical Analyst for a variety of projects. He received his B.A. in Biological Sciences (conservation biology) from California State University, Sacramento. Mr. Fischer has over 11 years of experience in conducting field studies, modeling on GIS systems, and preparing technical and regulatory reports. He is certified in habitat delineation techniques, habitat evaluation procedures, and several remote-sensing techniques. He has successfully developed habitat suitability index models and associated GIS models for several special-status species in California, including mesocarnivores, raptors, reptiles, and amphibians. Many of these models were subsequently used by land management agencies (such as the U.S. Forest Service) to assist in species management and in conducting impact analyses.

Niall McCarten, Ph.D., is senior biologist with ESA and Research Associate with the Section of Plant Biology at UC Davis, and the UC Jepson Herbarium at UC Berkeley. He received his B.A. in Botany at UC Santa Barbara, M.A. in Ecology and Systematics at San Francisco State University, and Ph.D. in Botany at UC Berkeley. He is a nationally recognized botanist and plant ecologist with peer-reviewed papers and conference presentations on rare and endangered

plants, wetlands ecology, and monitoring. He has served as the Project Manager on many large projects involving teams of scientists, resource agency staff, and consultants. He was one of the few non-public agency scientists asked to participate in the development of the original CALFED ERP plan, and to participate in the development of the CALFED MSCS. Dr. McCarten will be act as the Project Manager for collecting all vegetation data for the project and oversee statistical methods used in the HSI model.

Chris Rogers is a wetlands and plant ecologist with ESA. He has over 12 years' experience conducting habitat assessments, endangered species evaluations, preparation of environmental documentation and permitting applications, restoration and mitigation planning, and construction monitoring. He received his B.A. in Biology (emphasis in plant ecology) at San Francisco State University. His restoration experience includes preparing restoration and revegetation plans for Alhambra Creek in Martinez involving extensive planting of a native cordgrass marsh, developing long-term marsh and riparian habitat restoration. In addition, Mr. Rogers has conducted numerous site assessments of wetlands and streams and feasibility studies for restoration, enhancement and water treatment applications. Mr. Rogers will be an integral contributor to the vegetation sampling team and assist in designing restoration priorities.

Brian Pittman is a wildlife biologist and aquatic invertebrate specialist. He is a biologist with ESA. Mr. Pittman received his B.A. in Biology from the UCSanta Cruz and his M.S. in Environmental Studies from San Jose State University. Mr. Pittman's Master's thesis was a survey of inbenthic macrofauna at a south San Francisco Bay salt marsh. Mr. Pittman will contribute to the team's analysis of environmental variables in CCRA habitat, particularly as they may pertain to potential prey items.

D. Cost

1. Budget

The total estimate cost for the three-year project will be $238,907.

2. Cost-Sharing

Not applicable

E. Local Involvement

None yet identified.

F. Compliance with Standard Terms and Conditions

This proposal will comply with the standard terms and conditions for state and federal contracts as described in Attachments D and E of the Proposal Solicitation Package.

G. Literature Cited

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Table 1: Tasks, Activities and Key Questions

Tasks and Activities	Key Questions
Task 1 - Develop Habitat Suitability Model	How do habitat quality and quantity affect species distribution?
Task 1.1 - Collect Baseline Data	
A. Acquire and Review Existing Databases and Species Literature	
B. Construct Project Databases	
C. Conduct Field Surveys	
Task 1.2 - Identify Significant Variables	
Task 1.3 - Develop HSI Model	
Task 2 - Determine Spatial Requirements	How do habitat distribution and interrelationships affect the distribution of breeding CCRA?
Task 2.1 - Develop GIS Model	
Task 2.2 - Evaluate Model	
Task 2.3 - Identify Gaps in Habitat Distribution	
Task 3 - Evaluate Restoration Priorities	Where should land managers and resource agencies target efforts for restoration to best conserve CCRA?
Task 3.1 - Correlate Model to Habitat and Population Distribution	
Task 3.2 - Prioritize Habitat Polygons for Restoration	

Table 2. Proposed Work Schedule

Task/Activity	Start Date	End Date
Task 1 - Develop Habitat Suitability Model		
Task 1.1 - Collect Baseline Data	August 2000	March 2004
Task 1.2 - Identify Significant Variables	March 2004	May 2004
Task 1.3 - Develop HSI Model	May 2004	June 2004
Task 2 - Determine Spatial Requirements		
Task 2.1 - Develop GIS Model	June 2004	September 2004
Task 2.2 - Evaluate Model	September 2004	November 2004
Task 2.3 - Identify Potential Gaps in Habitat Distribution	November 2004	January 2005
Task 3 - Evaluate Restoration Priorities		
Task 3.1 - Correlate Model to Habitat and Population Distribution	January 2005	March 2005
Task 3.2 – Prioritize Habitat Polygons for Restoration	March 2005	May 2005

Figure 1
Conceptual Model