

ECOLOGICAL RESEARCH

Our company was founded upon the award of a five-year research contract with the Sierra Club, the results of which were used to assess the impacts of their wilderness expeditions. Since that first contract, we have continued to provide both applied and basic research services to a variety of public, private and conservation entities.

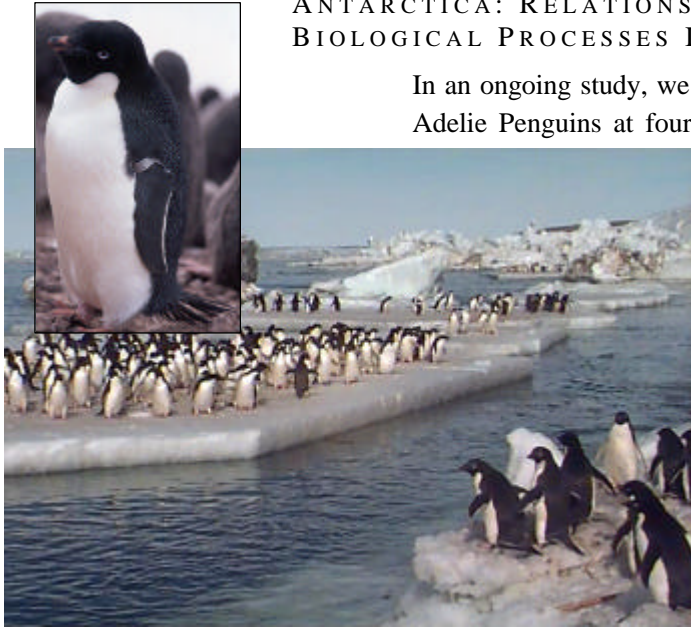
Today our staff, which includes many leaders in their respective fields, is encouraged to share their expertise through the presentation and publication of this research. Our scientists have published over 400 peer-reviewed research papers on a wide variety of subjects in the biological disciplines. The results of this cutting-edge research are applied to ecological problems, bringing the best available science to solve those problems. Our scientists have been deeply engaged in a variety of such environmental issues including:

- Determining possible effects of global warming on Antarctic species
- Reducing the effects of selenium contamination in agricultural drainwater on wildlife
- Refining tidal marsh restoration techniques
- Assisting with the recovery of seabird colonies after the Exxon-Valdez oil spill
- Developing rare plant transplantation and restoration techniques
- Planning endangered animal species management and recovery

Funding sources for these research programs include federal governmental agencies, such as the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and such appointed environmental response agencies as the Exxon Valdez Trust Fund. Various state and local agencies, conservation organizations, private foundations and private parties have also provided major funding.



Research Projects



ADELIE PENGUIN POPULATION DYNAMICS IN ANTARCTICA: RELATIONSHIPS TO PHYSICAL AND BIOLOGICAL PROCESSES IN THE ROSS SEA - *Antarctica*

In an ongoing study, we are investigating the population dynamics of Adelie Penguins at four colonies along the coasts of the Ross Sea,

Antarctica. The purpose of the study is to identify factors affecting the locations chosen by the penguins for initiation of colonies, and factors affecting colony size (e.g., reproduction, mortality, emigration, and immigration). Using sophisticated techniques (radio-telemetry, sub-dermal pit-tags, and stomach lasauge-sampling), we have quantified foraging energetics at each site, and related these findings to annual variation and trends in population size, reproductive success and survival of the

(banded) breeding adults. One of the purposes of the study is to relate changes in these population dynamics with global warming trends.

Client: National Science Foundation

CALIFORNIA WILDLIFE/HABITAT RELATIONSHIPS PROGRAM - *Statewide*

The California Interagency Wildlife Task Force was interested in compiling known information about the distribution of California's wildlife in relation to its habitats. This major contract involved a team of 19 researchers, who compiled information from available literature sources, previous Forest Service studies and individual field and research experience. We prepared species notes and habitat relationship matrices for 562 species of California mammals, birds, reptiles and amphibians. We created a habitat relationship matrix combining information on the geographic occurrence of each species, and the importance of each of 50 different California habitat types to the life history stages, movement and ecological requirements of each species. The habitats in turn were subcategorized into stand and cover types and additional food and ecological requirements were entered into the matrix. These data were published, and compiled into a database that has been a cornerstone of wildlife management in the state for over a decade.

Client: California Department of Fish and Game, California Division of Forestry.

SAN JOSE/SANTA CLARA WATER POLLUTION Control Plant:
Permit Assistance Program
- Santa Clara County

The Cities of San Jose and Santa Clara discharge treated effluent into the south San Francisco Bay. Concerns were raised in the late 1970's regarding what effect those freshwater discharges might be having on the salt marshes and associated species. We began by analyzing studies that detailed cumulative changes in marsh vegetation that might be related to discharge from the plant. We used a combined approach of interpreting historic aerial photos of the vicinity and conducting detailed ecological studies. We conducted two breeding season and one winter season survey for the endangered California Clapper Rail. We also trapped three representative marshes for the endangered salt marsh harvest mouse. We assisted with negotiations with federal and state agencies, helped establish the appropriate mitigation program, and assisted the plant with obtaining a new discharge permit. We have continued to monitor changes in the marsh vegetation over the past 12 years.

Client: City of San Jose, Department of Environmental Management

ALASKA PREDATOR EXPERIMENT (APEX): RECOVERY OF
SEABIRD POPULATIONS IN
PRINCE WILLIAM SOUND, ALASKA,
AFFECTED BY THE EXXON VALDEZ OIL SPILL
RESTORATION; A MODELING APPROACH

During the past 4 years, in collaboration with Glenn Ford Consulting, Inc., we have collaborated with several Principal Investigators to combine and synthesize their field data collected on recovering or non-recovering species of seabirds in Prince William Sound. Using GIS and statistical procedures we have assessed the degree to which colonies can grow given limited food resources; and have also modeled the foraging strategies of seabirds. Results indicate that large colonies, through competition for fish, can affect the growth potential of neighboring small colonies. Data have been collected through aerial censusing of fish schools and bird feeding flocks, as well as radio tracking of foraging sea birds. The effort is part of a multi-disciplinary effort called APEX: Alaska Predator Experiment. In addition to annual reports, results have been published in peer-reviewed scientific journals.

Client: Exxon Valdez Oil Spill Recovery Council (through NOAA).

Research Projects

SANTA CLARA VALLEY DUDLEYA, COUNTY-WIDE SURVEY - *Santa Clara County*

The county-wide survey results have been used in a variety of planning processes, and will be incorporated into a planned HCP



Standard Pacific built a housing development on Communications Hill in San Jose, California. That housing development disturbed a population of approximately 2000 individuals of a serpentine endemic, federally-endangered plant, the Santa Clara Valley Dudleya. Mitigation for the project included experimental relocation of the individuals, and a county-wide survey to better determine the current status of the species. The survey work involved identifying all suitable habitat, and conducting field surveys for previously undocumented populations. Approximately 14,810 acres of potentially suitable habitat were identified, of which 8,450 acres had never been adequately surveyed. We gained access to 2900 acres of those lands, and discovered approximately 13,500 individuals in 15 previously unreported populations. The distribution of the species seemed to be highly dependent on its initial establishment in the widely available rock outcrops in most areas underlain by serpentine bedrock. The species only rarely occurs in soil types with serpentine inclusions. The relocation of 2000 individuals has been generally successful, after three years of monitoring. The county-wide survey results have been used in a variety of planning processes, and will be incorporated into a planned HCP.

Client: Standard Pacific

CUMULATIVE IMPACTS OF SUBSURFACE AGRICULTURAL DRAINWATER EVAPORATION BASINS IN THE SOUTHERN SAN JOAQUIN VALLEY, TULARE BASIN REGION, *Kings - Tulare and Kern Counties*

We prepared a cumulative impacts analysis and mitigation design to be applied as part of EIR and Waste Discharge Permit conditions for individual evaporation basins in the Tulare Basin and surrounding areas. These evaporation ponds had been shown to contain selenium and other metals in varying concentrations. The focus was on biological effects of salinity, selenium, and other naturally occurring trace elements that were concentrated in evaporation basins. Our project documented the extent of contamination of the water and soils associated with the ponds, and wildlife use both by resident breeding waterbirds and shorebirds and by winter migrants. Based on the exposure risks, level of use and duration of exposure, the cumulative effects of the approximately 7000 acres of evaporation ponds were assessed. Mitigation measures were designed to limit the exposure of birds of the Pacific Flyway to the relevant metals. A comprehensive impact avoidance and mitigation plan was proposed. That plan later became the cornerstone for continuing operation of the evaporation basins at much lower risk levels and fully mitigated.

Clients: CH2MHILL for Department of Water Resources and Regional Water Quality Control Board (with participation by California Department of Fish and Game, and Central Valley Agricultural Pond Operators, Inc.)

OTHER REPRESENTATIVE RESEARCH PROJECTS:



- **ECOLOGICAL STUDY OF MOUNTAIN LIONS IN THE VICINITY OF CARLSBAD CAVERNS AND GUADALUPE MOUNTAINS NATIONAL PARKS - *New Mexico & Texas***
Client: U. S. D. I. National Park Service, Santa Fe, New Mexico.
- **SEABIRD SPECIES OF SPECIAL CONCERN IN THE INDIAN OCEAN: CORRECTION FACTOR FOR ESTIMATES OF POPULATION SIZES - *Indian Ocean***
Client: U.S. National Science Foundation in collaboration with the French Zoological Institute for Antarctic Research
- **TEMPORAL TRENDS IN SPECIES ABUNDANCE AND COMMUNITY STRUCTURE OF PELAGIC SEABIRDS IN THE EASTERN TROPICAL PACIFIC, WITH IMPLICATIONS FOR TUNA COMMENSALISM AND GLOBAL CHANGE - *CLIENT: NATIONAL SCIENCE FOUNDATION***

