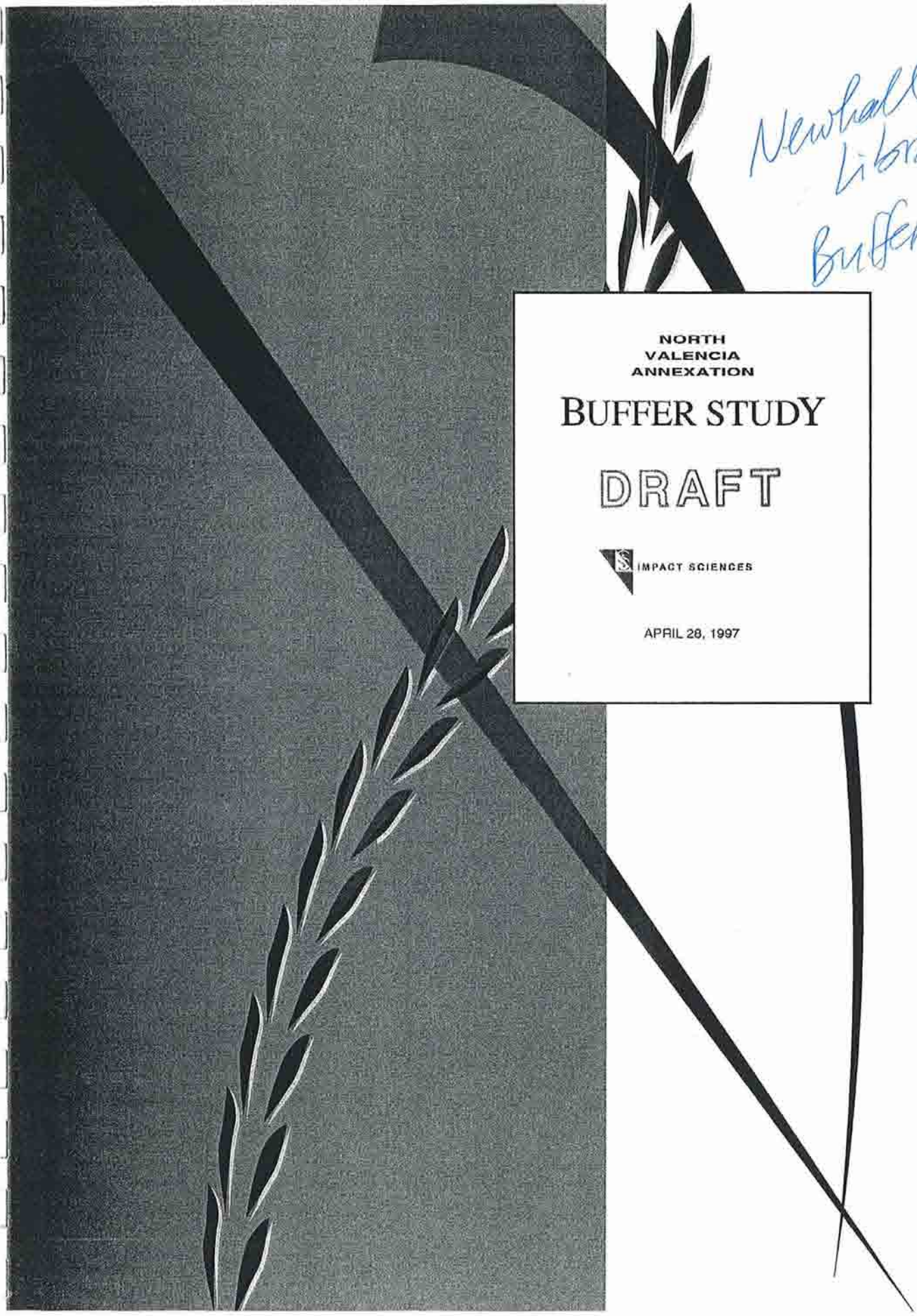
Impact Sciences, Inc., "North Valencia Annexation Buffer Study" (April 28, 1997)



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NORTH
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ANNEXATION

BUFFER STUDY

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APRIL 28, 1997

NORTH VALENCIA ANNEXATION

DRAFT
BUFFER STUDY

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April 28, 1997

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1. INTRODUCTION

Historically, planners and biologists have emphasized protection of riparian vegetation. It is acknowledged that the vast majority of California's riparian resources have been eliminated as a result of development projects or farming. This loss has resulted in a corresponding reduction in species diversity, richness, and abundance for those animals generally associated with this vegetation type. This fact is codified in that a large number of animals listed by the state as threatened or endangered are riparian or water dependent. In response to this direct loss and indirect impacts, many state and federal agencies have developed regulations intended to preserve and protect this vegetation type. Regulations include those associated with Section 404 1(b) of the Clean Water Act, State of California Department of Fish and Game (CDFG) Code Section 1603, and others as dictated by the U.S. Fish and Wildlife Service (USFWS), and State of California Regional Water Quality Control Board. These measures have focused on the protection of riparian vegetation.

More recently however, biologists have become concerned that protection of riparian vegetation in itself is not sufficient to protect the riparian ecosystem that in many cases extends beyond the bounds of the riparian canopy. This presumption is consistent with recent studies regarding this topic. Schaefer and Brown (1992) concluded that riparian and upland habitats are not closed autonomous systems, and that wildlife continuously move between aquatic, riparian, and upland habitats. Further, Swanson et al. (1982), in their study of riparian ecosystems, defined the riparian zone as the water's edge or ecotone between aquatic and upland ecosystems.

Wharten et al. (1982) made similar conclusions. His studies also indicated that wildlife species do not always occur in distinct zonal patterns within aquatic and adjacent upland areas. As such, many wildlife species are commonly associated with riparian vegetation due to their life history requirements, although few are entirely restricted to them. Also, wildlife use of riparian habitats differ by species, season, and flooding regime. For example, many terrestrial bird species nest in riparian habitats but forage over large areas of non-riparian vegetation. Other species concentrate their feeding activities in riparian habitats during the winter and spring but include drier sites during summer and fall (Guthrie, 1996). Other studies have indicated that even those species that are considered riparian-dependent require access to adjacent uplands in order to obtain essential food or nesting resources (Schaefer and Brown, 1992). These studies are at odds with the presumption

that wildlife associated with riparian vegetation are restricted to that zone and do not significantly utilize adjacent upland habitat. Rather, these studies conclude that most species associated with riparian systems are dependent on an array of vegetation types inclusive of more arid vegetation such as sage scrub and grassland communities.

Each of these studies implies that if critical habitat requirements are reduced in quality or quantity such that the ecosystem no longer satisfies a species' needs, a substantial life-history requirement is absent and that species will be unable to sustain its existence or will emigrate to areas with more suitable habitat (with varying success rates). Schaefer and Brown (1992) concluded that if enough of these life-history elements are removed for a number of animals, the natural functioning requirements of the riparian ecosystem will be adversely affected or lost altogether.

Although the literature base regarding riparian ecosystems is substantial, no direct research is known that serves to define an acceptable relationship between riparian habitat and urban land uses. To assist in defining this relationship, Impact Sciences performed extensive investigations that were intended to satisfy two goals: (1) to protect and enhance terrestrial species diversity within the Santa Clara River and San Francisquito Creek riparian corridors east of Interstate 5; and (2) to define an acceptable standard of separation (i.e., a buffer and/or protection zone) between the riparian corridor and development projects proposed proximal to the Santa Clara River and San Francisquito Creek east of Interstate 5. These investigations were conducted to assist the Newhall Land and Farming Company in the design of projects that accommodate their need for development but protect sensitive riparian resources.

2. PROJECT TEAM

To respond to the complexity of these issues, Impact Sciences involved five members of its own in-house biological resources team. Each of these biologists are well-versed with biological resources present in the Santa Clarita area. In addition, to fulfill the exacting and complex requirements of this study, other biologists with specific expertise regarding riparian/upland habitat and ecotone use, bird and mammal life history requirements, population viability analysis, and home range determination were consulted. While biologists from Impact Sciences conducted the majority of the study design, data collection and interpretation, other biologists assisted the Impact Sciences team as required in the field or during report preparation.

Impact Sciences biologist Scott Cameron specializes in small mammals and currently holds valid federal endangered and threatened species permits issued under Section 10(a) of the Endangered Species Act of 1973 as amended (Permit Number PRT-808242), as well as a joint federal and state Scientific Collecting Permit (Permit Number 2876). Mr. Keith Babcock is a bird specialist and has over 11 years of experience in both wildlife biology and project management. He serves on the State of California Swainson's Hawk Technical Advisory Committee and currently holds a federal Section 10(a) permit to survey for California gnatcatcher, as well as federal and state permits to trap a variety of raptor species. Mr. David Crawford is a fisheries specialist and currently holds a federal Section 10(a) permit for sensitive aquatic species and a state Scientific Collection Permit. Ms. Gwendolyn Kenney, Impact Sciences botanist, has extensive experience with southern California plants and vegetation communities and has conducted numerous studies in the Santa Clarita area. In addition to these Impact Sciences biologists, Dr. Daniel Guthrie, a wildlife biologist and ornithologist with extensive experience conducting bird surveys and studies in the Santa Clara River basin, provided assistance in the data collection efforts. Résumés for Impact Sciences biologists are included in this report as **Appendix A**.

In addition to the geographic and species-specific expertise of the project team, their knowledge of riparian ecosystems was expanded via an intensive review of the relevant literature. Prior to developing a study program, over 80 literature sources were reviewed to more completely understand the functioning characteristics of riparian species and ecosystems. Literature sources reviewed and cited in this text, and personal communications with other biologists pertaining to this study, are included in the bibliography in **Appendix B**. The combined experience of the project team served as a basis for conceptualizing a study plan, defining assumptions, and conducting the associated field investigations.

3. STUDY PLAN

a. Background

A mission of Newhall Land and Farming Company is to develop land in the Santa Clarita area. However, development is now proposed in areas proximal to riparian vegetation that are considered sensitive by state and federal agencies, local governments, and the public. As such, it is the intent of Newhall Land and Farming Company to develop land, but in a way that is responsive to the sensitive resources present and their ecology.

As previously indicated, studies of riparian ecosystems were substantial, but little direct research is known that provided specific standards for development proximal to sensitive riparian vegetation. Without such guidance, it is not possible for Newhall Land and Farming Company to confidently plan projects that balance their needs and protect sensitive riparian resources. Impact Sciences was retained by Newhall Land and Farming Company to study this issue and make specific recommendations that would protect the riparian resource and mitigate any residual impacts. Impact Sciences was hired based on their experience with the ecology of the Santa Clarita area, their understanding of the area's sensitive biological resources, their understanding of issues associated with land development, and their understanding of, and direct relationship to, the environmental impact report (EIR) and review process that would be the mechanism ensuring implementation of study recommendations.

Impact Sciences initiated this work with a thorough review of the relevant literature and historic aerial photographs of the Santa Clarita area. This review indicated that prior to farming, a mosaic of grassland, coastal sage, and Great Basin sage likely occurred adjacent to a well-defined riparian zone associated with the Santa Clara River and San Francisquito Creek. However, this area of southern California was settled early in the state's history, and farming and grazing have occurred since the 1700s. More recently, intensive land development and farming has further altered the physiography and hydrology of the region. It is understood that these alterations have had a corresponding effect on the area's ecology by reducing species diversity and abundance, as only vestiges of undisturbed riparian and adjacent upland habitat remain east of Interstate 5.

In any functioning riparian ecosystem, three biological resource zones are present; riparian vegetation (inclusive of water, substrate, etc.), adjacent uplands, and the upland/riparian ecotone. In the Santa Clarita region, riparian resources are well-defined and at least portions of the riparian corridor are in relatively good condition. This is not the case for the adjacent uplands. As mentioned

above, farming activities have occurred for many years adjacent to the riparian zone and have substantially reduced or eliminated upland habitat and the ecotone in areas where development is currently proposed east of Interstate 5.

b. Study Purpose

To satisfy the two goals of this study (i.e., the protection and enhancement of terrestrial species diversity within riparian resources east of Interstate 5 and to define a standard of resource protection), on-site data must be used to form the foundation of any recommendation(s). However, disturbances have virtually eliminated any viable upland habitat proximal to the riparian corridor east of Interstate 5; consequently, data describing the resource prior to these disturbances, and species diversity indices where riparian and uplands co-exist east of Interstate 5, are absent. For purposes of this report, it is assumed that loss of uplands adjacent to riparian vegetation associated with the Santa Clara River and San Francisquito Creek east of Interstate 5 have reduced species diversity in the riparian corridor.

To account for the goal of protecting and enhancing terrestrial species diversity in these riparian corridors, it was determined that two gaps in the existing data base were present, and filling these gaps was necessary before any informed recommendations could be developed. First, given historic disturbances, no site specific data is known that defines the extent to which riparian birds use the adjacent uplands within the Santa Clarita region, and if habitat quality positively correlates to this use as well as to riparian bird diversity. Therefore, as a fundamental measure of resource protection and enhancement, an objective of the study was to obtain information regarding avian use in areas of both high and low quality riparian and upland habitat.

Second, while general home range size and movement patterns are known for most small mammal species, little or no site specific data exists, with respect to habitats in the Santa Clarita area, that define any variation in home range size based on quality of the habitat present. Therefore, this study emphasized defining home range size for small mammals in areas of high and low quality upland and riparian habitat. Given this information, specific recommendations can be made with respect to ecosystem protection and enhancement based on the concepts of sustainable small mammal populations and, consequently, the protection and enhancement of riparian predators that occur within the resource.

Methods and results are defined in the following sections of this report. A discussion follows that defines specific recommendations that focus on achieving the goals defined above.

4. METHODOLOGY

a. Study Site Selection

As previously stated, the focus of the study was on upland habitat use by riparian dependent birds and by small mammals within the Santa Clarita area (**Figure 1**). Therefore, preferred study sites would include areas of relatively undisturbed upland habitat common to the study region (i.e., coastal sage scrub and/or Great Basin sage scrub) adjacent to moderate or high quality riparian habitat. Because it is assumed that preserved upland habitat zones along the Santa Clara River and San Francisquito Creek associated with future projects will be revegetated and enhanced with higher quality upland vegetation, particular emphasis was on selecting study sites with upland habitat considered of relatively high quality (as determined by such factors as dominant plant species, shrub density, percent cover, etc.). Areas containing lower quality upland habitat would also be studied for comparison. Some riparian resources in the Santa Clara River and San Francisquito Creek located east of Interstate 5 are considered to be of moderate to high quality and could provide useful information regarding riparian obligates. However, east of Interstate 5, naturally occurring upland habitat adjacent to or in the vicinity of the Santa Clara River or San Francisquito Creek is disturbed, if not absent altogether. Upland areas that remain are generally of small size (less than five acres), and have been disturbed either directly or indirectly through land development or farming. Locations west of Interstate 5 contain the best examples of both undisturbed riparian and upland habitat and their associated ecotone. Further, these areas are proximal (less than five miles) to sites proposed for development east of Interstate 5.

Evaluations by Impact Sciences biologists of aerial photographs and recent vegetation maps, as well as field reconnaissance trips, confirmed these observations. Based upon this analysis, four site locations (one high quality upland site and one low quality site for each of the target group of animals) were selected. The high quality site for the bird study was located on the southern edge of the Santa Clara River west of Castaic Junction (**Figure 2**). The low quality site was located along the Santa Clara River east of Interstate 5 south of Bouquet Canyon (**Figure 3**). The two small mammal study sites were located along the Santa Clara River west of Castaic Junction and were in close proximity to each other (**Figure 4**).

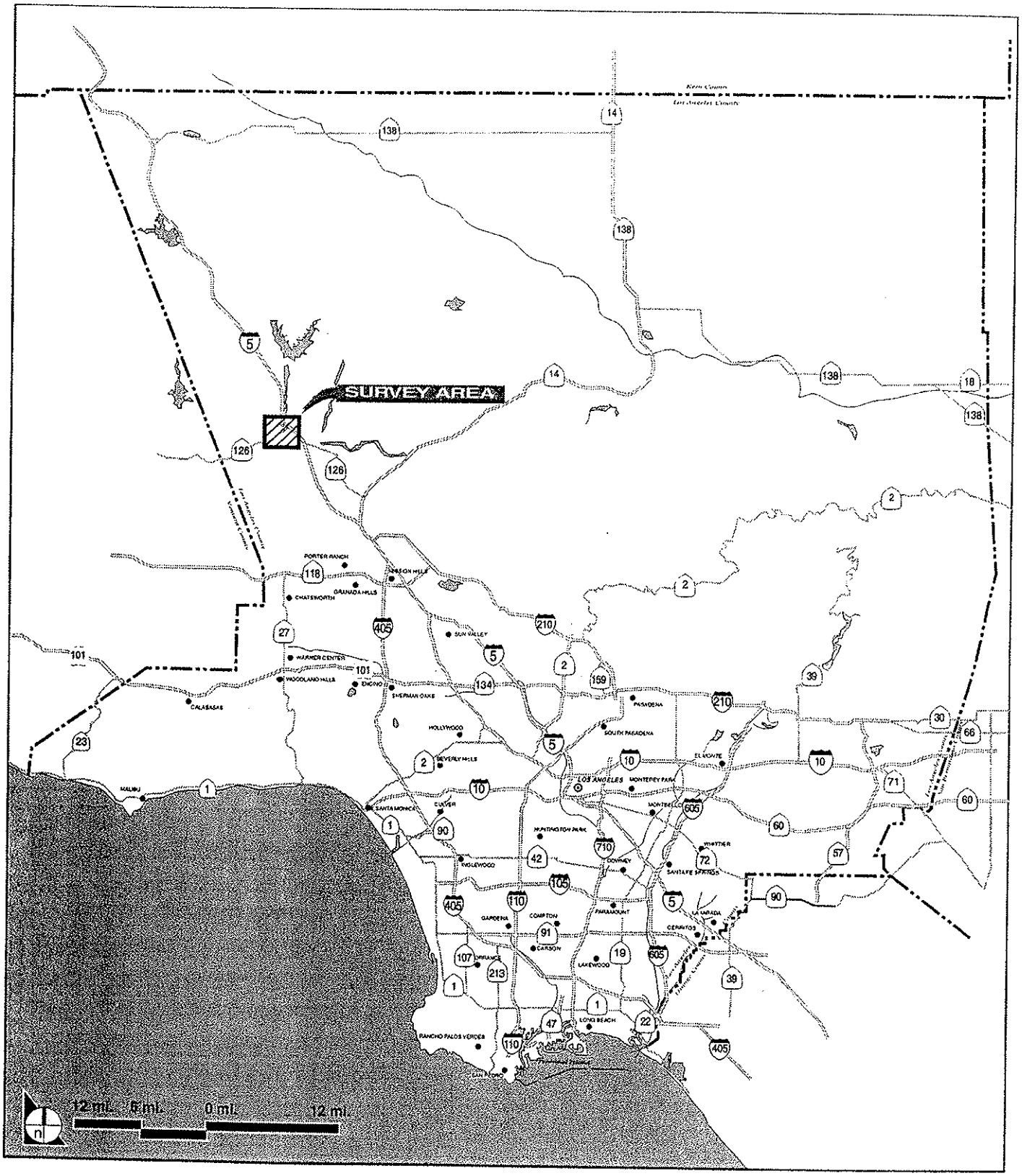

FIGURE 1

Regional Location Map

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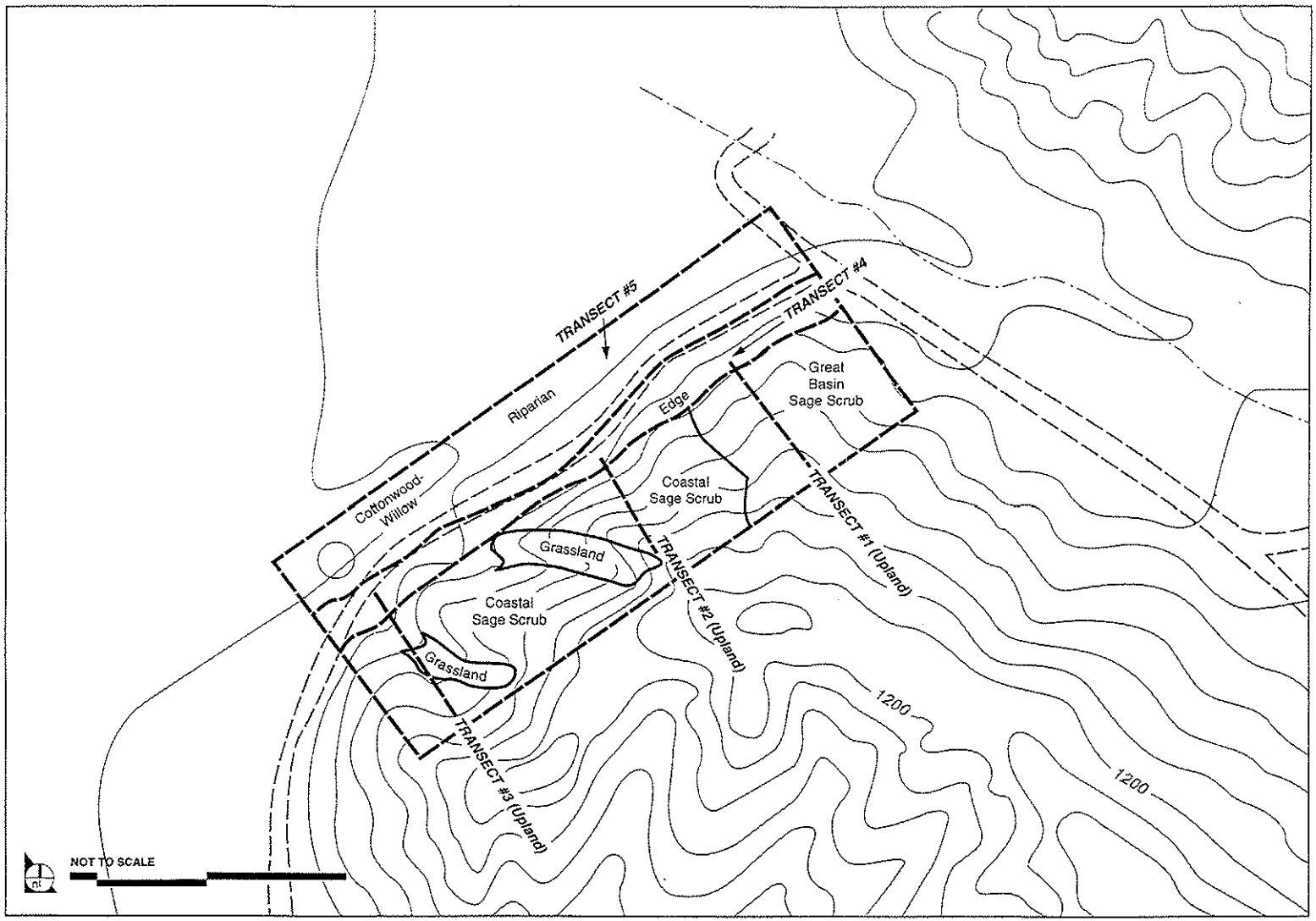

NOTE: *This figure is intended for graphic representation only. Although all information as seen here is placed on an enlarged U.S.G.S. 7.5 min. "Newhall" Quadrangle it is not to exact scale.*

FIGURE **2**

Western Bird Site (Low Quality Habitat)

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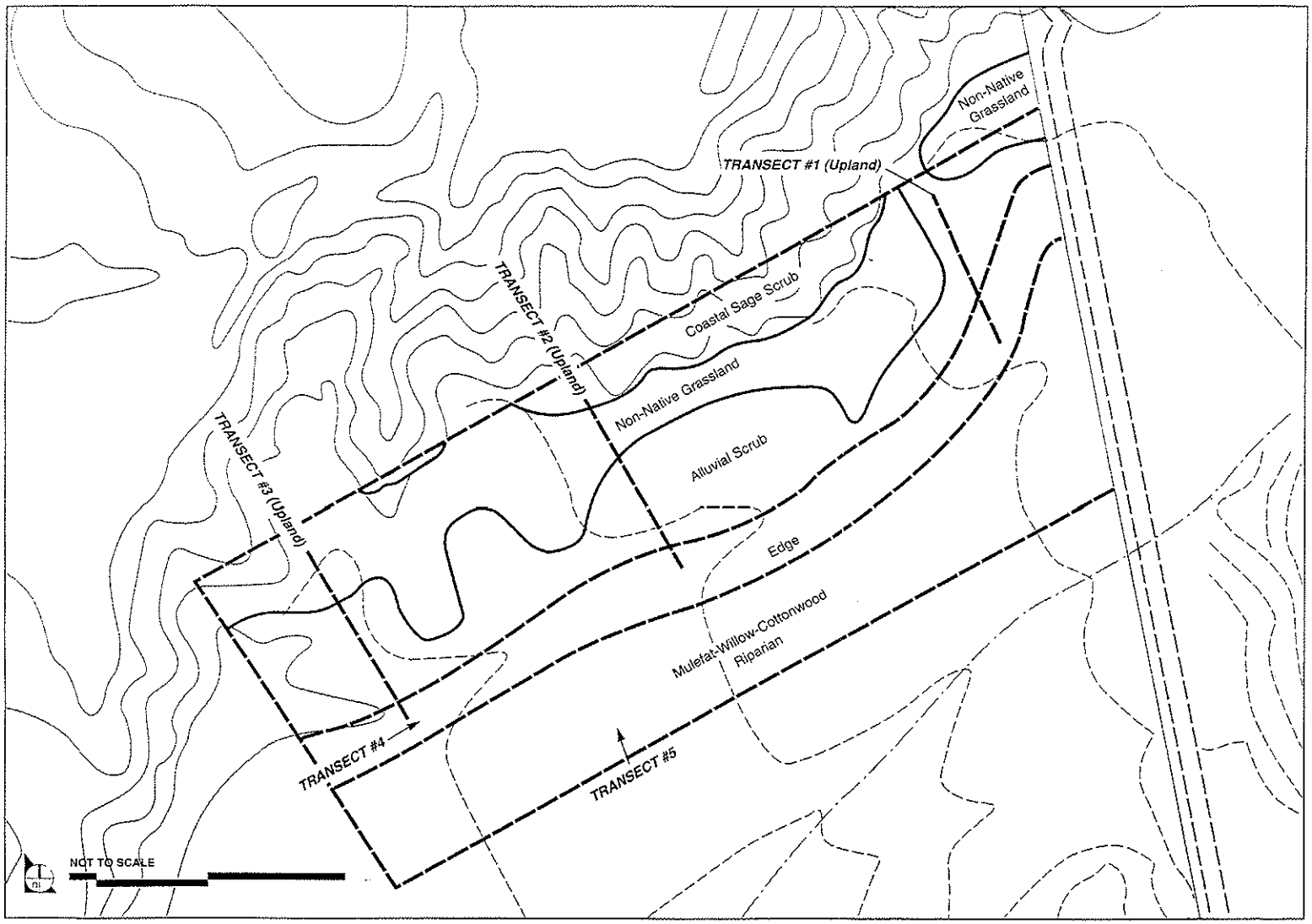

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FIGURE 3

Eastern Bird Site (Low Quality Habitat)

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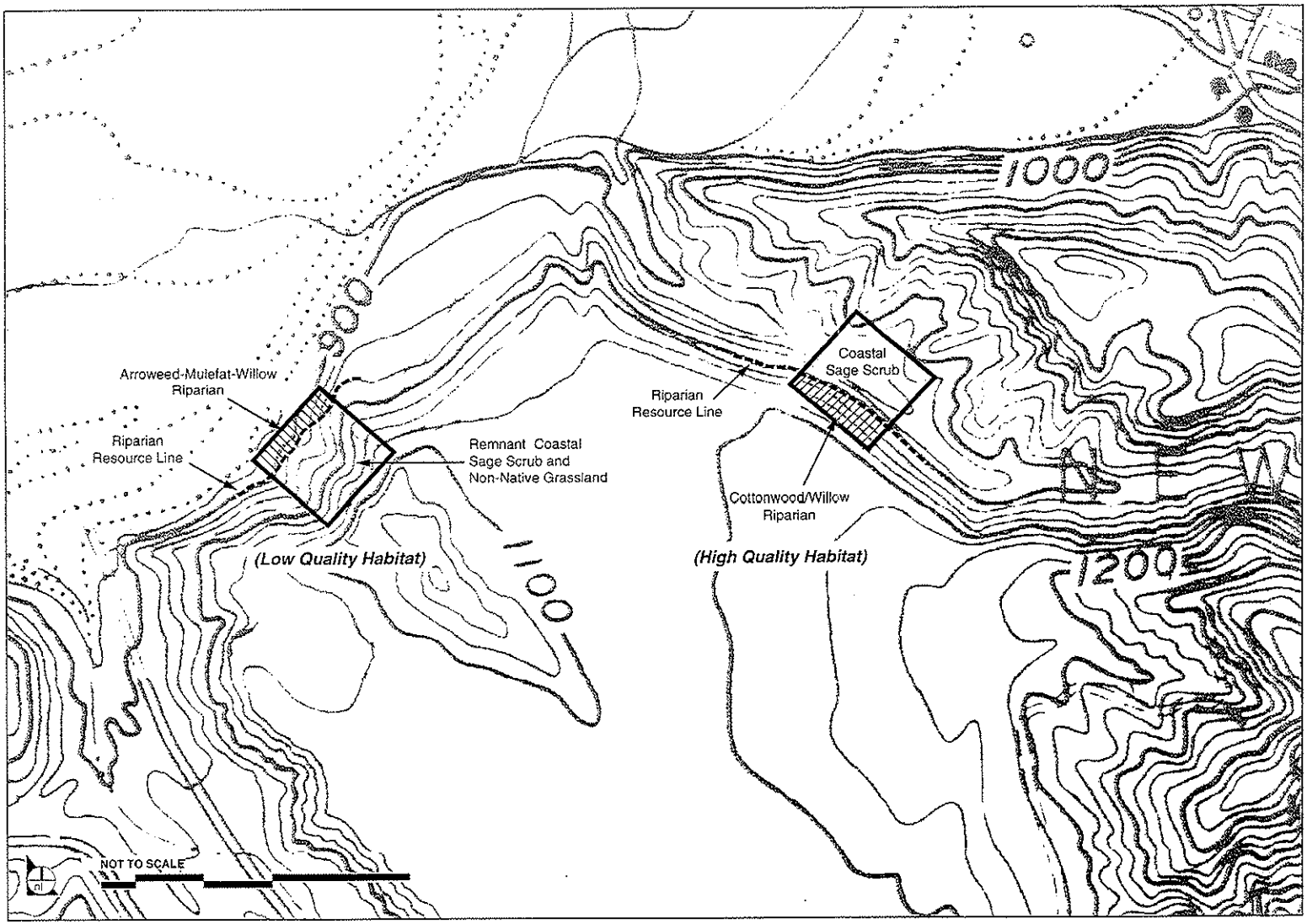

NOTE: *This figure is intended for graphic representation only. Although all information as seen here is placed on an enlarged U.S.G.S. 7.5 min "Val Verde" Quadrangle it is not to exact scale.*

FIGURE **4**

Small Mammal Study Sites

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b. Vegetation Analysis

Information regarding the floristics of the vegetation present on each study site was compiled and analyzed. This information included qualified data regarding plant species composition, canopy height, shrub/tree density, percent cover, and other species-specific criteria. Detailed vegetation analyses conducted for the bird and small mammal surveys are enumerated in their associated methodology sections. The purpose of this more micro-scale vegetation analysis was twofold. First, it provided a basis to define high quality versus low quality upland habitat in order to identify study plots to compare wildlife use and diversity within varying quality habitat. And second, this information would be required to define biological models that could be used as a guide in the development of revegetation plans for upland vegetation that may be identified as mitigation in EIRs prepared for future development projects in the region.

Floral taxonomy followed the Jepson Manual (Hickman, 1993). Common plant names not available in Hickman were derived from Munz (1974), Beauchamp (1986), Abrams (1923, 1944), and Abrams and Ferris (1951, 1960).

c. Wildlife Studies

Focused field investigations with respect to wildlife resources were conducted to fill the data gaps previously identified. These investigations were conducted under the direction of Mr. Babcock and involved all members of the Impact Sciences project team, as well as Dr. Guthrie. Phase I of the field effort, conducted in October and November of 1996, was intended to identify relative abundance and diversity of mammals and resident riparian birds in the Santa Clara River study region and to assist in the identification of target species for more intensive studies in the future. Phase II focused specifically on the use of upland habitat and the upland/riparian ecotone by riparian birds and small mammals and the comparison of this use in both high and low quality upland habitat areas. Specific field investigations involved time-area observations, belt-transect counts, an extensive small mammal live trapping program, and the use of scent stations and remote cameras. In total, the field investigations conducted by Impact Sciences totaled over 1,100 man-hours over a 62-calendar-day period. The specific methodologies for each of the animal groups are briefly described below.

(1) Birds

(a) Phase I

Phase I of the bird study consisted of literature review, contacting biologists familiar with riparian birds in southern California, and limited field reconnaissance to various riparian areas within the study region. Target bird species to be used as the basis of the Phase II study were also identified in the Phase I portion of this study.

Literature Review

Literature review included evaluation of the following: (1) studies and documentation of riparian/upland ecotone use by the riparian bird species in California; (2) surveys and studies conducted by Dr. Guthrie and other biologists along the Santa Clara River and San Francisquito Creek; (3) life history and habitat use information on the target species; and (4) environmental review documents for proposed projects within the study region. All studies, papers, reports, and other literature that were compiled and reviewed for this analysis are listed in the bibliography in **Appendix B**. A number of avian biologists familiar with riparian birds in the study region, particularly Dr. Guthrie, were contacted to obtain anecdotal and/or documented information on use of riparian and upland habitats by these birds. Individuals contacted are included in the bibliography.

Field Investigations

Three day-long surveys were conducted on November 2, 3, and 5, 1996, by Dr. Guthrie and Mr. Babcock to generally characterize the diversity and relative abundance of birds along the Santa Clara River in the study region. Surveys were conducted along San Francisquito Creek and along the northern side of the Santa Clara River from Interstate 5 upstream for about one mile. Potential target species for the future focused studies were also evaluated.

Target Species Selection

As a result of the Phase I literature review and field reconnaissance, target bird species were selected to serve as the basis for the Phase II studies. Bird species selected included two groups of riparian birds: those that are considered highly dependent on riparian habitat and those that are commonly associated with riparian habitat but that also are commonly found in upland habitats

adjacent to riparian and woodland areas. This latter group of birds was included because in this particular region there are relatively few species of birds that would be considered truly riparian dependent that also occasionally use upland habitats. In general, because of the relative lack of other woodland communities in the study region, it was assumed that most bird species known to occur in this area that are generally strongly associated with riparian and/or woodland habitats would be dependent upon, or associated with, the riparian habitat along the Santa Clara River.

The riparian dependent group of target species selected for this study included the following: song sparrow (*Melospiza melodia*), common yellowthroat (*Geothylpis trichas*), least Bell's vireo (*Vireo bellii pusillus*), yellow-breasted chat (*Icteria virens*), Wilson's warbler (*Wilsonia pusilla*), yellow warbler (*Dendroica petechia*), black phoebe (*Sayornis nigricans*) and blue grosbeak (*Guiraca caerulea*). Riparian associated birds that are more commonly found in upland habitat selected for the study included lazuli bunting (*Passerina amoena*), spotted towhee (*Pipilo maculatus*), black-headed grosbeak (*Pheucticus melanocephalus*), orange-crowned warbler (*Vermivora celata*), Bewick's wren (*Thryomanes bewickii*), house wren (*Troglodytes aedon*), and lessor goldfinch (*Carduelis psaltria*). These groups of bird species were also endorsed by Dr. Guthrie, who has over seven years of bird field research, encompassing over 1,500 field hours, along the Santa Clara River corridor (Guthrie, personal communication). It was concluded that information regarding least Bell's vireo was already well documented via previous investigations at appropriate locations throughout southern California, including the Santa Clara River corridor. Because substantial information had been previously compiled regarding the breeding status and behavior of this bird, it was felt by Impact Sciences that additional field research would not be necessary with respect to this species because it would not significantly add to or alter the existing data base.

(b) Phase II

Field Investigations

Phase II of the study involved focused time-area surveys at the selected study sites. At each of the two study sites, three parallel belt transects were established extending from the riparian habitat edge into the adjacent upland habitat (**Figures 2 and 3**). Each transect was 200 feet in length. Using a compass and a measuring tape, stakes with brightly colored surveyor's tape were placed at 50-foot intervals along the transect to aid in accurately mapping locations and foraging activities of individual target bird species. A width of 75 feet on either side of the transect was included in the survey area for a total belt transect that measured 150 feet by 200 feet. Each of the upland habitat belt transects were approximately 200 to 300 feet apart. Another transect was established along the

riparian/upland habitat ecotone edge to study ecotone use of target bird species. This transect extended a distance of approximately 1,500 feet. A fifth transect was established approximately 100 feet within the riparian habitat that paralleled the edge transect. This transect was established to determine the presence of riparian dependent birds in the event that none of these birds were observed in upland habitat areas. A width of 50 feet on either side of the edge and riparian transects was included in the survey area. The total area for each of the bird study plots measured approximately nine acres in size.

Field visits were made early in the morning (30 minutes after sunrise) and continued until approximately mid-day. Each upland habitat transect was walked slowly with 10-minute stops at each 50-foot interval. The edge and riparian transects were also walked slowly, with 10-minute stops at 100-foot intervals. The timing of the transect routes was designed to minimize the potential of duplicate counts of target bird individuals. All observations of target bird species were noted and recorded onto data sheets which included weather and observer information, target species, and location zone (0 to 50 feet, 50 to 100 feet, etc.) in which each target species was observed (**Appendix C**). Once a target bird was observed, all location zones visited by that bird during the 10-minute observation period were documented. Multiple visits to the same location zone by the same bird during the observation period were only recorded once for that zone. To avoid a bias toward edge and riparian bird counts, target bird species along these transects were only included in the analysis if the observation occurred within one of the upland belt transects (where these transects intersected the riparian habitat). Observations of non-target bird species were also noted. A total of seven consecutive visits, from April 9 to April 16, 1997, were made to each study site by an Impact Sciences biologist. To minimize observer bias on consecutive survey days, different transect start and end points from the previous visit were employed.

Vegetation Analysis

During the Phase II studies, a qualitative vegetation analysis was also conducted. Seven structural variables were measured along each of the five avian transects on each study site. Analysis of the habitats selected for the bird study included descriptions of the following: (1) shrub/tree cover variability; (2) percentage shrub/tree cover; (3) percentage of ground cover; (4) average shrub/tree height; (5) percentage of herbaceous cover; (6) herbaceous cover variability; and (7) shrub/tree height variability. Information relative to the structure of the habitat located along each transect was collected during the bird surveys. The vegetation variables were selected on the basis of their contribution to the plant structure along an approximately 75-foot-wide area on each side of the bird

transects. These variables were used to define habitat quality differences between the eastern (low quality) and western (high quality) study sites.

(2) Small Mammals

It is an assumption of this study that a fundamental requirement of a sustainable population of small mammals is the provision for an adequate home range size. On or near the study site, no useful data had been compiled that defined small mammal composition or home range size regardless of the quality of habitat. This information is fundamental if one is to accurately define the area of uplands necessary to sustain small mammal populations. Therefore, field work associated with this study focused on characterizing small mammal species diversity and defining site-specific home range sizes in the selected study areas. This information, combined with what is considered a complete literature base characterizing the life history and breeding behavior of small mammals, provided the inputs necessary to define home range size and contribute to the analysis of what is considered an adequate buffer. Specific methodologies for the Phase I and Phase II small mammal study are presented below.

(a) Phase I

Phase I of the small mammal study consisted of literature review and field studies to more accurately define small mammal species composition and relative distribution within riparian habitats and along the riparian/upland edge (which consisted primarily of agricultural lands and ruderal habitat) associated with San Francisquito Creek and the Santa Clara River. Field work included a small mammal trapping program and the use of scent stations and remote camera stations. Target small mammal species to be used as the basis of the Phase II study were also identified in the Phase I portion of this study.

Literature Review

Existing biological information relative to selected target species determined to be pertinent to this study was obtained from the following sources: (1) documents describing previously conducted surveys of wildlife occurring within, or in the vicinity of, the study areas; (2) known habitat use requirements and behavior of wildlife species expected to occur within the study areas; (3) literature pertaining to establishing riparian buffers for wildlife species; and (4) the California Natural Diversity Data Base (CNDDB, 1996). This information was used to aid in the

identification of target small mammal species for Phase II of the study as well as to better understand home range and movement patterns by selected small mammal species.

Live-Trapping Program

To determine an appropriate buffer width that effectively addresses the needs of native wildlife within a system, those species occupying the area must be identified. Field surveys provide a representative list of species occurring within a specified area. In order to directly identify small mammal species occurring in selected study areas, a small mammal live-trapping program was conducted by Impact Sciences in October and November 1996. Areas selected for this phase of the trapping program included sites located at the confluence of San Francisquito Creek and the Santa Clara River, along portions of San Francisquito Creek, and adjacent to selected areas of the Santa Clara River.

Both large (12-inch) and medium (9-inch) Sherman folding aluminum live-traps were used during the trapping study. A total of 12 transects were established within riparian habitats in selected study areas. Five 100-meter (approximately 325 feet) linear traplines, one 150-meter (approximately 500 feet) linear trapline, and six 125-meter (approximately 400 feet) linear traplines were established by placing trap stations every three meters (approximately 10 feet). Traps were set in the early evening and checked early the following morning. Captured mammals were identified to species, age, and sex, and released unharmed at the capture site. Small mammals recorded during the surveys were marked by non-permanent methods (e.g., hair-clipping) and released at the point of capture. To avoid mortality due to cold nighttime temperature, the traps were closed after being checked in the morning, and reset in the evening. A total of 1,210 cumulative trapnights were conducted during the Phase I live-trapping program by Impact Sciences biologists.

Remote Camera Stations

Remote camera stations were also used to document wildlife species moving through particular areas of the project site. Six nights of camera stations were conducted at selected locations on the project site. A total of three fixed positions were set in the confluence area of San Francisquito Creek and the Santa Clara River. All wildlife species observed were recorded onto data sheets. In addition to species identification, transect location, species behavior, and time of observation were also recorded. Cameras were set to gather photographs over a 24-hour period.

Scent Stations

Baited scent stations were set at various points along the Santa Clara River and San Francisquito Creek, particularly near the confluence of these two riverine systems. Scent stations were established by carefully clearing an area approximately four feet in diameter and layering the clearing with smoothed diatomaceous earth. An opened can of cat food was placed in the center of the station. The diatomaceous earth provides a suitable substrate to allow deposition and identification of tracks.

Target Species Selection

As a result of the Phase I analysis, the following small mammal species were selected as target species for the Phase II study: dusky-footed woodrat (*Neotoma fuscipes*), California mouse (*Peromyscus californicus*), brush mouse (*Peromyscus boylii*), deer mouse (*Peromyscus maniculatus*), and western harvest mouse (*Reithrodontomys megalotis*).

(b) Phase II

The Phase II small mammal study examined habitat relationships between sympatric small mammals species occurring in higher and lower quality vegetation communities located within the same physiographic area. It was also our intention to: (1) evaluate the average daily movement patterns (and ultimately calculate home range diameter) of the target small mammal species; and (2) provide an overall small mammal daily movement and home range comparison between relatively high quality and relatively low quality upland habitat types located at the riparian/upland ecotone. Phase II trapping was conducted in December 1996 and January 1997.

Live-Trapping Program

Two separate live-trapping grids (A and B) comprising 121 Sherman live-traps each were established in two habitat types of varying quality so that daily small mammal activity could be quantitatively measured (**Figure 4**). Both large (12-inch) and medium (9-inch) Sherman folding aluminum live-traps were used during the Phase II trapping study. Each Sherman trap was placed at 20-foot (6-meter) intervals in a 200- by 200-foot (61-meter) grid. Each grid contained 11 rows with 11 traps per row. Traps were set in the early evening and checked early the following morning. Captured mammals were identified to species, age, and sex on data sheets (**Appendix C**), and released unharmed at the capture site. Small mammals recorded during the Phase II (December 19

to January 11, 1997) surveys were marked by non-permanent methods (e.g., hair-clipping) and released at the point of capture. To avoid mortality due to cold nighttime temperature, the traps were closed after being checked in the morning, and reset in the evening. A total of 1,210 cumulative trapnights were conducted during the Phase II live-trapping program conducted by Impact Sciences.

A total of 2,420 cumulative trapnights were conducted during the Phase I and Phase II live-trapping program conducted by Impact Sciences. All data collected during the live-trapping program (1) conformed to established protocols or accepted methodologies; (2) was carried out under a rigid management and quality assurance program, and (3) was conducted by qualified and appropriately certified and/or permitted individual(s).

Home Range Analysis

Home ranges are assumed to be somewhat circular in shape (Fitch, 1958). Therefore, the average of the two largest single movement distances that resident small mammal species moved within each grid over a five-day period was used as the specific home range radius. Intrinsically, circular home ranges were developed for each species by doubling the radius (i.e., diameter). The diameter of the home range circle was determined to represent the approximate width of each home range. While it is understood that home ranges are not exact circles (Sanderson, 1966), Anderson and Hudson (1980) suggest that it is more valuable to use existing models despite their imperfections, rather than to take no action until refined methods are developed. Furthermore, it is also understood that some situations require a more thorough home range analysis, and therefore, should consider the amount of circular overlap within each species (Schaefer and Brown, 1992).

Vegetation Analysis

Eight structural variables were measured around each grid trap station. Discriminant analysis of the habitats selected for this study were primarily based on three correlated parameters including: (1) canopy height; (2) shrub density; and (3) percentage of ground cover. Additional analysis included: (4) plant species composition; (5) dominant plant species; (6) soil characteristics; (7) slope; and (8) aspect. Information relative to the structure of the habitat at each trap station was collected during the live-trapping effort. The vegetation variables were selected on the basis of their contribution to the plant structure in an approximately three-foot (one-meter) square area at each trap station. The vegetation data was used to test the hypothesis that habitat quality influences small mammal diversity and daily movement patterns.

5. RESULTS

Because the goals of the study focused on target species use of upland habitat and the upland/riparian ecotone in areas adjacent to riparian habitat, the discussion of study results focuses on the Phase II analysis. A brief discussion of Phase I results, where these results contribute to the overall study analysis, is also included.

a. Birds

(1) Phase I

Anecdotal observations from other biologists (DeSante, 1996; Guthrie, 1996) regarding the use of adjacent upland areas by riparian bird species indicated that the distance traveled from the riparian edge varied considerably depending on the particular bird species and the nature of the adjacent habitat. Some species almost never travel into adjacent upland areas, while others, particularly raptors (birds of prey), may travel large distances from their riparian nests in search of food. Most raptor species that are known to nest within riparian areas are fairly opportunistic and will utilize both adjacent upland habitats as well as other suitable habitats in the vicinity of the riparian area. In general, the consensus of the biologists contacted for this study was that most smaller (non-raptor) bird species that depend on riparian vegetation for breeding would not travel much more than 200 feet from the riparian zone, and would generally stay closer.

(2) Phase II

(a) Western Site

Upland habitats on the western study site consist primarily of dense Great Basin sage and coastal sage scrub. The percentage of observations (n=102) of riparian dependent (List A) birds in the seven location zones are as follows (**Table 1**): 62.7 percent of observations were in riparian habitat; 13.7 percent were in edge habitat; 17.6 percent were in upland habitat within 50 feet of resource edge; 4.9 percent were between 50 and 100 feet of resource edge; and 1.0 percent (1 bird observation) were between 100 and 150 feet. No List A birds were observed beyond 150 feet. The percentage of observations of List A birds dropped dramatically beyond the riparian habitat, and again beyond 50 feet within upland habitat. All total, 94.2 percent of the observations of List A birds were within 50 feet of the riparian resource edge (including the riparian habitat); 99.0 percent of the observations of List A birds were within 100 feet of the riparian resource edge.

Table 1
Percentage of Observations of Riparian Dependent and
Riparian Associated Birds at the Western Study Site

	% RIPARIAN	% EDGE	% 0-50	% 50-100	% 100-150	% 150-200	% >200
TARGET LIST A	62.74	13.73	17.64	4.91	0.98	0	0
TARGET LIST B	17.86	30.95	19.64	16.08	4.76	7.14	3.57
BEWR	21.68	33.33	28.33	13.33	3.33	0	0
BHGR	50.00	0	0	50.00	0	0	0
COYE	53.33	20	20	0	6.67	0	0
HOWR	10.53	47.37	31.57	10.53	0	0	0
LABU	7.69	30.78	0	7.69	0	46.15	7.69
LEGO	33.33	16.67	0	33.33	0	16.67	0
OCWA	35.29	29.42	23.53	11.76	0	0	0
SOSP	69.09	7.27	21.82	1.82	0	0	0
SPTO	9.37	12.5	0	28.12	18.75	15.63	15.63
WIWA	56.25	21.88	9.37	12.5	0	0	0

List A: Riparian dependent target bird species
List B: Riparian associated target bird species

BEWR = Bewick's Wren
BHGR = Black-Headed Grosbeak
COYE = Common Yellowthroat
HOWR = House Wren
LABU = Lazuli Bunting
LEGO = Lessor Goldfinch
OCWA = Orange-Crowned Warbler
SOSP = Song Sparrow
SPTO = Spotted Towhee
WIWA = Wilson's Warbler

The percentage of observations (n=168) of riparian associated (List B) birds in the seven location zones are as follows: 17.9 percent of observations were in riparian habitat; 30.9 percent were in edge habitat; 19.6 percent were in upland habitat within 50 feet of the resource edge; 16.1 percent were between 50 and 100 feet of the resource edge; 4.8 percent were between 100 and 150 feet; 7.1 percent were between 150 and 200 feet; and 3.6 percent were observed beyond 200 feet. All total, 84.5 percent of the observations of List B birds were within 100 feet and 89.3 percent were within 150 feet. Three of the List B bird species (spotted towhee, lazuli bunting, lessor goldfinch) account for all observations of List B birds beyond 150 feet.

When we consider the percentage of the observations of List A birds in *upland* habitat only, the following results were found (**Table 2**): 74.0 percent were within 50 feet of the resource edge,

21.7 percent were between 50 and 100 feet, and 4.3 percent (1 bird observation) were between 100 and 150 feet. All total, 95.7 percent of all observations of List A birds using upland habitat were within 100 feet of the resource edge.

Table 2
Percentage of Observations of Riparian Dependent and Riparian Associated Birds in Upland Habitat at the Western Study Site

	% 0-50	% 50-100	% 100-150	% 150-200	% >200
TARGET LIST A	74.00	21.70	4.30	0	0
TARGET LIST B	37.60	31.80	9.40	14.10	7.10
BEWR	62.96	29.63	7.41	0	0
BHGR	0	100.00	0	0	0
COYE	75.00	0	25.00	0	0
HOWR	75.00	25.00	0	0	0
LABU	0	12.50	0	75.00	12.50
LEGO	0	66.67	0	33.33	0
OCWA	66.67	33.33	0	0	0
SOSP	92.31	7.69	0	0	0
SPTO	0	36.00	24.00	20.00	20.00
WIWA	42.86	57.14	0	0	0

List A: Riparian dependent target bird species
List B: Riparian associated target bird species

BEWR = Bewick's Wren
BHGR = Black-Headed Grosbeak
COYE = Common Yellowthroat
HOWR = House Wren
LABU = Lazuli Bunting
LEGO = Lessor Goldfinch
OCWA = Orange-Crowned Warbler
SOSP = Song Sparrow
SPTO = Spotted Towhee
WIWA = Wilson's Warbler

Of the observations of List B birds in *upland* habitat, 37.6 percent were within 50 feet of the resource edge, 31.8 percent were between 50 and 100 feet, 9.4 percent were between 100 and 150 feet, 14.1 percent were between 150 and 200 feet, and 7.1 percent were beyond 200 feet. All total, 69.4 percent of all observations of List B birds in upland habitat were within 100 feet of the resource edge; 78.8 percent of the observations were within 150 feet.

(b) Eastern Site

The percentage of observations (n=10) of riparian dependent (List A) birds in the seven location zones at the Eastern site are as follows (**Table 3**): 30.0 percent of observations were in riparian habitat; 40.0 percent were in edge habitat; 10.0 percent were in upland habitat (primarily degraded Great Basin sage, coastal sage scrub, and ruderal grassland) within 50 feet of resource edge; 10.0 percent were between 50 and 100 feet of resource edge; and 10.0 percent were between 100 and 150 feet. No List A birds were observed beyond 150 feet. The percentage of observations of List A birds dropped dramatically outside the riparian resource edge. All total, 90.0 percent of the observations of List A birds were within 100 feet of the riparian resource edge.

Table 3
Percentage of Observations of Riparian Dependent and Riparian Associated Birds at the Eastern Study Site

	% RIPARIAN	% EDGE	% 0-50	%50-100	%100-150	%150-200	%>200
TARGET LIST A	30.00	40.00	10.00	10.00	10.00	0	0
TARGET LIST B	20.00	23.33	33.33	16.67	2.22	3.33	1.11
BEWR	21.05	21.05	44.74	13.16	0	0	0
BHGR	50.00	0	0	50.00	0	0	0
HOWR	25.00	12.50	37.50	25.00	0	0	0
LEGO	0	33.33	55.56	11.11	0	0	0
SOSP	50.00	25.00	0	0	25.00	0	0
SPTO	21.21	27.27	15.15	18.18	6.06	9.09	3.03
WIWA	16.67	50.00	16.67	16.67	0	0	0

List A: Riparian dependent target bird species
List B: Riparian associated target bird species

BEWR = Bewick's Wren
BHGR = Black-Headed Grosbeak
HOWR = House Wren
LEGO = Lessor Goldfinch
SOSP = Song Sparrow
SPTO = Spotted Towhee
WIWA = Wilson's Warbler

The percentage of observations (n=90) of riparian associated (List B) birds in the seven location zones at the Eastern site are as follows (**Table 3**): 20.0 percent of observations were in riparian habitat; 23.4 percent were in edge habitat; 33.3 percent were in upland habitat within 50 feet of the resource edge; 16.7 percent were between 50 and 100 feet of the resource edge; 2.2 percent were between

100 and 150 feet; 3.3 percent were between 150 and 200 feet; and 1.1 percent were observed beyond 200 feet. Of the observations of List B birds, 93.4 percent were within 100 feet; 95.6 percent were within 150 feet. Percentage of observations of List B birds dropped dramatically beyond 50 feet, and again beyond 100 feet. The spotted towhee accounted for all observations of List B birds beyond 150 feet.

When we consider the percentage of the observations of List A birds in *upland* habitat only, the following results were found (**Table 4**): 33.3 percent were within 50 feet of the resource edge, 33.3 percent were between 50 and 100 feet, and 33.3 percent were between 100 and 150 feet. Of the observations of List B birds in *upland* habitat, 59.6 percent were within 50 feet of the resource edge, 28.9 percent were between 50 and 100 feet, 3.8 percent were between 100 and 150 feet, 5.8 percent were between 150 and 200 feet, and 1.9 percent were beyond 200 feet. All total, 88.5 percent of all observations of List B birds in upland habitat were within 100 feet of the resource edge; 91.5 percent of the observations were within 150 feet.

Table 4
Percentage of Observations of Riparian Dependent and Riparian Associated Birds in Upland Habitat at the Eastern Study Site

	% 0-50	% 50-100	% 100-150	% 150-200	% >200
TARGET LIST A	33.33	33.33	33.33	0	0
TARGET LIST B	60.00	29.00	4.00	6.00	1.00
BEWR	77.27	22.73	0	0	0
BHGR	0	100.00	0	0	0
HOWR	60.00	40.00	0	0	0
LEGO	83.33	16.67	0	0	0
SOSP	0	0	100.00	0	0
SPTO	29.41	35.29	11.76	17.65	5.88
WIWA	50.00	50.00	0	0	0

List A: Riparian dependent target bird species
List B: Riparian associated target bird species

BEWR = Bewick's Wren
BHGR = Black-Headed Grosbeak
HOWR = House Wren
LEGO = Lessor Goldfinch
SOSP = Song Sparrow
SPTO = Spotted Towhee
WIWA = Wilson's Warbler

b. Small Mammals

(1) Phase I

(a) Live-Trapping

The results of the small mammal trapping effort indicate that many of the same species occurring within riparian areas also occur along the riparian/upland ecotone (very narrow bands of degraded coastal sage scrub, grassland, and Great Basin scrub). However, two species trapped within the ecotone habitats, but that were not recorded within the riparian zone (California pocket mouse, San Diego desert woodrat), were not included as target species. Movement of target small mammal species recorded during this trapping study that are known to occupy and utilize both riparian and upland habitat types (i.e., moved between riparian and upland habitats), exhibited average daily movement patterns consistent with previously documented small mammal home range diameters (e.g., WHRS).

(2) Phase II

(a) Live-Trapping

Results of Phase II trapping performed by Impact Sciences revealed that Grid B (n=6) supports a higher diversity of small mammal fauna than Grid A (n=4). Grid A was located in low quality upland habitat (primarily degraded coastal sage scrub), while Grid B was located in high quality upland habitat (dense coastal sage scrub). Grid A (lower quality habitat) supported deer mouse, western harvest mouse, dusky-footed woodrat, and California pocket mouse. Grid B (higher quality habitat) supported western harvest mouse, dusky-footed woodrat, desert woodrat, California mouse, California pocket mouse, and brush mouse. Only three species co-occurred on both grids: western harvest mouse, dusky-footed woodrat, and California pocket mouse. Total number of captures was 63 on Grid A and 58 on Grid B. Capture success was 10.4 percent on Grid A and 9.6 percent on Grid B. **Tables 5 and 6** present results of the number and species of small mammals trapped.

Table 5
Small Mammals Recorded on Grid A

Species	Number of Individuals	Percent of total sample size	Number of Captures	Percent of Total Captures
REME	12	48 %	26	42 %
NEFU	2	8 %	4	6 %
PEMA	10	40 %	29	46 %
CHCA	1	4 %	4	6 %
Totals	25	100 %	63	100 %

REME = *Reithrodontomys megalotis*
NEFU = *Netoma fuscipes*
PEMA = *Peromyscus maniculatus*
CHCA = *Chaetodipus californicus*

Table 6
Small Mammals Recorded on Grid B

Species	Number of Individuals	Percent of total sample size	Number of Captures	Percent of Total Captures
REME	5	20 %	9	16 %
NEFU	7	30 %	19	33 %
PECA	3	12.5 %	6	10 %
PEBO	3	12.5 %	6	10 %
CHCA	4	17 %	14	24 %
NELE	2	8 %	4	7 %
Totals	24	100 %	58	100 %

REME = *Reithrodontomys megalotis*
NEFU = *Neotoma fuscipes*
PECA = *Peromyscus californicus*
PEBO = *Peromyscus boylii*
CHCA = *Chaetodipus californicus*
NELE = *Neotoma lepida*

In addition, more than two times the percentage of small mammals were recorded within 100 feet of riparian resource on Grid B (high quality) than on Grid A (low quality). Beyond 100 feet from the riparian resource edge, percentages of animals captured were more consistent between the two grids. This may suggest that for those small mammals occurring in high quality upland habitats located adjacent to riparian habitats, they tend to utilize the habitats located closer to the riparian habitat.

On Grid B (high quality), all brush mouse were recorded within 60 feet of the riparian resource line; all California mouse were recorded within 80 feet of the resource line; all dusky-footed woodrat were recorded within 40 feet of the resource line (including riparian habitats). These three species are associated with riparian or mesic habitats, and are reported to actively search-out free water sources. Of particular note, the dusky-footed woodrat (considered a riparian associate when habitat available) moved on average 60 percent more on Grid A than Grid B. Average movement for this species was 56.4 feet further on Grid A than Grid B (92.4 feet average movement on Grid A and 36.0 feet average movement on Grid B). Western harvest mouse moved an average of 8.0 percent further on Grid A than Grid B.

Home range sizes were calculated for the six species trapped on Grid B and the four species trapped on Grid A. Grid A (low quality) average home range for all species present was calculated as 150.3 feet in diameter, or a 75.15 feet radius; Grid B (high quality) average home range for all species present was calculated as 103.0 feet in diameter or a 51.5 feet radius (**Table 7**).

Table 7
Small Mammal Home Range Size Comparison

Species	Low Quality Habitat (Grid A)	High Quality Habitat (Grid B)
REME	224.2	127.2
NEFU	184.9	120.0
PECA	—	84.7
PEBO	—	92.1
CHCA	40.0	84.7
NELE	—	109.4
PEMA	152.1	—
Average	**150.3**	**103.0**

REME = *Reithrodontomys megalotis*
NEFU = *Neotoma fuscipes*
PECA = *Peromyscus californicus*
PEBO = *Peromyscus boylii*
CHCA = *Chaetodipus californicus*
NELE = *Neotoma lepida*
PEMA = *Peromyscus maniculatus*

(b) Vegetation Analysis

Habitat analysis is a very important parameter when studying the interactions of sympatric species because habitat quality is highly correlated with species-specific niches such as food supply and nesting sites. Interpretation of the trapping and vegetation analysis results suggests that small

mammal diversity is positively correlated with shrub density, canopy height, and plant species composition. Grid B provided enhanced opportunities (e.g., additional niches) for arboreal activity for foraging, movement, and predator escape, as well as a larger volume of shrub debris for nest building woodrats. In total, the three co-occurring species moved an average of 25 percent further on Grid A (low quality) than Grid B (high quality). **Tables 8 and 9** illustrate selected positively correlated habitat variables present on the Phase II trapping grids.

Table 8
Grid A Selected Habitat Variables for Each Small Mammal Species

Habitat Variable	*N. fuscipes*	*R. megalotis*	*C. californicus*	*P. maniculatus*
Canopy Height (feet)	5.75	2.42	3.00	2.10
Shrub Density Index*	2.25	1.24	1.25	1.37

*SDI average calculated as follows: Open = 0, Low = 1, Moderate = 2, High = 3

Table 9
Grid B Selected Habitat Variables for Each Small Mammal Species

Habitat Variable	*N. fuscipes*	*R. megalotis*	*C. californicus*	*P. californicus*	*P. boylii*	*N. lepida*
Canopy Height (feet)	7.80	3.39	3.17	8.00	9.17	4.63
Shrub Density Index*	2.50	2.56	2.21	2.08	2.17	2.25

*SDI average calculated as follows: Open = 0, Low = 1, Moderate = 2, High = 3

6. DISCUSSION AND CONCLUSIONS

a. Introduction

Prior to any discussion of study results, it is important to note that during the conduct of these investigations two issues were of continuous concern. First, this study was restricted to specific goals and cannot, or should not, be treated as a study that addressed a broad range of river corridor issues. Second, data compiled during our field investigations could be questioned with respect to their timing or duration. Each of these issues is discussed below.

With respect to issue one, this study was oriented towards responding to two goals. Goal one emphasized the protection and enhancement of terrestrial species diversity and abundance within the riparian corridor east of Interstate 5, while goal two aimed to define an acceptable standard for a separation zone (i.e., a buffer) between riparian resources and proposed development projects. East of Interstate 5, engineering studies prepared by Newhall Land and Farming Company indicated that with the exception of bridges proposed at road crossings, only limited disturbances are proposed within the streamcourse or to riparian vegetation within the banks of the Santa Clara River or San Francisquito Creek. Rather, most impacts occur in areas inland of the bank edge. Therefore, impacts to river resources associated with projects proposed east of Interstate 5 generally occur on the terraces where development is proposed proximal to the existing riparian edge and not within the streamcourse. Also, Newhall Land and Farming Company is in the process of completing an Environmental Impact Statement (EIS) for a United States Army Corps of Engineers general permit that would govern all activities (e.g., bridges and bank stabilization) proposed within the streamcourse. As part of this EIS, measures are proposed that focus on improvements to aquatic resources within that area administered by the Corps (i.e., the mean high water mark). In response to these facts, this study did not focus on the hydrodynamics of the river, issues associated with substrate, impacts to the banks of the river, or the associated fishery. Rather, the focus of the study is limited to the specific goals defined above.

The second issue of concern focused on the adequacy of the data. As stated, Impact Sciences and Newhall Land and Farming Company were concerned that the recommendations of this study might be questioned due to the timing of the field investigations as well as the extent of field work conducted. It is acknowledged that additional data can always be used to more precisely define conclusions or identify recommendations with greater authority. In response, it was our obligation to consider these issues and to affirmatively seek information that would remove data gaps to the extent feasible. Action was taken to conduct additional surveys during the spring season and to

expand the scope of selected field investigations. However, it must be understood that the analysis undertaken can never be perfect and the information available could always be augmented or challenged.

The adequacy of data, particularly as it relates to environmental documents, has been regularly tested in court. In response to analytical data within an Environmental Impact Statement, the District of Columbia Circuit Court held in Alaska v. Andrus, that agencies and their associated projects may not be precluded from proceeding merely because study results remain to some extent speculative. The California Environmental Quality Act (CEQA) generally defines adequacy as a "good faith effort at full disclosure." For the purpose of this study, it is assumed that some degree of speculation is implicit in our work. However, we are confident that the work conducted is verifiable, replicative, and is based on accepted protocols where and when they were required or appropriate.

b. Discussion

The two goals of this study are not separate or distinct. Rather, they are at least, in part, interrelated. However, to accomplish the objectives of this study it was necessary to first account for the protection and enhancement of terrestrial species diversity within the riparian resource. That information is prerequisite to defining the physical characteristics of a separation zone that could serve to buffer two incompatible land use types (i.e., the riparian resource and urban development).

As a first step in meeting the study goals, it was necessary to define the condition of the resource present. It was assumed that due to the type and extent of historic disturbances, species diversity in the riparian zone east of Interstate 5 has substantially declined from historic levels. These disturbances have generally occurred in the form of farming and urban development. Although these disturbances have had a moderate effect on the riparian corridor and its associated vegetation or substrate, substantial impacts have occurred in uplands adjacent to the Santa Clara River and San Francisquito Creek. These disturbances have resulted in the elimination of any viable upland habitat as well as the riparian/upland ecotone that is fundamental to the life history of several terrestrial vertebrates.

The available literature, Impact Sciences field observations, and the observations of other experts have confirmed this assumption. Many studies indicate that species diversity is significantly greater in riparian areas where adjacent uplands are present versus areas that lacked upland vegetation adjacent to the riparian resource. In addition, field observations conducted by Impact

Sciences during our Phase I field investigations also support this conclusion. Anecdotal information collected by Impact Sciences biologists and Dr. Guthrie observed that species diversity within riparian habitats associated with the Santa Clara River was substantially greater in areas where adjacent uplands were present, versus riparian areas where uplands and the associated ecotone was absent.

Results of Phase I work conducted by Impact Sciences are also consistent with the conclusions of Schaefer and Brown and other authors who suggest that riparian habitat is not a closed or autonomous system. Rather, most riparian dependent wildlife species utilize adjacent uplands to obtain essential food or nesting resources and continuously move between riparian and upland zones. Previous studies and our Phase I field observations indicate that in areas of low quality habitat, some riparian dependent species were not observed. These observations, and the similar observations of others, confirmed recent studies that concluded if critical habitat requirements (e.g., the adjacent uplands) are reduced in quality or quantity, the ecosystem will no longer satisfy the needs of selected species. For these animals, a substantial life-history requirement is absent; these species will be unable to sustain their existence, and these animals likely will emigrate with varying success rates to areas with more suitable habitat. Based on the sum of this information, it can be concluded that adjacent upland habitat zones are critical in accounting for species diversity. Therefore, re-establishment of upland habitat, inclusive of the riparian/upland ecotone adjacent to the Santa Clarita River and San Francisquito Creek, is a critical prerequisite in achieving the goal of protecting and enhancing terrestrial species diversity within the riparian corridor east of Interstate 5.

Given this conclusion the remainder of the study focused on the nature and extent of the uplands and how uplands could further protect and enhance riparian species diversity. An assumption of this study was that adjacent uplands and the ecotone are important elements of the predator–prey relationship. However, it has been documented that only a portion of the overall prey base for riparian predators is derived from small mammals that occur within the ecotone. Further, the ecotone often does not provide the array of vegetation necessary to satisfy the diverse dietary needs of these predators. As such, it was assumed that the ecotone alone does not provide a sufficient prey base (in the form of small mammals) or vegetation for the riparian predators as a group. Given these facts, riparian predators were considered in all study recommendations but were not the subject of extensive field investigations. However, to maintain the diversity of riparian predators in the corridor, a sustainable small mammal population in the ecotone and adjacent uplands is essential.

As defined early in this report, Schaefer (personal communication, 1997) and Reed (1986) indicated that in open systems two requirements are necessary to sustain small mammal populations. First, in areas that cannot account for the minimum number of home ranges necessary for sustainability (defined as 50 animals with enough habitat to accommodate for the home range needs of each individual to account for short-term survival, 500 animals for long-term survival, and 200 animals/home ranges being considered the working median), open space areas must be connected such that opportunities exist for small animals to move between areas of suitable habitat. Second, Schaefer (1997) and Reed (1986) concluded that if a corridor or buffer is at least wide enough to support the home range requirement of the small mammals present, and is continuous or connects to other large open spaces, it is assumed that the entire corridor or buffer will accommodate the home range needs of enough animals to sustain those populations for the long-term.

In response to these habitat requirements, Phase II studies conducted by Impact Sciences focused on defining the home range size of small mammals present in areas of high and low quality habitat. Trapping data determined that a higher diversity of small mammal fauna occurred in areas of high quality habitat (six species recorded in high quality habitat versus four species recorded in areas of low quality habitat). Interpretation of the trapping data suggested that small mammal diversity positively correlated to enhanced opportunities for arboreal activity inclusive of foraging, movement, predator escape, and a larger volume of shrub debris for nest building. Trapping data also indicated that for the three co-occurring species trapped in both high and low quality habitat, animal movement was on average 25 percent greater in areas of low quality habitat.

As stated, another focus of the small mammal trapping program was a determination of home range size as it related to criteria set forth by Schaefer and Reed. Home range data was calculated (in diameter versus area) for all species trapped on each grid during the study. This data is presented again below and generally indicates that home range size is smaller in areas of high quality habitat due to reduced movement requirements and increased niche opportunities.

Small Mammal Home Range Size

	Low Quality Habitat	High Quality Habitat
Deer Mouse	152.1 feet	—
Dusky-footed Woodrat	184.9 feet	120.0 feet
Western Harvest Mouse	224.2 feet	127.2 feet
California Pocket Mouse	40.0 feet	84.7 feet
California Mouse	—	84.7 feet
Brush Mouse	—	92.1 feet
Desert Woodrat	—	109.4 feet

In areas of low quality habitat, the average home range size (again calculated in diameter versus area) for all of the species was calculated at 150.3 feet, while in areas of high quality habitat the average home range size was calculated at 103.0 feet.

Data compiled by Schaefer (personal communication, 1997) and Reed (1986) also indicated that connectivity is an important consideration in the sustainability of small mammal populations in linear open space areas. As such, information regarding the movement of small mammals was an important study consideration. Studies of the genus *Peromyscus* provide varied information. Some data indicates that animals generally remain within or close to their respective home ranges once established (King, 1968). However, other studies note that individuals of this genus move from 1,200 to 1,500 feet (Blair, 1948). Blair indicated that reasons for large movements vary but include dispersal of young from birth sites, invasion of depauperate areas, destruction of existing habitat, or exploratory trips. Most recently, Genoways and Brown (1993) cited that most species of small mammals (*Dipodomys* being the target) moved less than 100 meters during their life history. This later standard should be used as a maximum measure of habitat separation in the planning of all urban projects.

Maintenance of a sustainable small mammal population is a fundamental requirement in protecting and enhancing species diversity within the riparian corridor. However, other subgroups of animals typical of riparian habitat are also known to significantly utilize the riparian/upland ecotone and contribute to species diversity in the riparian corridor as well as the adjacent uplands. Important among these are the birds.

As described in the methodology and results sections, birds were assigned to two groups. The first group of birds (List A birds) consisted of species that are considered riparian dependent, while List B species are defined here as riparian associates but are commonly observed in upland habitats as well. Because the List A birds are more dependent on true riparian habitat for their life history requirements than List B birds, the analysis and conclusions of the bird study focused on the List A birds. Data from each of these groups of birds provided additional information regarding use of the ecotone and upland habitat and could serve as an additional measure in defining an upland buffer requirement and measures to protect and maintain avian diversity.

As described above, studies of bird use in upland habitat and the riparian/upland edge or ecotone was conducted in areas where riparian and upland resources were of both high and low quality based on a qualitative vegetative analysis (i.e., percent cover, dominant plant species, species diversity and structure, etc.). The results of this work indicated that in areas of high quality habitat List A

birds were common in the ecotone, but rarely used uplands beyond 100 feet. Indeed, 99.0 percent of all observations of List A birds in high quality habitat occurred within 100 feet of the riparian canopy. In areas of low quality habitat, use of the ecotone by List A birds was also high. However, observations were more evenly distributed between the riparian edge and in uplands up to 100 feet. Ninety percent (90.0) of all observations of List A birds in areas of low quality habitat occurred within 100 feet of the riparian canopy. Further, no List A birds occurred in uplands beyond 150 feet of the riparian edge regardless of the quality of the vegetation.

These data also suggest several observations. First, given the paucity of vegetation in the low quality riparian and upland zones, List A birds forage over a greater area when compared with similar foraging behavior in areas of high quality habitat. Second, List A birds regardless of habitat quality, do not move great distances away from the riparian edge. Observations indicate that List A birds generally do not extend more than 100 feet beyond the riparian canopy. Third, as expected, the ecotone was most often utilized by List A birds (74 percent of all occurrences in areas of high quality habitat and 33 percent of all occurrences in areas of low quality habitat). Finally, these data confirm and augment work conducted on habitat use by least Bell's vireo in San Diego and Santa Barbara Counties (Gray and Greaves, 1984; San Diego Association of Governments, 1988). These studies found that where the riparian resource is greater than 300 feet in width (such as the condition that occurs in the Santa Clara River and San Francisquito Creek east of Interstate 5), least Bell's vireo are infrequently observed in upland habitat greater than 150 feet from the resource edge. However, where the riparian resource is less than 100 feet in width, this bird occurs in the adjacent uplands up to 300 feet from the resource edge. These studies concluded that this behavior generally occurs in response to the presence or absence of food within the riparian zone. Where the extent of the resource is greater, food resources are increased and there is a corresponding reduction in foraging requirements outside the riparian zone.

As expected, in some cases List B birds occurred in the uplands farther from the riparian canopy edge when compared with data for the List A birds. In areas of high quality habitat, 84.5 percent of all occurrences for List B birds were within 100 feet of the riparian canopy as compared with 99.0 percent of the List A birds. This observation was expected in areas of high quality habitat. List B birds are often associated with upland vegetation communities and the uplands present in areas of high quality were of sufficient density and height as to provide the cover preferred by the List B birds. However, in areas of low quality habitat, 93.4 percent of the List B birds occurred within 100 feet of the riparian canopy as compared with 90.0 percent of the List A birds. The fact that List B birds remained closer to the riparian canopy may have been due to the dense vegetation present in the riparian zone versus a relatively sparse upland ecotone. However, in low quality

habitat List B birds did move to upland habitat beyond 150 feet where the uplands were better developed and provided additional cover. These data suggest that for List B birds the ecotone was also an important element, but as expected, observations of List B birds were more evenly distributed in areas beyond the ecotone and observed greater distances from the ecotone given appropriate vegetation.

Early in this report it was concluded that terrestrial species diversity in the riparian corridor was reduced due to the elimination of upland vegetation and the riparian/upland ecotone. To achieve the goal of protection and enhancement of terrestrial species diversity within the riparian corridor east of Interstate 5, a required first step was to re-establish the presence of viable upland habitat and the riparian/upland ecotone via implementation of an upland preserve zone. To ensure the biological integrity and sustainability of this created habitat and ecotone, it was important to define some minimum parameters. Parameters suggested in this report are based on our review of the literature and the results of our field investigations. Indirectly, these parameters would also satisfy the second goal of this study, which was intended to define standards for a separation zone that would buffer riparian resources and urban uses. In recommending an upland preserve zone, it is understood that the created uplands and the associated ecotone should be afforded a similar sensitivity status as the riparian vegetation, as the uplands are a critical component of the riparian ecosystem and the adjacent uplands are a fundamental requirement in protecting and enhancing species diversity.

Data compiled as part of this study indicates that two standards are recommended based on the quality of upland vegetation present. If the upland preserve zone is left to revegetate naturally, it is expected that the quality of the vegetation would be low to moderate, and re-establishment would occur over a relatively long period of time. Should this approach be taken, a minimum upland preserve zone of 150 feet is recommended. This standard is based on the small mammals present and their known home range requirements as well as the behavior of List A and B birds in uplands of low quality. Should the upland preserve zone be revegetated rapidly based on natural models derived from the local area and maintained as high quality upland habitat, based on the information obtained from field investigations regarding small mammal home ranges and the movement patterns of List A and List B birds in high quality uplands, the width of the upland preserve zone could be reduced to 100 feet. These recommendations are consistent with recently documented CDFG recommendations for upland preserve areas adjacent to riparian and wetland habitats in the San Joaquin Valley. For riparian habitats and river systems similar to those in the Santa Clarita region, CDFG also recommended a minimum "conservation area" of 100 feet and a planning buffer of at least 50 feet to separate riparian and upland areas from incompatible land uses.

Consistent with this recently prepared CDFG study, it is further recommended that a "planning buffer" shall occur between the upland preserve zone and any urban development. This buffer should be a minimum of 50 feet in width and, similar to studies conducted for the San Diego Association of Governments, it is recommended that only passive uses occur within this buffer (e.g., trails, roads, passive recreational uses, etc.). The intent of the planning buffer is to separate two incompatible land uses (in this case the upland preserve zone and urban uses). Given the importance of the planning buffer, special consideration shall be afforded to this area during the decisionmaking process to ensure that light and glare, noise, and use of the upland preserve zone and more distant riparian resources by domestic animals and human uses are minimized or eliminated. It is further recommended that in lieu of the 50-foot planning buffer, an impenetrable wall or fence could be substituted. A physical barrier such as a wall or fence would also reduce or eliminate the effects of light and glare, noise and indiscriminant use of the upland preserve zone by humans or domestic animals.

APPENDIX A

Résumés of Impact Sciences Biologists

SCOTT D. CAMERON

Senior Biologist

Mr. Cameron is a Senior Biologist with experience in sensitive biological resources inventories, endangered species surveys, general wildlife biology, environmental mitigation monitoring, and wildlife and botanical habitat evaluations in the counties of Los Angeles, San Diego, Orange, Kern, Fresno, Kings, Santa Barbara, Alameda, Ventura, Santa Barbara, Monterey, Riverside, San Bernardino, Imperial, Del Norte, Sacramento, and San Joaquin. Documentation experience includes preparation of numerous environmental and biological assessments, Environmental Impact Reports (EIRs), and mitigation/monitoring plans. Mr. Cameron has handled thousands of small mammals (50,000+ cumulative trapnights and over 5,000 captures) in California and Wyoming, and has been included in multiple Memoranda of Understanding (MOUs). He has designed numerous study plans to evaluate the presence/absence of special-status small mammals and reptiles. He has also handled and/or surveyed for sensitive, threatened, and endangered birds and reptiles under federal and state permits. Other projects include wildlife corridor evaluations, extensive linear pipeline and transmission facility experience, and interpretation of aerial photography and topographic-based data for incorporation into Geographical Information System (GIS) format. Additionally, Mr. Cameron is responsible for personnel supervision and project management. Mr. Cameron currently holds federal permits to conduct focused surveys for California gnatcatcher, arroyo toad, and Pacific pocket mouse (1996-2000).

Selected Professional Experience

Principal Investigator for evaluating habitats potentially suitable to support Pacific pocket mouse at the Playa Vista project site. Conducted mammal inventory on the project site located in the Playa del Rey area, Los Angeles County, California (a type locality for the Pacific pocket mouse). Tasks included designing and submitting a formal study plan to USFWS and conducting a focused field survey effort for the Pacific pocket mouse and other sensitive small mammal species. Principal investigator for the 3,000+ trapnight effort utilizing both Sherman live-traps and pitfall trapping arrays. Performed these surveys under the authority of federal permit (PRT-808242).

Principal Investigator for live-trapping program to evaluate the presence/absence of the federal-listed endangered Pacific pocket mouse (*Perognathus longimembris pacificus*) in the Del Mar area, San Diego County, California. Performed these surveys under the authority of federal permit (PRT-808242).

Principal Investigator for live-trapping program to evaluate the presence/absence of the federal-listed endangered Pacific pocket mouse in the Silver Strand area, San Diego County, California. Performed these surveys under the authority of federal permit (PRT-808242).

Principal Investigator for live-trapping program to evaluate the presence/absence of the federal-listed endangered Pacific pocket mouse in Crystal Cove State Park, Orange County, California. Performed these surveys under the authority of federal permit (PRT-808242).

Senior Biologist/Trap Manager for evaluating habitats potentially suitable to support Pacific pocket mouse on USMC Camp Pendleton (Base). Directed trap assistants, established trapping transects, and handled endangered Pacific pocket mice during the course of a large trapping study conducted throughout the Base located in San Diego County, California.

Principle Investigator/Project Biologist for a small mammal inventory and distribution study program conducted in the northeastern portion of Wyoming. Permitted as Principal Investigator (under MOU) to conduct the trapping program by Wyoming Department of Game and Fish (WDGF).

The trapping program was a component of a Gap Analysis project that was a cooperative effort between WDGF, Bureau of Land Management (BLM), The Nature Conservancy (TNC), and the University of Wyoming (UW). Specific job-related duties included conducting over 8,500 trapnights, ground-truthing GIS vegetation polygons for accuracy, evaluating habitat quality, and identifying dominant and subdominant plant communities occurring in a tri-county area. All small mammals captured were measured and identified to species. Additional work involved hantavirus research, collection of museum specimens, and raptor rehabilitation. Responsible for supervising trapping assistants and producing final report for publication.

Principal Investigator/Senior Biologist for conducting focused small mammal trapping surveys for sensitive biological resources including the Los Angeles pocket mouse (*Perognathus longimembris brevinasus*) near the City of Chatsworth, Los Angeles County. Project was located in a Significant Ecological Area (SEA), and as such involved preparation of a Biota Report and subsequent planning meetings with the SEA Technical Advisory Committee (SEATAC).

Project Ecologist/Trap Manager for 50,000+ trapnight program to evaluate the presence/absence of the federal-listed endangered Pacific pocket mouse. Trap manager for 10,000+ trapnights, and supervised numerous trap assistants involved in the project.

Project Ecologist for barn owl (*Tyto alba*) pellet analysis to provide information on the presence and relative distribution of the Pacific little pocket mouse. Individually examined and identified over 500 small mammal skulls and bone fragments of various small mammal species occurring in Orange and San Diego counties.

Project Biologist for vegetation mapping based on field truthing surveys and aerial photographic interpretation for the entire Orange County element to develop a sensitive wildlife species database and map the vegetation (especially coastal sage scrub), using a GIS in support of several subregional Natural Community Conservation Planning (NCCP) efforts. Data gathered were coded to specific and subspecific vegetation types for incorporation into a GIS data set to be used for resource evaluation, planning, and conservation purposes by the County of Orange and resources agencies.

Project Ecologist for several projects that involved interim habitat loss mitigation plans pursuant to the 4(d) special rule for impacts to coastal sage scrub resulting from grading operations associated with various development projects located in Orange County, California. The projects involved the application of an Interim Habitat Loss Permit for impacts to coastal sage scrub and evaluating if the proposed habitat loss conformed with the Southern California Coastal Sage Scrub Natural Community Conservation Planning Process Guidelines (Conservation Guidelines). The objective of the biological surveys was to evaluate the presence and abundance of California gnatcatchers potentially occurring at each project site. The USFWS listed the California gnatcatcher as threatened on March 25, 1993, under a proposed special ruling that recognizes regional conservation efforts already underway in Southern California, including the Natural Communities Conservation Planning (NCCP) program.

Senior Biologist/Principal Investigator for numerous biological studies in the Newhall area of Los Angeles County, California. Tasks included conducting surveys for sensitive wildlife species, designing and implementing a small mammal live-trapping programs, evaluating small mammal habitat usage of selected study areas, and evaluating biological resources present on potential mitigation properties.

Senior Biologist for performing a biological assessment of a 333-acre site located in Ventura County, near Camarillo, California. Tasks included directing and managing the field survey effort, conducting a small mammal live-trapping program, conducting focused avian surveys, conducting focused sensitive plant surveys, mapping the site's existing vegetation communities, conducting general aquatic herpetological surveys, and establishing scent and infrared camera stations.

Senior Biologist for conducting biological assessment on over 700 acres located in Ventura County, California. Conducted general wildlife surveys, special-status species surveys, vegetation mapping, and conducting and directing a focused small mammal sampling program effort.

Senior Biologist for performing a biological assessment of an approximately 100-acre site located in the Mountaingate area of Los Angeles County. Conducted a small mammal live-trapping program, performed general avian and reptile surveys of the project site, developed a plant compendium of the site, mapped the site's vegetation communities, and established scent stations. Results of these surveys will be used to evaluate the site's existing flora and fauna, as well as potentially occurring sensitive biological resources.

Project Ecologist/Project Manager for over 70 field days of California gnatcatcher surveys conducted in San Diego, Orange, San Bernardino, Riverside, Ventura, and Los Angeles counties for various clients throughout southern California. Observed hundreds of gnatcatchers during the course of these surveys. Developed and submitted numerous California gnatcatcher submittal letters to USFWS. Also evaluated and mapped gnatcatcher territories during the course of many of these surveys. Worked under the authority of federal permit (#PRT-782274 and 808242) to conduct California gnatcatcher surveys.

Senior Biologist for multiple field survey efforts and habitat-based evaluations to determine the presence/absence of the endangered Delhi Sands flower-loving fly (*Raphiomidas terminatus abdominalis*) in San Bernardino County, California. Assisted in conducting surveys following USFWS protocol, during which multiple fly individuals were observed. In addition, measured and recorded characteristics of occupied Delhi Sands flower-loving fly habitat at two sites known to support this species.

Project Manager/Ecologist for preparation of numerous Biological Assessments for Los Angeles Department of Water and Power (LADWP) reservoir sites and expansion facilities EIR. Duties included preparing proposal, scope of work, and budget. Responsible for directing other biologists in completing various field tasks and data collection. Conducted extensive literature searches and numerous field evaluations including California gnatcatcher surveys to identify sensitive biological resources.

Project Ecologist for conducting numerous focused and/or habitat evaluations surveys over a two-year period along the proposed Foothill Transportation Corridor located in Orange and San Diego counties, California. Focused surveys included, but were not limited to: California gnatcatcher, grasshopper sparrow, tricolored blackbird, Bell's sage sparrow, California horned lark, coastal cactus wren, loggerhead shrike, northern harrier, western burrowing owl, southern California rufous-crowned sparrow, San Diego horned lizard, Southwestern pond turtle, Arroyo southwestern toad, western spadefoot toad, silvery legless lizard, coastal rosy boa, orange-throated whiptail, San Bernardino ring-necked snake, coast patch-nosed snake, red diamond rattlesnake, Pacific pocket mouse, San Diego desert woodrat, and San Diego black-tailed jackrabbit. Food plant searches were also conducted to evaluate the potential presence/absence of Quino checkerspot butterflies. In addition, numerous surveys for sensitive plant species were conducted for species such as many-stemmed dudleya, Blochman's dudleya, and Palmer's grapplinghook.

Project Manager/Ecologist for preparation of numerous Biological Assessments and Biological Constraints Analysis in Orange, San Diego, Los Angeles, Ventura, and Imperial counties. Duties included preparing proposals, scope of work, and budgets. Responsible for directing other biologists in completing various field tasks and data collection.

Project Biologist for conducting baseline inventory of flora and fauna for multiple Caltrans highway projects in the Fresno and Coalinga areas. Surveys included small mammal trapping (included in MOU for short-nosed kangaroo rats), scent station monitoring, spotlighting, and focused reptile and

avian surveys. Evaluated habitat along highway ROWs for potential occurrence of sensitive species.

Project Biologist for over 30 proposed small energy development projects, including linear facilities, such as pipelines and transmission lines, for the Westside Development Program and Kern River Oilfield Development Program, Kern and Monterey Counties. As staff biologist, was responsible for inventory of rare, threatened, and endangered plant and animal species using various field and literature search techniques, including transect surveys, small mammal trapping surveys under MOU with CDFG, scent station and burrow monitoring, and evaluations based on animal sign. Evaluated presence/ absence of sensitive habitats. Also responsible for training field biologists and coordination of field activities.

Project Ecologist for Fiesta Island Replacement Project/Northern Sludge Processing Facility (FIRP/NSPF) EIS/EIR in the Miramar area for the City of San Diego Metropolitan Wastewater Department. Conducted vernal pool surveys that included evaluating the presence of sensitive plant and amphibious wildlife species. Additionally, prepared a vernal pool appendices report for inclusion in the EIS/EIR.

Project Ecologist for a California Department of Corrections electrified fence EIR project. Duties included evaluating correctional facilities throughout California and involved evaluating wildlife mortality (mainly migrating avifauna) along perimeter fences. Developed various methods to prevent or reduce "take" of special-status wildlife species.

Project Biologist for conducting field surveys for threatened and endangered species along various drainages as part of ACOE Section 404 and CDFG Section 1603 wetlands jurisdiction evaluation for proposed aquifer recharge and development program in Kern County, California.

Project Ecologist for surveys for arroyo toad (*Bufo microscaphus californicus*) in Orange and San Diego counties. Surveys were conducted at night and involved identifying toads by vocalization and direct observation (including juveniles and tadpoles). Additionally, all arroyo toad locations were mapped for future population estimates and documentation. Federal permit number PRT-808242 to conduct surveys for this species.

Project Biologist for a sensitive biological resources study on 6,250 acres of land between the Algodones Dunes and the Chocolate Mountains. Directed six biologists conducting surveys for desert tortoise (*Gopherus agassizii*), flat-tailed horned lizard (*Phrynosoma mccallii*), and Colorado Desert fringe-toed lizard (*Uma notata*). Acquired certification from the Arizona Department of Game and Fish to survey for the flat-tailed horned lizard.

Biological Technician for black-footed ferret (*Mustela nigripes*) trapping project in Medicine Bow, Wyoming. Conducted spot-light surveys for captive-bred introduced ferrets, and assisted biologists set live-traps, bar-code scan, and release captured ferrets.

Biologist for preconstruction surveys to evaluate areas that support desert tortoise in Nevada and California along the 900 mile-long Kern River natural gas pipeline ROW. Evaluations based upon presence/ abundance of burrows, scat, tracks, drinking depressions, and carapace remains, as well as the use of fiber-optic scopes to visually inspect deep burrows for tortoise occupation. Monitored all phases of construction throughout known tortoise habitat. Documented all tortoise encounters, removed tortoises from the construction site, and performed handling procedures following USFWS protocol, which included marking scutes, painting and numbering, photographing, and monitoring overnight before release. Included on the MOU for the Kern River Pipeline project and was certified to handle and inventory desert tortoises by USFWS. Also worked as lead environmental monitor along a 70-mile section of ROW and was responsible for endangered species education of construction personnel and supervision.

Project Ecologist for California Department of Corrections involving mitigation monitoring of a Pacific Gas and Electric (PG&E) along a pipeline corridor. Included on MOU to trap and translocate short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*) in Kern and Fresno counties.

Project Biologist for field mapping and aerial photographic interpretation of sensitive riparian vegetation types occurring along portions of the Mojave River corridor. Responsible for transferring data onto multiple topographic cross sections for use in flood control engineering models.

Project Biologist for botanical and wildlife reconnaissance surveys at two water reservoir sites on and near McGinty Mountain (San Diego County) to evaluate the potential occurrence of several sensitive animal species, including coastal California gnatcatcher, San Diego horned lizard, and orange-throated whiptail, as well as several rare plants, including dehesa nolina (*Nolina interrata*) and San Diego thornmint (*Acanthomintha ilicifolia*).

Staff Biologist for development of the Kern County Habitat Conservation Plan (HCP). Assisted in the field inventory of threatened and endangered species on approximately 150 sites in the San Joaquin Valley floor portion of Kern County, as well as data reduction, accessing pertinent data bases, and figure production.

Project Biologist for desert tortoise clearance surveys. Performed burrow closing procedures and documented and relocated tortoise and tortoise eggs from a flood control project construction site in Nevada. Worked under an MOU with USFWS.

Staff Biologist for baseline biological inventories for wildlife and botanical resources, including sensitive wildlife species surveys for the proposed Elsmere Solid Waste Facility landfill site in Los Angeles County. Field work involved small mammal trapping and sensitive bat surveys using mist nets, night-vision scopes, and hand-held bat echolocation detectors. Plant communities were mapped based on aerial photographic interpretation and field-truthing. Plotted sensitive species, habitats, and vegetation types and assisted in wildlife corridor identification for incorporation into a GIS. Also assisted in wetland delineations.

Research Assistant for the capture, electronic passive infrared transmitter tagging, bar-code scanning, and release of giant kangaroo rats (*Dipodomys ingens*) and blunt-nosed leopard lizard (*Gambelia silus*) on the Elkhorn and Carrizo Plains. Worked with San Joaquin Endangered Species Recovery Program Team, and the CSU Stanislaus Foundation. The dispersal and reproductive data gathered was used to develop future species recovery plans.

Professional History

Impact Sciences, Inc. - Senior Biologist
Michael Brandman Associates - Project Ecologist/Manager
The Nature Conservancy - Project Biologist/Principle Investigator
Wyoming Department of Game and Fish - Biological Technician
Dames and Moore - Staff Biologist
San Joaquin Endangered Species Recovery Program/CSU Stanislaus Foundation - Research Assistant
University of California, Santa Barbara - Undergraduate Assistant
County of Santa Barbara, Department of Environmental Review - Intern
California Department of Parks and Recreation - Assistant
College of the Redwoods - Undergraduate Assistant

Education/Permits/Certifications

- B.A., Environmental Studies (Biological Sciences and Natural Resource Management Emphasis; graduate-level courses in Ecology), University of California, Santa Barbara
- Certification, Flat-tailed Horned Lizard Survey Techniques, Arizona Department of Game and Fish
- Certification, *Desert Tortoise Handling, burrow construction, and egg handling Techniques*, U.S. Fish and Wildlife Service
- Certification, Marine Sciences Program, Santa Barbara City College
- Certification, Rescue Diver, PADI
- Joint Federal and State Scientific Collecting Permit, California Department of Fish and Game, 1992-1997
- CDFG Agreement to trap and release small mammal California Species of Special Concern, 1996-1997
- Federal Section 10(a) Permit to capture and release an endangered small mammal species, Pacific pocket mouse, 1996-2000 (PRT-808242).
  Federal Section 10(a) Permit to capture and release threatened and endangered amphibian species, arroyo toad, 1996-2000 (PRT-808242)
- Federal Section 10(a) Permit for performance of California Gnatcatcher surveys, 1996-2000 (PRT-808242)

Professional Affiliations

The Wildlife Society
Desert Tortoise Council
Society for the Study of Reptiles and Amphibians

Publications

Cameron, S. D. and R. W. Hanson. 1994. *Range Extension of the Western Patchnose Snake (Salvadora hexalepis mojavensis).* Herpetological Review, 25 (1): 34-35.

Cameron, S. D. and C. S. Garber, (in prep.). *Inventory and Monitoring of Small Mammal Distribution in the Bureau of Land Management's Casper District, Buffalo Resource Area.* The Nature Conservancy, Wyoming Natural Diversity Database. Cooperative Agreement Number K910-A4-0011, Task Order TO-002.

KEITH W. BABCOCK

Director of Biological Services/Wildlife Biologist

Mr. Babcock is Director of Biological Services at Impact Sciences, Inc., and is a wildlife biologist with over 10 years of experience in both wildlife biology and project management. He has directed, managed, or conducted a broad range of terrestrial wildlife research and studies, biological resource inventories, sensitive species surveys, environmental impact assessments, biological constraints analysis, habitat conservation/management plans, and mitigation monitoring plans for a variety of private and public sector clients in virtually every major habitat type in California. Mr. Babcock has a thorough understanding of the California Environmental Quality Act, both state and federal Endangered Species Acts, and state and federal regulations and permits involving biological resources. He has worked on over 150 environmental compliance projects, including EIRs, EISs, Section 10(a) permits, Habitat Conservation Plans, Section 7 consultations, Section 404 permits, and Streambed Alteration Agreements. His biological expertise includes knowledge of a wide range of terrestrial organisms and ecological relationships, with particular emphasis on general ornithology, raptors, threatened and endangered species, and wildlife movement corridors.

Representative Professional Experience

Environmental Compliance

- Managed and participated in field investigations, data collection, and preparation of the biological resources assessment portion of EIRs for the California Department of Corrections for proposed prison facilities throughout northern and central California. Significant issues included potential impacts on numerous state- and federally-listed threatened or endangered animal species including desert tortoise, San Joaquin kit fox, Swainson's hawk, blunt-nosed leopard lizard, Tipton kangaroo rat, and California red-legged frog. Potential impacts on wildlife movement corridors were also addressed. In some cases, consultations were conducted with the USFWS and CDFG in preparation of the need for a potential federal Section 10(a) permit and a state Section 2090 permit.

- Managed field surveys, data collection, and documentation of sensitive biological resources for a 5,000-acre study area, and participated in preserve area design for a 45,000-acre study area, on the Rancho Mission Viejo ranch in southern Orange County, California, for inclusion in the Natural Communities Conservation Planning (NCCP) multispecies habitat management program. Directed and participated in focused surveys for more than 15 sensitive species including the California gnatcatcher, coastal cactus wren, least Bell's vireo, yellow-breasted chat, San Diego horned lizard, orange-throated whiptail, many-stemmed dudleya, Palmer's grappling-hook, southwestern pond turtle, arroyo toad, and several raptor species.

- Managed all field studies and documentation efforts for the biological resources assessment and impact analysis component of the 4,200-acre Specific Plan Area 8 EIR for the City of Moorpark, Ventura County. Field evaluations included focused surveys for a number of sensitive plant and animal species, a wildlife movement corridor analysis, tree surveys, and wetland delineations. Meetings were conducted with individuals of the USFWS, CDFG, and other environmental interest groups to gain consensus on field survey methodology and results. All biological information was incorporated into a Geographic Information System (GIS) for impact analysis and land use planning.

- Directed and participated in field investigations and documentation of the biological resources inventory and impact assessment component of a statewide EIR for proposed electrified fences at 29 state prisons throughout California. Tasks involved determining species at risk of

electrocution, managing baseline assessments of habitats and species at each prison site, developing creative measures to mitigate impacts, and consulting with state and federal resource agencies. Also assisted in the management of, and participated in, a similar investigation for two prisons in the state of Washington.

- Directed and participated in field surveys and documentation for the biological resources component of a Mitigated Negative Declaration for a seismic upgrade project of a 15-mile portion of the Mokelumne Aqueduct in San Joaquin and Contra Costa Counties. Directed subconsultants to perform wetland delineations, coordinated field verifications and meetings with ACOE, CDFG, and USFWS, and managed all aspects of a Section 404 ACOE wetland fill permit, a Section 7 Consultation with USFWS, and a Section 1600 Streambed Alteration Agreement with CDFG. Potential impacts of the project on the biological resources associated with three major rivers and two sloughs were addressed.

- Managed and participated in the field survey design and methods of focused surveys for the federally-listed endangered desert tortoise on a site proposed for a new state prison in eastern Los Angeles County. The survey effort included characterizing and mapping suitable habitat for the tortoise as well as for other special-status species, including Mohave ground squirrel and San Joaquin antelope squirrel. Consultations were conducted with the USFWS and CDFG in preparation of the need for a potential federal Section 10(a) permit and a state Section 2090 permit.

- Managed and participated in field surveys, data collection, and preparation of a biological assessment for potential impacts on the federally-listed threatened California gnatcatcher as a result of a proposed project in San Diego County. The biological assessment was used as a basis for a Section 7 consultation with the USFWS which resulted in a no jeopardy determination. Informal and formal consultations and meetings with USFWS were conducted throughout the process.

- Managed biological surveys and analysis of potential impacts on the federally-listed threatened California gnatcatcher on a proposed OHV Park on the Otay Mesa in southern San Diego County for the California Department of Parks and Recreation. Surveys were also conducted to determine the presence or absence of several other special-status plant and wildlife species. An extensive mitigation plan was developed to minimize potential impacts on the gnatcatcher and other special-status species.

- Directed and participated in field surveys and documentation for the biological resources component of an EIR for a proposed gravel mining operation in Yolo County. Analysis focused on the potential impacts of out-of-channel mining along Cache Creek, especially with respect to riparian vegetation and stream associated wildlife. Special-status species issues included Valley elderberry longhorn beetle and Swainson's hawk.

- Prepared the biological documentation necessary for the proposed central coast NCCP in Orange County. The NCCP documentation established plans for The Irvine Company (TIC), the Transportation Corridor Agencies (TCA), the County of Orange, and other affected parties to comply with the NCCP Act of 1992, providing a comprehensive approach to resolving inherent conflicts between the need to protect sensitive and critical coastal sage scrub habitat and wildlife, and the need to proceed with TIC, TCA, and other development projects.

- Managed and participated in field surveys, impact analysis, and documentation of an Environmental Assessment of a proposed 15-mile water and gas pipeline corridor in the Mojave Desert of southern California. Focused surveys and habitat analysis for the federally-listed endangered desert tortoise and Mojave ground squirrel were also conducted within the corridor

alignment. Consultations were conducted with the USFWS and CDFG in preparation of the need for a potential federal Section 10(a) permit and a state Section 2090 permit.

- Directed and participated in the environmental documentation of biological resources for an EIR on the Water Forum Agreement, an agreement between over 20 water purveyors and water districts on the future use and management of water along the lower American River. The project involved the documentation of existing biological resources along the river and an analysis of potential impacts on these resources as a result of projected changes in water flow levels.

- Directed field investigations and managed documentation of the biological resources inventory and impact assessment component of the Big Bear Dam Bridge Route 18 EIR/EIS in San Bernardino County, California. Directed and participated in focused surveys for several sensitive species, including the federally-listed bald eagle, the state-listed southern rubber boa, and the southern spotted owl.

- Managed and participated in the field surveys and documentation efforts for the biological components of several environmental compliance documents in northern California including the Rancho Dorado EIR in El Dorado County, two gravel and rock mining projects in Yolo County, the Roseville General Plan in Placer County, the Palos Colorados EIR in Contra Costa County, the North Rocklin Circulation Element EIR in Sacramento County, and the Paradise Treatment Plant Biological Assessment in Butte County. Issues included potential impacts on vernal pools, wildlife movement corridors, wetlands, sensitive plants, and numerous sensitive animal species including bald eagle, red-legged frog, Valley elderberry longhorn beetle, Swainson's hawk, western spadefoot toad, and California tiger salamander.

- Managed field studies and documentation of the biological resources component of the 1,500-acre East Orange Specific Plan area in eastern Orange County, California. Coordinated surveys, evaluated impacts, and developed mitigations for a variety of biological resources, including sensitive species such as California gnatcatcher, western spadefoot toad, many-stemmed dudleya, San Diego cactus wren, and several raptor species.

- Managed field investigations, impact analysis, mitigation planning, and overall biological assessment documentation for several proposed projects within Significant Ecological Areas (SEAs) in Los Angeles County, California. Significant issues included several sensitive plant and wildlife species, sensitive habitat areas, and potential impacts on wildlife movement corridors.

- Managed field surveys, impact analysis, documentation, and project coordination efforts for the biological component of the Stetson Ranch EIR and the Bear Mountain Ski Resort expansion project EIR/EIS in the San Bernardino National Forest. Significant issues included potential impacts on the bald eagle, California spotted owl, mule deer, mountain lion, black bear, and San Bernardino flying squirrel.

- Assisted in the management and preparation of the biological resources assessment for the East Coyote Hills EIR in Orange County, California. Coordinated field surveys and analyses of the onsite population of California gnatcatchers. The assessment resulted in the development of a pre-listing Habitat Conservation Plan (HCP) for the California gnatcatcher that resulted in the issuance of a Section 10(a) permit pursuant to the federal Endangered Species Act.

- Managed and participated in field surveys, impact analysis, and documentation of an Environmental Assessment of a proposed 20-mile transmission line for SDG&E in Orange County. The project entailed focused surveys for a number of sensitive plant and animal species, an analysis of several alignment alternatives, and an extensive mitigation development, implementation, and monitoring program.

- Participated in developing a Habitat Conservation Plan (HCP) for the federally-endangered Stephens' kangaroo rat for the Metropolitan Water District of Southern California in Riverside County, in accordance with Section 10 of the Endangered Species Act.

- Managed and conducted numerous biological resources inventories and baseline assessments in a variety of habitat types in the counties of Sacramento, Contra Costa, Solano, Yolo, Merced, San Joaquin, Tulare, Fresno, Ventura, Los Angeles, San Bernardino, Riverside, and Orange, California. Issues included potential impacts on vernal pools, riparian habitats, wildlife movement corridors, wetlands, special-status plants, and numerous special-status animal species including bald eagle, California red-legged frog, Valley elderberry longhorn beetle, Swainson's hawk, desert tortoise, California gnatcatcher, San Joaquin kit fox, vernal pool and fairy shrimp, and California spotted owl. Most of these assessments were used in subsequent environmental impact reports and other regulatory documents.

- Managed field investigations and document preparation for biological resources inventory within the 5,700-acre Villages of Laguna San Luis proposed project in Merced County, California. Sensitive species surveys included San Joaquin kit fox and burrowing owl.

- Managed a comprehensive biological baseline inventory of habitat types and both common and sensitive plant and wildlife species for a 3,000-acre undeveloped site in western Riverside County owned by the Lockheed Corporation. Focused surveys for sensitive species included the California gnatcatcher, coastal cactus wren, several plant species, and a trapping program for the Stephens' kangaroo rat.

Focused Studies

- Designed and managed a Swainson's hawk radio-telemetry study over an 8,000-acre study area in West Sacramento, California, to determine home range and habitat use of eight pairs of nesting Swainson's hawks. Responsible for overall study design, capture and attachment of radio transmitters on five Swainson's hawks, radio tracking methodology, staffing, and overall data analysis and interpretation. All data was incorporated into a Geographic Information System (GIS) for analysis and presentation. The information obtained was used to evaluate potential impacts on nesting Swainson's hawks and to develop suitable mitigation measures. The project involved coordination between CDFG, the City of West Sacramento, and the applicants during all phases of the study. The information was eventually used as part of a Section 2081 consultation pursuant to CESA.

- Designed and managed wildlife movement corridor studies for four proposed projects in Ventura County and three proposed projects in Orange County, including a 16-mile transportation corridor project. The studies, which involved the use of remote motion-triggered camera, track plates, and other wildlife movement data collection techniques, were designed to identify and quantify target wildlife species using the project sites, identify areas that are used by these species as travel routes, and to evaluate the relative importance of these areas as potential movement corridors. Recommendations on corridor design were also developed to mitigate potential adverse impacts on movement corridors.

- Managed a comprehensive wildlife movement corridor study on the 45,000-acre Rancho Mission Viejo ranch in southern Orange County, California. Directed and participated in field investigations and assimilation of data from previous studies. Produced a wildlife movement corridor map and documentation of all field work and analysis.

- Designed, managed, and implemented a mitigation and construction monitoring program for a large-scale project potentially impacting breeding burrowing owls in Fresno County, California. Designed and presented educational materials at a pre-construction meeting attended by

40 individuals. Trapped and banded burrowing owls. Coordinated and consulted with CDFG on all aspects of the program.

- Conducted numerous focused surveys for the federally-listed threatened California gnatcatcher in San Diego, Orange, Los Angeles, and Ventura Counties. Surveys were conducted under a federal USFWS survey permit.

- Directed the surveys for three federally-listed threatened and endangered fairy shrimp species in a large vernal pool complex (over 100 pools) in eastern Sacramento County. Managed subcontractor contracts and directed the compiling of data and information into a document that met USFWS documentation protocols for surveys of fairy shrimp species.

- Managed an analysis of potential impacts of wind turbines on biological resources on a proposed wind energy site in Solano County. The study focused on the potential effects of wind anemometer towers and wind turbine towers on avian species, particularly raptors and migratory birds.

- Directed and prepared a comprehensive raptor management plan for the 1,500-acre East Orange Specific Plan area and a 3,000-acre dedication area in Orange County. The plan included an analysis of foraging and perch habitat enhancement strategies, nest box and nest platform design criteria and placement, and plan monitoring and evaluation.

- Directed and participated in a focused survey for Swainson's hawks and burrowing owls for the Department of Public Works, City of Davis. An analysis of potential impacts on habitat for these species, consultation with CDFG, and development of measures to mitigate potential impacts were also conducted.

- Directed and managed a comprehensive survey for mule deer on the 1,500-acre East Orange Specific Plan area for The Irvine Company in Orange County. Analyses included descriptions of population density, habitat use, and distribution.

- Served as field investigator and principal author of a biological resources assessment for a U.S. Navy development project in Mono County, California. Conducted a survey for mule deer and specifically addressed potential impacts on mule deer migration areas.

- Served as field investigator for a comprehensive great blue heron breeding and foraging study in East Orange County, California. Responsibilities included retrieving great blue heron chicks from nests, attaching radio transmitters and leg bands, and radio-tracking fledged herons throughout southern California.

- Conducted field surveys and completed associated descriptive analyses for the presence of habitat and populations of the federally-listed endangered Stephens' kangaroo rat for several development projects in Riverside County, California.

- Participated in development and maintenance of a captive breeding program for the federally-listed endangered bald eagle at the USFWS Patuxent Wildlife Research Center. Assisted in the methodology and analysis of studies on bald eagle eggshell thinning, lead shot poisoning, and breeding behavior.

- Participated in captive breeding programs of the federally-listed endangered black-footed ferret, peregrine falcon, and California condor.

Professional History

Impact Sciences, Inc. - Director of Biological Services, Wildlife Biologist
Michael Brandman Associates - Senior Project Manager, Wildlife Biologist
U.S. Fish and Wildlife Service (USFWS), Patuxent Wildlife Research Center - Biological Technician

Education

M.S., Business Management, Colorado State University
B.S., Wildlife Biology, Colorado State University

Professional Affiliations

Association of Environmental Professionals (AEP)
Raptor Research Foundation
Society for Conservation Biology
California Swainson's Hawk Technical Advisory Committee

Permits/Certifications

Scientific Collecting Permit, State of California, CDFG
Federal Bird Banding Permit, USFWS
Section 10(a) Permit to Survey for California Gnatcatcher, USFWS
Habitat Evaluation Procedures, USFWS
Certified Scuba

Publications

Babcock, K.W. 1995. Home range and habitat use of breeding Swainson's hawks in the Sacramento Valley of California. *J. Raptor Research* 29(3):193-197.

DAVID G. CRAWFORD

Staff Fisheries and Wildlife Biologist

Mr. Crawford serves as a Fisheries and Wildlife Biologist for Impact Sciences, Inc. He has managed or conducted a variety of aquatic and terrestrial studies, endangered species surveys, mitigation monitoring plans, wetlands delineations, and environmental document preparation. Mr. Crawford has over three years field experience and has conducted over 1,000 field hours sampling fish in rivers, streams, estuaries, and ponds and has conducted over 16,000 cumulative trapnights surveying small mammals in a variety of habitats in California. He has a thorough understanding of both State and Federal Endangered Species Acts, and has been included in Memoranda of Understanding (MOUs), as well as conducted special status fish, small mammal, reptile and amphibian surveys under state permits. Additionally, Mr. Crawford has conducted aquatic habitat evaluations and developed sport fishery management plans.

Representative Professional Experience

Environmental Compliance

Project Biologist for multiple terrestrial and aquatic surveys associated with Newhall Land and Farming Co. EIRs in the Santa Clara River and San Francisquito Creek areas. Conducted over 1,000 small mammal trap-nights, spotlight surveys, habitat evaluation, and focused sensitive aquatic species surveys.

Lead Project Biologist - The Los Angeles District Army Corps of Engineers developed a five-year monitoring program to study the effects of dredging on the California grunion in Santa Barbara. Mr. Crawford headed the hatch survey and monitoring portion of the program for the fifth year of the project. Mr. Crawford directed efforts involving egg excavation, incubation, hatching, and hatch data collection over a period of four months. Collected data was tabulated and summarized in a report presented to the Army Corps of Engineers.

Project Biologist for Playa Vista EIS/EIR and Ballona wetlands restoration plan. Duties included coordination of and participation in marine, estuarine, and freshwater fisheries surveys, over 3,000 trapnights of focused endangered small mammal surveys, as well as focused sensitive reptile surveys.

Project Ecologist on surveys associated with the Johnson Drive extension EIR in the Santa Clara River. Mr. Crawford conducted aquatic resource surveys that resulted in the capture and release of numerous arroyo chubs, Santa Ana suckers (and hybrid suckers), tidewater gobies, and southwestern pond turtles.

Project Biologist for Camarillo Regional Park EIR. Field activities included 600 small mammal trap-nights, focused sensitive aquatic species surveys, and assistance with focused sensitive plant and avian species surveys.

Project Ecologist for Section 7, preconstruction endangered species surveys for Mobil Exploration & Producing U.S. Inc., North and South Midway Operations Areas in California's Central Valley. Duties included focused surveys for San Joaquin kit fox, San Joaquin antelope squirrel, blunt-nosed leopard lizard, and western burrowing owl. Survey activities included walk-over transects to identify endangered species through direct observation and location of dens, tracks, and scat, as well as monitoring of scent and track stations.

Project Biologist - Designed mitigation relocation plan for southwestern pond turtles (*Clemmys marmorata pallida*) and two-striped garter snakes (*Thamnophis hammondi*) for development project in Newbury Park, California. Implementation will begin in spring 1998.

Wildlife Technician on 7,500 trapnight small mammal survey effort for the U.S. Army Corps of Engineers Land Condition Trend Analysis study at Camp San Luis Obispo and Camp Roberts in San Luis Obispo and Monterey counties. Duties involved live trapping, handling and identifying several small rodent species including the sensitive Salinas pocket mouse and Monterey dusky-footed woodrat. Listed as Authorized Person on CDFG MOU. During trapping efforts, Mr. Crawford documented the presence of California red-legged frog and western yellow-bellied racer.

Research Assistant at California Polytechnic State University for California Department of Fish and Game's Environmental Impact Report on the implications of the trout stocking program in California over the last 80 years. Duties included literature search and data evaluation. Presented data to interdisciplinary team for document preparation.

Focused Studies

Project Biologist for Endangered tidewater goby (*Eucyclogobius newberryi*) surveys in Pismo Lagoon, Pismo Beach, San Luis Obispo County. Employed various sampling methods that determined the presence of tidewater gobies and water quality.

Project Biologist for endangered tidewater goby surveys in Ormond Beach Lagoon for Ventura County Flood Control. Water quality and goby distribution is currently being evaluated for pre- and post-breach conditions. Several thousand gobies were identified and released.

Project Ecologist - Conducted focused California red-legged frog (*Rana aurora draytonii*) habitat evaluation in the Conejo Creek and Calleguas Creek watersheds for CamRosa Water District. Duties included evaluation and mapping of potential red-legged frog habitat, water quality evaluations, and potential prey base evaluations.

Project Biologist - Participated in 1,150 trapnight focused survey for Pacific pocket mouse (*Perognathus longimembris pacificus*) at Crystal Cove State Park in Orange County for the California State Parks Department.

Wildlife Technician for the Camp Roberts Kit Fox Recovery Program conducted by California Polytechnic State University at San Luis Obispo for the Department of the Army. Duties included spotlight surveys, scent station surveys, habitat evaluation, and data entry.

Project Ecologist/Principle Investigator for a year-long aquatic survey of Chorro Creek in San Luis Obispo County. Data was collected to quantify seasonal changes in fish diversity in a 15-mile portion of this coastal stream.

Field Assistant at California Polytechnic State University for multiple wildlife and fisheries projects conducted by University faculty. During the course of these projects, Mr. Crawford captured, identified, and released numerous sensitive fish, mammal, reptile and amphibian species.

Mitigation Monitoring

Project Ecologist for Santa Clara River oil spill monitoring program. Duties included fish sampling, herpetofaunal surveys, water and soil sample collections, general riparian habitat analysis, and mapping of survey results along a 14 -mile portion of the Santa Clara River. Efforts included several hundred hours of surveying fishes including unarmored threespine sticklebacks and arroyo chubs.

Surveys were also conducted for arroyo toads, two-striped garter snakes, and southwestern pond turtles.

Project Biologist - Mr. Crawford was responsible for supervision the California Conservation Corps (CCC) during mitigation efforts for the Fiore Gardens Family Housing/Arroyo Conejo Bank Stabilization projects. Mr. Crawford monitored the CCC during non-native vegetation removal and is currently conducting quarterly evaluations of the riparian restoration for this joint project between the County of Ventura Area Housing Authority and the City of Thousand Oaks.

Project Biologist - for the performance of mitigation monitoring on streambed alteration for a Kaufman & Broad-Coastal Valleys, Inc. project on a USGS blue-line stream in the City of Thousand Oaks, Ventura County. Supervised the California Conservation Corps in the removal of non-native trees and shrubs and performs quarterly monitoring on the survivorship of native vegetation planted in the project area.

Project Biologist - Mr. Crawford has been conducting quarterly mitigation monitoring procedures for a riparian restoration project on the Arroyo Simi for Cal-West Ready Mix, Inc. in Simi Valley, California. He calculates survivorship and total cover of native riparian vegetation planted as mitigation and summarizes the data in annual reports to the California Department of Fish and Game.

Professional History

Impact Sciences, Inc. - Fisheries and Wildlife Biologist
Crawford Ecological Surveys - Principal/Ecologist
Cal Poly San Luis Obispo - Wildlife Technician; LCTA Program
Cal Poly San Luis Obispo - Wildlife Technician; Kit Fox Recovery Program
Cal Poly San Luis Obispo - Project Biologist, Pismo Lagoon;
Research Assistant, Trout Research;
Laboratory Assistant/ Collection Curator, Ichthyology

Education and Certifications

Bachelor of Science, Ecology and Systematic Biology (Fisheries and Wildlife Science Concentration); California Polytechnic State University at San Luis Obispo
Joint State and Federal Scientific Collecting Permit, valid through April 1999
Federal Section 10A Permit for Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*). Permit #PRT-821229 (Expires 3/5/01)
Pending State Agreement to conduct surveys for aquatic species of special concern
Certification, Desert Tortoise: handling, burrow construction, and egg handling techniques; U.S. Fish and Wildlife Service approved workshop and training session
Certification, Advanced Open Water Diver, PADI

Professional Affiliations

American Fisheries Society
American Society of Mammalogists

GWENDOLYN I. KENNEY

Botanist and Wildlife Biologist

Ms. Kenney is a botanist and wildlife biologist with over six years of experience in conducting biological resources inventories, endangered species surveys, environmental mitigation monitoring, and habitat evaluations. Ms. Kenney is experienced in field survey protocols and holds federal permits to conduct surveys for sensitive wildlife species. She has also handled and/or surveyed for sensitive, threatened, and endangered reptiles, birds, and mammals under federal and state permits. Her expertise is in the identification and characterization of plant communities, common plant species, and special status plant species. She is particularly familiar with the special status plants of southern and central California, from the coastal regions to the inland valleys and deserts.

Selected Professional Experience

City of San Diego Metropolitan Wastewater and Waste Management Departments. Project Ecologist and contributing author for the biological resources inventory and impact assessment for the Fiesta Island Replacement Project/Northern Sludge Processing Facility/West Miramar Landfill Overburden EIR/EIS located on Naval Air Station Miramar, San Diego County, California. Served as field investigator for California gnatcatcher, oak tree, and vernal pool surveys. Conducted a vernal pool survey of a potential vernal pool mitigation site and prepared associated letter report.

Keller/Swinerton & Walberg and Southwest Division of the U.S. Department of the Navy. Project Ecologist for conducting biological monitoring during demolition of the Chollas Heights Naval Radio Transmitting Facility and the 415-unit Navy housing development project located in San Diego County, California. Biological monitoring activities involved educating and directing construction personnel regarding adherence to established mitigation protocol. Additional responsibilities included seedbank collection from impacted vernal pools, and San Diego barrel cactus relocation from impacted coastal sage scrub habitat. Also supervised and monitored soil decompaction, topographic recontouring, hydroseeding, and vernal pool restoration procedures. Prepared associated post-monitoring report.

City of Chula Vista and City of San Diego. Project Ecologist for mitigation monitoring for several riparian and salt marsh revegetation sites located in San Diego County, California. The cover, height, and health of hydroseed and container stock plants were recorded along fixed transects. Identified invasive weeds occurring on the sites. Instructed field personnel for the removal of exotic species.

City of San Diego. Conducted revegetation mitigation monitoring for the City of San Diego's North Mission Valley Interceptor Sewer Phase I within riparian vegetation along the San Diego River, San Diego County, California. During the surveys, recorded the cover, height, and health of hydroseed plants using a quadrate at fixed locations. The diameter at breast height and health of the container stock was also recorded at the fixed locations.

San Diego Port District. Conducted mitigation monitoring for the San Diego Port District within a salt marsh restoration site at the Chula Vista Wildlife Reserve located in Chula Vista, San Diego County, California. During the surveys, recorded the frequency cover, height, and health of salt marsh plant species using a quadrate along fixed transects.

Kaufman & Broad. Conducted mitigation monitoring within a riparian restoration site located in Thousand Oaks, Ventura County, California. Responsible for collecting qualitative and quantitative data on the health of the restoration species, presence of weeds, pest and erosion problems, and evaluation of the site meeting performance standards.

Ventura County Area Housing Authority/City of Thousand Oaks. Conducted mitigation monitoring within a riparian restoration site located in Thousand Oaks, Ventura County, California. Responsible for collecting qualitative and quantitative data, and directing the weed eradication program.

Woodridge Associates. Botanist for performing a biological assessment of the Wood Ranch Property located in Thousand Oaks, Ventura County, California. Assessed and documented the botanical resources on a proposed residential development site. Surveyed site for special status plant species. Counted and mapped populations of Catalina and Plummer's mariposa lilies, and California black walnut. Delineated Army Corps of Engineers and California Department of Fish and Game jurisdictions.

Orange County Training and Shooting Club. Performed biological field surveys for a biological assessment of a proposed development site located in Santiago Canyon, Orange County, California. Characterized and mapped plant communities based on aerial photographic interpretation and field-truthing. Conducted focused surveys for California gnatcatcher and coastal cactus wren.

County of Ventura. Botanist for performing a biological assessment of Toland Park located in Santa Paula/Fillmore, Ventura County, California. Assessed and documented botanical resources for a proposed golf course development. Characterized and mapped plant communities based on aerial photographic interpretation and field-truthing. Prepared floral inventory and surveyed site for special status plant species.

County of Ventura. Botanist and Regulatory Specialist for performing a biological assessment of a 333-acre proposed golf course site located in Ventura County, near Camarillo, California. Tasks included counting and mapping populations of Blochman's dudleya, Verity's dudleya, and California black walnut. Delineated Army Corps of Engineers and California Department of Fish and Game jurisdictions. Prepared the jurisdictional analysis for the project site.

City of Oxnard. Botanist for performing a biological assessment of the North Shore property located in Oxnard, Ventura County, California. Assessed and documented the botanical resources for a proposed development project. Characterized and mapped plant communities based on aerial photographic interpretation and field-truthing. Prepared floral inventory and surveyed site for special status plant species

U.S. Forest Service. Staff Biologist for conducting baseline inventory of terrestrial flora and fauna for a municipal landfill development EIR/EIS on and adjacent to the Angeles National Forest, Los Angeles County, California. Conducted a literature search for special status plant and wildlife species, and biologically sensitive habitats. Identified and mapped plant communities. Conducted spot-light surveys, scent station monitoring, and small mammal trapping. Also assisted with bat surveys, using bat frequency detectors, mist nets, and night-vision.

Trust for Public Lands. Staff Biologist for conducting baseline inventory of terrestrial flora and fauna for eight proposed land exchange sites located within the Angeles National Forest, Los Angeles County, California. Characterized and mapped plant communities and evaluated their potential to support endangered or sensitive species.

Newhall Land & Farming Company. Biologist for performing a biological assessment of the Westridge property located in Newhall, Los Angeles County, California. Characterized and mapped the habitats present on site and evaluated their potential to support special status plant and wildlife species. Prepared associated letter report.

Diamond Bar Partners East. Biological monitor for geological investigations at a proposed residential development site located in Los Angeles County, California. Specific issues included

impacts to oak trees, migratory bird nests, and jurisdictional wetlands. Prepared associated letter report.

Transportation Corridor Agency. Project Ecologist for performing biological studies along the southern segment of the Foothill Transportation Corridor located in Orange and northwestern San Diego Counties, California. Conducted focused surveys for special status plant species, and searched for the food plants preferred by the Quino checkerspot butterfly. Also conducted focused surveys for Pacific pocket mouse, California gnatcatcher, coastal cactus wren, southern California rufous-crowned sparrow, grasshopper sparrow, southwestern arroyo toad, orange-throated whiptail, and San Diego horned lizard.

MCI Telecommunications Corporation. Project Ecologist for the assessment and documentation of plant and wildlife resources for a coastal zones constraints analysis along the MCI fiber optic route from Dana Point to the Torrey Pines State Reserve, Orange and San Diego Counties, California. The analysis included a literature search for special status plant and wildlife species, and biologically sensitive habitats. Conducted reconnaissance surveys to identify and map environmentally sensitive areas. Represented MCI at all agency meetings and public hearings.

U.S. Marine Corps. Biologist for performing focused California gnatcatcher surveys for the El Toro Base Closure EIR located in Orange County, California. Surveyed site for the presence of California gnatcatchers and prepared an inventory of wildlife species present on site.

San Diego Gas & Electric. Project Ecologist for literature search for the occurrence of special status plant and wildlife species, and biologically sensitive habitats along San Diego Gas & Electric's proposed Pipeline 2000 and Project Vecinos natural gas pipelines. Identified and mapped plant communities and conducted focused surveys for the California gnatcatcher, coastal cactus wren, Bell's sage sparrow, willowy monardella, and other special status species.

U.S. Army Corps of Engineers. Staff Biologist and contributing author for an Environmental Assessment for ordnance clearance at Mission Trails Regional Park located in San Diego County, California. Identified and mapped plant communities, including vernal pool habitat. Conducted focused California gnatcatcher and special status plant surveys. Counted and mapped populations of slender-pod jewelflower, Orcutt's brodiaea, summer-holly, variegated dudleya, San Diego barrel cactus, San Diego goldenstar, Palmer's grapplinghook, San Diego sunflower, western dichondra, spiny rush, California adder's-tongue fern, and ashy spike-moss.

General Dynamics. Project Ecologist for performing a biological assessment of the Sycamore Canyon and Kearny Mesa properties located in San Diego County, California. Assessed and documented the botanical resources. Characterized and mapped plant communities, including vernal pool habitat, based on aerial photographic interpretation and field-truthing. Conducted focused surveys for the following wildlife species: California gnatcatcher, orange-throated whiptail, and San Diego horned lizard. Counted and mapped populations of willowy monardella, San Diego mesa mint, San Diego button-celery, Orcutt's brodiaea, spreading navarretia, and long-spined spineflower.

Pardee Company. Biologist for performing a Biological Assessment of Pardee Company's Neighborhood 10 located in Del Mar, San Diego County, California. Prepared a biological assessment for a proposed residential development. The habitats present on site were characterized and mapped, and evaluated for their potential to support special status plant and wildlife species. Surveyed site for the presence of California gnatcatchers and special status plant species. Counted and mapped populations of San Diego barrel cactus, Del Mar Mesa sand aster, prostrate spineflower, white coast ceanothus, and ashy spike-moss.

AT & SF. Project Ecologist and Regulatory Specialist for a biological resources assessment for a railroad relocation project located in San Juan Capistrano, Orange County, California. Served as

main author for this biological resources assessment. The habitats present on the site were characterized and mapped, and evaluated for their potential to support special status plant and wildlife species. Assisted with wetland delineations to determine the nature and extent of Army Corps of Engineers Section 404 jurisdiction.

Butler Roach Group, Inc. Project Ecologist for preparing a biological resources evaluation for the Aspen Road and Gregory Canyon proposed landfill sites located in Pala and Fallbrook, San Diego County, California. The habitats present on site were characterized and mapped, and evaluated for their potential to support special status plant and wildlife species. Coordinated field staff for biological field investigations, including focused surveys for sensitive amphibian, reptile, and bird species.

Robert Jackson, esq. Project Ecologist for preparing a biological constraints analysis for a proposed property subdivision located in Fallbrook, San Diego County, California. Served as field investigator, primary author, and project manager for this analysis. The habitats present on the site were characterized, mapped, and evaluated for their potential to support special status plant and wildlife species.

Mobil Exploration & Producing U.S. Inc. Biologist for pre-construction biological resources studies and construction monitoring for the construction of Mobil's 17Z gas transmission pipeline project located in Kern County, California. Conducted focused surveys for blunt-nosed leopard lizard, San Joaquin kit fox, San Joaquin antelope squirrel, Giant kangaroo rat, and Hoover's Eriastrum, recurved larkspur, and Kern mallow over a two-year period. Surveys included spotlighting and scent station monitoring. Responsible for endangered species education and training programs, construction personnel supervision, and production of regular activity reports to document the implementation of mitigation measures detailed in the Biological Opinion. Monitored all phases of construction throughout known sensitive species habitat. Documented all sensitive biological resources encounters, removed common and sensitive biological resources from the construction right-of-way.

Shell Western E&P Inc. Biologist for Shell's 17Z portion of a gas transmission pipeline project located in Kern County, California. Responsible for endangered species education and training programs, construction personnel supervision, and production of regular activity reports to document the implementation of mitigation measures.

The Nature Conservancy. Biological Technician for a small mammal trapping inventory program located in northeastern Wyoming. The trapping program was part of a gap analysis project that was a cooperative effort between The Nature Conservancy, Wyoming Game and Fish Department, and Bureau of Land Management. Duties included assisting project biologist conduct 8,500 trapnights, ground-truthing GIS vegetation polygons, and identifying dominant and subdominant plant communities. All collected animals were utilized for museum specimens, raptor rehabilitation, and hantavirus research.

Wyoming Game and Fish Department. Biological Technician for the Black-footed Ferret Reintroduction Program located in Shirley Basin, Wyoming. The reintroduction program involved cooperation between the Wyoming Game and Fish Department, USFWS, and various agencies, institutions, conservation groups, and private individuals. Duties included conducting spot-light surveys for the black-footed ferret, trapping and identifying black-footed ferrets, and assisting with the release of captive bred black-footed ferrets into the wild.

Professional History

Impact Sciences, Inc. - Biologist
Kenney Biological Consulting - Owner
Wyoming Department of Game and Fish - Biological Technician
The Nature Conservancy - Biological Technician
Michael Brandman Associates - Project Ecologist
Dames & Moore - Staff Biologist

Education

B.S., Environmental and Systematic Biology, California Polytechnic State University at San Luis Obispo

Professional Affiliations

California Botanical Society
California Native Plant Society

Permits and Certifications

Federal Section 10(a) Permit to conduct California gnatcatcher surveys, 1995-1999
Federal Section 10(a) Permit to capture and release an endangered small mammal species, Pacific pocket mouse (List of Authorized Individuals), 1996-2000
California Department of Fish and Game agreement to trap and release small mammal California Species of Special Concern (Subpermittee), 1996-1997
California Department of Fish and Game Scientific Collecting Permit, 1996-1997
Certification, Desert Tortoise Handling, burrow construction, and egg handling Techniques, U.S. Fish and Wildlife Service
Basic Wetland Delineation Certification, Wetland Training Institute, 1993

APPENDIX B
Bibliography

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APPENDIX C

Data Forms

Riparian Buffer Bird Survey

Date: Study Location: Transect No. Survey No:
Observer(s):
Survey Start Time: End Time:
Temp-S: /E: Cloud Cover-S: /E: Wind/Direction-S: /E:

Target	Initial Observation			Movement Distance					Final Observation		
Species	Rip	Up	Edge	<50	50-100	100-150	150-200	>200	Rip	Up	Edge
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

Other Bird Species Observed:

Comments:

Riparian Buffer Bird Survey
Vegetation Analysis

Transect No. Page of
Study Location:

Upland Plant Dominants (code):

Percent Bare Ground: Percent Shrub Cover:
Shrub Cover Variability (circle): uniform moderate high
Average Shrub Height (circle): 0-3.0 ft 3.0-5.0 ft 5.0-8.0 ft >8.0 ft
Shrub Height Variability (circle): uniform moderate high
Percent Herbaceous Cover:
Herb Cover Variability (circle): uniform moderate high

Riparian Plant Dominants (code):

Percent Bare Ground: Percent Tree Cover:
Tree Cover Variability (circle): uniform moderate high
Average Tree Height (circle): <10 ft. 10-15 ft 15-20 ft 20-25 ft >25 ft
Tree Height Variability (circle): uniform moderate high

Transect No.
Study Location:

Upland Plant Dominants (code):

Percent Bare Ground: Percent Shrub Cover:
Shrub Cover Variability (circle): uniform moderate high
Average Shrub Height (circle): 0-3.0 ft 3.0-5.0 ft 5.0-8.0 ft >8.0 ft
Shrub Height Variability (circle): uniform moderate high
Percent Herbaceous Cover:
Herb Cover Variability (circle): uniform moderate high

Riparian Plant Dominants (code):

Percent Bare Ground: Percent Tree Cover:
Tree Cover Variability (circle): uniform moderate high
Average Tree Height (circle): <10 ft. 10-15 ft 15-20 ft 20-25 ft >25 ft
Tree Height Variability (circle): uniform moderate high

Grid Number ________

Date ________

Small Mammal Trapping Data

Species	Trap #	Sex	Age	Repro Cond	Capture	Clip	Remarks:

Grid Number _____

Date _____

Small Mammal Trapping Data
Vegetation Analysis

Vegetation Community Description

_____
_____
_____
_____
_____
_____

Trap #

Species Present: _____

_____

Dominants: _____

Canopy Height_____Density_____% Cover_____Soil Type_____

Slope_____Aspect_____

Trap #

Species Present: _____

_____

Dominants: _____

Canopy Height_____Density_____% Cover_____Soil Type_____

Slope_____Aspect_____

Trap #

Species Present: _____

_____

Dominants: _____

Canopy Height_____Density_____% Cover_____Soil Type_____

Slope_____Aspect_____