Appendix J

Introduction

The RMV Open Space would be managed and monitored over the long term to protect, maintain and, where feasible, to enhance/restore habitat values (Figure 1). A complete description of the existing biological resources and values documented within the RMV Open Space is contained in Section 4.9 of GPA/ZC Draft EIR.

The RMV Open Space Monitoring and Adaptive Management Program (collectively called the Adaptive Management Program) is the framework for the policies and programs that would guide the future uses and activities in the RMV Open Space.

The Adaptive Management Program is comprised of several components. These components are discussed in the following sections:

1.1. Characteristics of the Adaptive Management Approach
1.2. Overview of the Biological Management and Monitoring Program
1.3. Elements of the RMV Open Space Adaptive Management Program
1.4. Major Vegetation Communities and Associated Species
1.5. Site-specific Resources
1.6. Habitat Linkages and Wildlife Corridors
1.7. Fire Management Plan
1.8. Grazing Management Plan
1.9. Habitat Restoration Plan
1.10. Invasive Species Control Plan

This document provides the programmatic framework for the Adaptive Management Program and general descriptions of the key components of the program for each section listed above. Although some template examples are provided for illustrative purposes, the full details of the following key components of the Adaptive Management Program are provided in separate technical appendices:

- Plant Species Translocation, Propagation and Management Plan (*Appendix X-1*)
- Habitat Restoration Plan (*Appendix X-2)*
- Invasive Species Control Plan (*Appendix X-3*)
- Grazing Management Plan (*Appendix X-4*)
- Fire Management Plan (*Appendix X-5*)

Each of these components is attached to this document and would be approved by the County of Orange as a part of the overall approval of this management program.

Implementation of the Adaptive Management Program will be tied to the phased dedication of RMV Open Space, which in turn is tied to development phasing. Management by RMV in accordance with the Adaptive Management Program will occur upon dedication of a specific phase of Open Space. For example, it is likely that dedication of Chiquita Ridge would be tied to development in Planning Area 2. Upon this dedication occurring, RMV would initiate management of the biological resources associated with Chiquita Ridge based on the management priorities and stressor models established in the Adaptive Management Program. Until such time as the dedication occurs, RMV would continue to implement its current management practices which to date have protected the biological resources found on RMV lands. In this way, the mitigation provided by the RMV Open Space and Adaptive Management Plan is properly tied to impacts resulting from development of RMV lands.

Although not part of the Adaptive Management Program, the Water Quality Management Plan for the Ranch Plan project has an adaptive management program of its own, which will coordinate with this Adaptive Management Program. In particular, the WQMP addresses three stressors; 1) "pollutants" generated by urban development with the potential to impact species and habitats; 2) "altered hydrology" due to urban development with the potential to impact species and habitats and 3) "altered geomorphic processes" with potential to impacts species and habitats. By addressing these stressors, the WQMP helps assure that these stressors will not significantly impact net habitat value.

1.1 Characteristics Of The Adaptive Management Approach

1.1.1 NCCP Conservation Guidelines

The NCCP Conservation Guidelines adopted by the CDFG (1993) and incorporated into the Section 4(d) Special Rule (Special Rule) for the coastal California gnatcatcher recommend that an "adaptive management" regime should be implemented to manage biological resources in the Southern Subregion.

> *Management and restoration practices should be addressed as part of a well-coordinated research program. Management and restoration research will be valuable to subregional NCCP planning. Even after a NCCP is adopted, ongoing restoration research will be essential to adaptive management of coastal sage scrub habitat.*
> (NCCP Conservation Guidelines, November 1993, CDFG, at pg. 7)

Appendix J

As used in this program, adaptive management is defined as a flexible, iterative approach to long-term management of biotic and abiotic resources that is directed over time by the results of ongoing monitoring activities and other information.

The NCCP Conservation Guidelines identified three key areas relevant to the management of coastal sage scrub:

- *Exotic species control, including both animals (in particular, cowbirds and feral and domestic mesopredators such as house cats and introduced red foxes) and plants (weedy species, especially annuals of old world origin).*

- *Recreational use of coastal sage scrub and other open space reserve areas, including identification of suitable low impact recreational pursuits consistent with preservation goals.*

- *The role of fire in natural ecosystem dynamics and processes, including the application of control burns and the control of ignitions of accidental and vandal origin.*

(NCCP Conservation Guidelines, November 1993, CDFG, at pgs. 7-8).

The science of adaptive management has evolved since the NCCP Conservation Guidelines were adopted in 1993, but the concept of adaptive management remains essentially the same. By definition, adaptive management is an experimental and flexible approach to resource management that integrates ecological theory, modeling, hypotheses generation, field manipulations and interventions, and feedback that allows for refinement of the model(s) and hypotheses and, ultimately, improved management of the resource. As stated by Gunderson (1999), adaptive management is adaptive because it acknowledges that managed resources will always change as a result of human intervention, that surprises are inevitable, and that new uncertainties will emerge. A key concept of adaptive management is that the world is uncertain and flexibility in resources management is crucial (Holling 1995; Holling and Meffe 1996). This approach requires a departure from the traditional command-and-control approach to management, which assumes that the managed system is relatively simple and predictable (Holling and Meffe 1996).

Adaptive management programs exhibit the following characteristics:

- Available theory, empirical information, and expertise are used to develop dynamic models that make predictions about the outcomes of different management actions (Carpenter et al. 1999; Walters 1997). Modeling is a powerful tool to simulate the spatial and temporal dynamics of key ecosystem factors, or what Holling (1995) terms Astructuring variables, and to generate and screen hypotheses that may not yield useful data or are unlikely to be effective management policies (Walters 1997).

- Models, hypotheses and experiments must meet on-the-ground managers' needs and should be developed in collaboration with managers (Rogers 1998). As part of this process, the monitoring tools, the options and strategies available to managers, and strategies for utilizing new data and information should be developed (Bosch et al. 1996).

- Adaptive management is a "dual control problem" where short-term management goals and objectives need to be met while also learning about the managed system (Nichols 1999).

- Adaptive management strategies may not yield decisive results for a decade or two and, thus, the agencies and stakeholders must be patient (Lee 1993; Walters 1997).

- Adaptive management strategies may pose risks for some populations and habitats of endangered and rare species (Johnson 1999a; Walters 1997), but the focus should be on restoring and maintaining ecological resiliency such that risk and catastrophe to other resources are avoided. In other words, there are likely to be difficult tradeoffs in the adaptive management of habitats and species.

- Reversible treatments should be used where possible so that if hypotheses turn out to be incorrect, the resource is not permanently lost (e.g., loss of a population, state-transition of a habitat) (Walters 1997).

The purpose of adaptive management within the framework of the statewide NCCP/HCP Program and HCPs is to help maintain and, where feasible, enhance the long-term net habitat value within a subregion. The NCCP Conservation Guidelines define the manner in which the creation and management of the RMV Open Space contributes to assuring no net reduction over the long term in the ability of the subregion to maintain viable populations of Identified Species (termed "target species" in the Conservation Guidelines) and their associated habitats:

Appendix J

> *…subregional NCCPs will designate a system of interconnected reserves designed to : (1) promote biodiversity, (2) provide for high likelihoods for persistence of target species in the subregion, and (3) provide for no net loss of habitat value from the present taking into account management and enhancement. No net loss of habitat value means no net reduction in the ability of the subregion to maintain viable populations of target species over the long-term.*
>
> *With improved techniques for management and restoration, the goal of no net loss of habitat value may be attainable even if there is a net loss of habitat acreage.*
> (NCCP Conservation Guidelines, November 1993, CDFG, pg. 9)

While the NCCP Process and Conservation Guidelines provide the regulatory framework and general guidance for an adaptive management approach, they do not address specific management issues in the subregion. The Southern Orange County Science Advisors (Science Advisors) elaborated on the principles of adaptive management and their "Principles for Adaptive Management" are discussed in detail in *Section 18.2.1*.

1.1.2 Consistency with U.S. Fish and Wildlife Service "Five Points Policy"

The "Five Points Policy" was promulgated by the U.S. Fish and Wildlife Service (USFWS, 2000) to provide guidance for the preparation of habitat conservation plans (HCPs) to agency staff, landowners and other public agencies. RMV will be preparing a HCP to provide the basis to obtain required federal Endangered Species Act (FESA) Section 10 "incidental take permits" for impacts to impacts to federally-listed species and their habitat. This AMP has been designed to address the policies and recommendations contained in the USFWS "Five Points Policy" including:

- Long-term adaptive management of designated habitats that support listed species and other sensitive species;
- "Compliance monitoring" determine whether implementation of the adaptive management program is consistent with terms of agency approvals;
- "Effectiveness monitoring" of designated species and habitats to determine the effectiveness of specific adaptive management measures in terms of promoting species survival and recovery;

- Funding to support the adaptive management and monitoring program; and

- Consideration of alternative conservation actions and approaches.

1.2 Overview Of The Biological Management And Monitoring Program

The Science Advisors identified five fundamental elements of an adaptive management program that were reflected in the Southern " Draft NCCP/HCP Planning Guidelines" (Southern NCCP/HCP Guidelines):

1. **Setting Management Objectives:** The specific goals and objectives of the adaptive management program need to be established before specific management actions can be identified; i.e., what is the future desired condition of the RMV Open Space? The objectives should be measurable, meet the regulatory requirements of the program, should incorporate the diverse views of the stakeholders, and be feasible to implement.

2. **Preparing Management Plans and Conceptual Models:** Specific management plans should be prepared for RMV Open Space. These plans will incorporate the management objectives for the RMV Open Space and be tied to conceptual models of each focal vegetation type that describe known and/or hypothesized dynamic relationships for the vegetation type (e.g., fire effects on coastal sage scrub) that can be empirically tested and refined through management.

3. **Identifying Uncertainties and Knowledge Gaps in Management Plans:** Concurrent with preparation of the conceptual models and management plans, it is important to identify the knowledge gaps and weaknesses in the conceptual models. These gaps and weaknesses form the basis for posing management questions that can be tested empirically in the field. The feedback from hypothesis-driven management actions is used to refine the conceptual models and lead to better models and management over time.

4. **Monitoring the Management Program:** As stated by the Science Advisors, "The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program."

5. **Incorporating Monitoring and Research Results Into Revised Management Plans:** As management actions yield information, the conceptual models and management plans will be revised to reflect the new information, leading to new hypotheses, refined models and more effective management actions better able to meet the goals and objectives of the Adaptive Management Program.

Figure 2 shows a conceptual flowchart for adaptive management that incorporates these fundamental concepts and which are addressed in the description of the Adaptive Management Program that follows.

Appendix J

1.2.1 Environmental Stressor Approach

The Science Advisors and Southern NCCP/HCP Guidelines identify three broad land management goals for the Southern Subregion that can be translated to apply to and establish the foundation for the Adaptive Management Program for the RMV Open Space:

1. Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.

2. Restore or enhance the quality of degraded vegetation communities and other habitat types.

3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The first and underlying guiding principle of the Adaptive Management Program is that management and monitoring should be directed towards environmental factors known or thought to be directly or indirectly responsible for ecosystem changes that would be inconsistent with meeting the three broad goals cited above. For example, allowing fire to type-convert coastal sage scrub to non-native annual grassland would be inconsistent with the goal of ensuring the persistence of a native-dominated mosaic in the planning area. These factors, called "environmental stressors," may have both adverse and beneficial effects on ecosystem characteristics such as vegetation communities and species. Fire is necessary for sustaining healthy stands of chaparral, and likely coastal sage scrub, but fire at frequent intervals can result in the conversion of these communities to annual grassland. Environmental stressors may be natural or human-caused, and some may be both. For example, ignitions of wildfires can be both natural (lighting strikes) and human-caused (arson and accidental human-caused ignitions). Natural and human-caused stressors that significantly affect vegetation communities and species in the Southern Subregion include wildfires, over-grazing, exotic plants and animals, altered hydrology, altered geomorphic processes, and, to a lesser extent, drought. This emphasis on "environmental stressors" has increasingly become the central focus of adaptive management in large-scale ecosystem programs such as the Northwest Forest Plan.

It is important to understand that the vegetation communities and associated species in the RMV Open Space are basically in good general health, but that certain known and potential stressors operate and can be identified (e.g., giant reed invasion of San Juan Creek, three recent fires in the Upper Chiquita Canyon Conservation Area). For this reason, the stressor approach is particularly appropriate and the basic management needs are to: **(1)** address existing stressors so that net habitat value can be increased; and **(2)** identify future stressors that could reduce or adversely alter long-term net habitat value.

In conclusion, the environmental stressor approach is the guiding principle of the Adaptive Management Program both because it is state of art science for management and monitoring of ecological systems (e.g., Noon 2003) and is particularly appropriate for theRMV Open Space.

a. Characteristics of Conceptual Environmental Stressor Models

The second fundamental element of an adaptive management program identified by the Science Advisors and reflected in the Southern NCCP/HCP Guidelines is the preparation of management plans and conceptual models. Conceptual models are the theoretical bases for the management plans because they illustrate known and hypothesized dynamic ecological relationships that can be empirically tested and refined through management. Conceptual models can range from basic qualitative models (e.g., unidirectional cause-and-effect) to extremely complex quantitative ecosystem models. The adaptive management approach described here relies on relatively simple qualitative conceptual models that show known and hypothesized directional and interactive relationships between "environmental stressors" (as described below) and vegetation community and species-level responses. In contrast, complex ecosystem models, while having great value for testing and understanding basic and complex ecological relationships, tend to be too unwieldy for the purpose of identifying specific, practical management and monitoring actions. Direct application of such relatively abstract information to on-the-ground monitoring and practical management of the RMV Open Space would be difficult. Furthermore, because not all components of general ecosystem models are relevant to monitoring and management, a complex ecosystem model may obscure the variables most important for monitoring and management.

The Adaptive Management Program would be implemented based on the assumption that practical management and monitoring should focus on the issues most relevant to the managed system. The "environmental stressor" approach to monitoring and managing natural resources is receiving more attention in recent years because it provides a conceptual method more amenable to an enhanced understanding of causal relationships that can be addressed through management actions. Laying the foundation for the environmental stressor approach, Noon (2003) states:

> *To be most meaningful, a monitoring program should provide insights into cause-and-effect relations between environmental stressors or between specific management practices and anticipated ecosystem responses. Prior knowledge of the factors likely to*

> *stress an ecological system or the expected outcomes from management should be incorporated into the selection of variables to measure and the sampling design. Indicators should be chosen based on a conceptual model that clearly indicates stressors (e.g., pollutants, management practices) and indicators with pathways that lead to effects on the structure and function of the ecological system (NRC 1995, 2000). This process enables the monitoring program to investigate relations between anticipated stressors, or between management practices and environmental consequences, and provides the opportunity to develop predictive models.* (pg 34)

This environmental stressor approach is currently being applied to other adaptive management programs, and, for example, is an integral component of the *Adaptive Management and Monitoring Program* prepared for the Coachella Valley Multiple Species Conservation Plan and Natural Communities Conservation Program (Center for Natural Lands Management 2002)

In order to identify causative environmental factors responsible for ecosystem changes, Noon (2003) distinguishes between two kinds of "disturbance events" or stressors related to ecological change: intrinsic drivers and extrinsic drivers of ecological change. *Intrinsic drivers* are factors that occur naturally in the system and cause expected changes, such as stochastic variation, successional trends following disturbance events, and cyclic variation. Intrinsic drivers are not human-induced impacts and generally are not directly amenable to management nor, in many cases, would management be appropriate (Noon 2003). The ecosystem response should behave as a self-regulated system because the system presumably has evolved in the context of the intrinsic driver (e.g., coastal sage scrub has evolved in the context of wet/dry cycles and natural wildfires, riparian habitats have evolved in the context of regular flooding).

In contrast, e*xtrinsic drivers* are those external factors, usually human-induced, that in combination with intrinsic factors, can adversely drive the ecosystem to a degraded state. These extrinsic drivers push the system beyond its natural resilience (i.e., expected range of variation) and essentially "break" the system. Noon (2003) describes extrinsic drivers and the way they can affect an ecosystem system as follows:

> *Of most interest to monitoring programs are extrinsically driven changes to environmental indicators that arise as a consequence of some human action. Concern arises when extrinsic factors, acting singly or in combination with intrinsic factors, drive ecosystems outside the bounds of sustainable variation. Thus, one key goal of a monitoring program is to discriminate between extrinsic and intrinsic drivers of change; that is, a mechanism to filter out the effects of expected intrinsic variation or cycles*

> *(noise) from the effects of additive, human-induced patterns of change (signal).* (pg. 29, underline added for emphasis)

Noon (2003) suggests that a goal of monitoring is to develop a "structural model" of how the ecosystem responds to both intrinsic and extrinsic drivers. Indicator variables that are sensitive to intrinsic drivers should be selected and regularly measured to determine their range of natural variation. The model indicates the range of natural variation and provides a benchmark to compare future deviations (*noise + signal*) from the expected natural variation (noise). For example, arroyo toad breeding success appears to vary with wet/dry years in a fairly predictable pattern with reasonably well understood causes (i.e., extent and duration of breeding pools). A model of this cyclic behavior would indicate the "natural" variation in breeding success (e.g., measured by recruitment into the breeding population a following year) in relation to rainfall patterns. Two or three consecutive dry years would be expected to result in low recruitment over those years. However, poor recruitment following an otherwise good year (i.e., adequate extent and duration of breeding pools) would suggest that an extrinsic driver (stressor) (e.g., bullfrog proliferation) has adversely affected toad breeding success.

b. Formulation of Stressor Models for Vegetation Communities

Preliminary stressor models have been formulated for each of the five major vegetation communities in the RMV Open Space: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. The models are based both on the available scientific literature and on the professional judgment and experience of biologists familiar with the RMV property. As such, the models represent an amalgam of basic ecological theory, empirical scientific studies and direct observation of current Ranch conditions.

Two kinds of models were generated for each vegetation community. The first set of models (Figures 3-7) postulates the relationships between general landscape-level environmental stressors and vegetation community responses. This set of models provides a broad overview of the stressor-response relationships and identifies six general environmental stressors known or likely to be relevant to the Habitat Reserve[1]:

1. Too frequent/too infrequent fire

[1] The six stressors are intended to address "changed circumstances" as defined in the federal "No Surprises" rule. Changed circumstances are defined under No Surprises rule as "changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably anticipated by the plan developers and the USFWS and that can be planned for."

2. Over-grazing
3. Exotics (plants and animals)
4. Altered hydrology
5. Altered geomorphologic processes
6. Drought

At the scale of the Habitat Reserve, all but the drought stressor have human-induced components, and thus would be extrinsic drivers that may require management and monitoring. Although at a global scale, drought also may have a human-induced component (e.g., global warming-induced climate change), it cannot be directly managed at the RMV Open Space scale. However, drought can have direct effects on other stressors (e.g., fire) that, in turn, have direct effects on vegetation communities.

Under the first set of models, the "line weights" in Figures 3 through 7 represent the postulated strength of the relationship between an environmental stressor and the community response. For example, for coastal sage scrub (Figure 3), fire is considered to have a stronger direct influence in driving sage scrub to annual grassland than exotic species. Although exotic species directly influence sage scrub and help drive it to grassland, fire is a strong mediator of exotic invasion, as depicted by the arrow from the fire component to the exotics component of the model. Likewise, drought increases the likelihood and intensity of fire through reduced moisture content and greater dead fuel loads, and thus can cause a state-transition of coastal sage scrub to annual grassland. Although Figures 3 through 7 depict conceptually simple models, they reveal quite complex interactions between environmental stressors and community responses.

The second set of models depicted in Figures 8 through 12 focuses on selected "focal species."[2] For the purpose of RMV Open Space monitoring and management,

> "Focal species serve an umbrella function in terms of encompassing habitats needed for many other species, play a key role in maintaining community structure or processes, are sensitive to changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability." (as defined by the Committee of Scientists, 1999).

Noon (2003b) further refines focal species categories:

---

[2] Focal species generally are species that provide information about other species or community structure or processes, are sensitive to environmental changes, or serve as indicators of ecological sustainability. See Section 1.2.2.c for a detailed discussion of the approach used to select and species considered as candidate focal species.

Appendix J

(1) *Indicator species*: *"An organism whose characteristics (presence or absence, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species or environmental conditions of interest" (Landres et al. 1998). In addition, Patton (1987) describes an indicator as a organism so intimately associated with particular environmental conditions that its presence indicates the existence of those conditions. Indicator species can further be broken down into 3 categories (Caro and O'Doherty 1999).*

- *Early warning indicator: Provides an early warning of a stressor acting on a key ecosystem process. (Traditional interpretation of an indicator species from ecotoxicology.)*
- *Population surrogate indicator: Species whose status and trend are indicative of the status and trends of other species.*
- *Biodiversity indicator: A species, or more commonly a taxonomic group, that functions as a surrogate measure of the number of poorly known taxonomic groups.*

(2) *Umbrella species: A species that needs such large areas of habitat that managing for its viability meets the needs of numerous other species with similar resource requirements but smaller area requirements (Wilcox 1984). The principal requirement for an umbrella species is its range is large compared to sympatric species.*

(3) *Keystone species: A species that significantly affects one or more key ecological processes or elements to an extent that greatly exceeds what would be predicted from its abundance or biomass (Mills et al. 1993, Power et al. 1996).*

(4) *Flagship species: A species that can be use to anchor a conservation campaign because it arouses public interest and sympathy (normally a charismatic large vertebrate) (Simberloff 1998).*

(5) *Link species: A species that occupies a key position in a food web and efficiently transfers energy and matter between trophic levels.*

(6) *Ecological engineer: A species that directly or indirectly controls the availability of resources to other organisms by causing physical state changes in biotic or abiotic materials (Jones et al. 1994, 1997).*

Of these various focal species categories, "indicator species" and "umbrella species" likely will be the most useful for the Adaptive Management Program. The RMV Open Space may support a "keystone species" but no information is yet available to indicate that such a species occurs in the subregion. The subregion also does not support a candidate “flagship species.” The mountain lion and golden eagle would be two obvious candidates, but while the RMV Open Space will accommodate these two species, neither is “symbolic” of the conservation effort. As with “keystone species,” there is insufficient information at this time to identify candidate “link species” or “ecological engineers” in the subregion.

Both Identified Species and other non-covered species may serve as focal species for the purposes of overall RMV Open Space monitoring and management. Monitoring and management of these species will facilitate management of the overall RMV Open Space.

The models show more detail and postulate the relationships between stressors, community responses and their consequent impacts on selected focal species. These more detailed models incorporate the postulated relationships between human-induced environmental stressors and community responses of the first set of models depicted in as well as postulated relationships between these and additional environmental stressors and focal species. For example, for coastal sage scrub (Figure 8), additional species-based stressors include mesopredators, human collection/harassment, roads and trails, and pesticides. The pathways between stressors and species may be both direct (e.g., Argentine ants displace native prey of San Diego horned lizards) or indirect via community responses (e.g., long-term spatiotemporal changes to habitat structure and function cause the gradual decline of a species).

18.2.2 Goals and Objectives

As stated in the previous section, the three broad goals of the Adaptive Management Program are to:

1. Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.
2. Restore or enhance the quality of degraded vegetation communities and other habitat types.
3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The previous section also described the “environmental stressor” approach as the foundation of the Adaptive Management Program for achieving these goals and presents conceptual stressor models for the five major vegetation communities: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. However, as stated, these are general goals and do not define specific management objectives and activities that would enable management actions and outcomes to be systematically monitored and measured in the Habitat Reserve.

The conceptual environmental stressor models address management and monitoring of resources at three fundamental scales: **(1)** natural community landscape mosaic; **(2)** specific vegetation communities and habitats; and **(3)** species and species assemblages. Although there is overlap, dependence, and interaction among the difference scales, clearly stated conceptual relationships and coordinated management objectives at all three scales are needed to meet the management goals of the program.

1. Landscape management pertains to the dynamic and interacting biotic natural communities and abiotic factors within the entire subregion, and focuses on the natural processes that maintain the condition and dynamics of the natural communities. For example, the interaction of geomorphic and hydrologic processes, periodic events such as flooding, fire, and weather (i.e., drought/wet cycles), and the structure and function of vegetation communities, species and species assemblages must be understood in order to manage resources. A question that may be asked in this landscape context, for example, is: what is the role of flooding in maintaining southern willow scrub that is suitable breeding habitat for the least Bell's vireo?

2. Management and monitoring of specific vegetation communities and habitats refers to site-specific conditions, as contrasted with the broader landscape scale that focuses on the dynamic interaction of biotic and abiotic processes. Vegetation communities would be monitored and managed in terms of *net habitat value*, as discussed above, thus providing flexibility in the management and monitoring in recognition of the natural stressor-induced changes (i.e., intrinsic drivers) that occur in vegetation community associations that alter the relative amounts of the community at any give time (e.g., natural succession, fire, flooding, etc.).

3. Management and monitoring of species and species assemblages refers to maintaining species populations, including Identified Species or other "focal species" (e.g., indicator or umbrella species as defined below in *Section 1.2.2.c*). Management and monitoring of species and species assemblages would be important for both permit compliance monitoring for Identified Species (see *Section 1.2.3.a*) and adaptive management of the RMV Open Space (*Section 1.2.3.b*).

The next section provides a review of the ecological processes that operate at the three management scales identified above -- community landscape, vegetation communities and habitats, and species and species assemblages -- and proposes adaptive management objectives related to each of the processes.

a. Landscape Processes

The Adaptive Management Program addresses several landscape processes in the subregion that were identified by the Science Advisors in their refinement of the NCCP Tenets of Reserve Design: (1) fire; (2) hydrology and geomorphology; (3) habitat connectivity; and (4) edge effects and encroachment. These landscape processes and their relation to the Adaptive Management Program and the environmental stressor approach are discussed in this section.

1. Fire

Fire is considered to be a fundamental component of the coastal southern California ecosystem, and particularly of the coastal sage scrub and chaparral shrub communities (see Chapter 3, Section 3.2). While it is generally acknowledged that fire is essential for maintaining healthy shrub communities over the long term, there is considerable debate about the natural frequency and intensity of fires in the southern California (e.g., Keeley 1986, 1992; Keeley and Fotheringham 2001a,b; Minnich 2001). That is, under what regime does fire drive shrub communities beyond their natural range of variation or resilience to the extent that natural successional processes are disrupted? High fire frequency (i.e., short intervals between fires) may permanently alter the floristic composition and structure of a site, including the extirpation of weak resprouting species such as California sagebrush (Malanson and O'Leary 1982). Fires at five- to 10-year intervals may result in type conversion from chaparral to coastal sage scrub (Keeley 1987; O'Leary et al.1992). Type conversion from coastal sage scrub or chaparral to grassland may result from repeated burning in successive or alternate years (Zedler et al. 1983).

These empirical observations in southern California provide the framework for managing and monitoring shrub communities in the Habitat Reserve. As an example, recent fires in the subregion provide the opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Portions of the Upper Chiquita Conservation Area experienced three burns in six years: 1996, 1997 and 2002, with the 2002 wildfire re-burning the 1997 burn area. Prior to the most recent burn in 2002, Harmsworth (2001) had documented that after three and four years post-burn, the 1997 and 1996 burn areas were recovering to mature coastal sage scrub composition, with general declines in fire-followers such as deer weed (*Lotus scoparius*) and morning glory (*Calystegia macrostegia*), and an increase in the dominance of shrubs such coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Saliva mellifera*), and laural sumac (*Malosma laurina*).

Appendix J

An important observation would be the response of the 1997 fire area that was burned again in 2002.

It also should be noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record. The Wiegand fire in 1954 burned lower Chiquita Ridge and Chiquadora Ridge. The Steward fire burned Chiquadora Ridge again in 1958. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years does not appear to be an adverse situation for this species. However, this area also has been subject to grazing during that period of time, so an important interaction between fire and grazing may be related to sustaining highly suitable gnatcatcher habitat in this area (e.g., a more open, lower habitat structure). Understanding the potential interaction between these two stressors (i.e., grazing and fire) will be crucial for managing the system, especially because allowing wildfires to burn or conducting prescribed burns in some areas of the RMV Open Space would not be feasible due to public safety and property concerns.

The Adaptive Management Program must address the role of fire (and possibly in conjunction with managed grazing) in maintaining a healthy ecosystem in the subregion such that the planning area at any given time would support a mosaic of upland habitats in stands of various ages (i.e., time since last burn).

Based on the current understanding of the fire ecology of southern coastal shrub and grassland communities, objectives of the Adaptive Management Program for fire that are consistent with the management objectives of species and habitats include:

- Identify appropriate spatial scales and patterns for the long-term management of fire.
- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species.
- Quantify effects of varying fire regimes on selected wildlife species.
- Utilize prescribed fire to reduce unplanned fire events from known ignition corridors.
- Define fire prescriptions that aid in the restoration of degraded shrublands.
- Investigate active restoration techniques following fire treatments.

- Develop a social environment supportive of active fire management.

The Fire Management Plan to achieve these objectives is described in more detail in *Section 1.7.*

2. Hydrology and Geomorphology

Abiotic hydrologic and geomorphic processes shape and alter creek systems in the planning area over time and thus are fundamental components of the regional landscape. Maintaining natural hydrologic and geomorphic process to the maximum extent possible is essential for preserving natural ecosystem structure and function. Alterations in hydrologic and morphologic processes have significant impacts on spatial and temporal distributions, structure, and function of riparian and wetland vegetation communities that provide essential habitat for numerous species.

The Draft Watershed and Sub-basin Planning Principles (Draft Watershed Principles) should be used as management objectives of the Adaptive Management Program as follows :

a) Surface and Groundwater Hydrology

- Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover.

- Address potential effects of future land use changes on hydrology.

- Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.

- Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains.

- Utilize infiltration properties of sandy terrains for groundwater recharge and to offset potential increases in surface runoff and adverse effects to water quality.

b) Water Quality

- Protect and manage water quality using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas.

c) Geomorphology/Terrains

- Recognize and account for the hydrologic response of different terrains to new development, rainfall/climate and proposed management/restoration activities at the sub-basin and watershed level.

d) Sediment Sources, Transport and Storage

- Maintain coarse sediment yields, storage and transport processes.

3. Habitat Connectivity

Disruptions in habitat connectivity results in habitat fragmentation. Fragmentation, in addition to increased "edge" area addressed in the next section, has two main effects that are generally accepted as adverse to ecosystem function: (1) reduction in total habitat area (which affects population sizes and extinction rates); and (2) redistribution of the remaining area into disjunct fragments (which affects dispersal and thus immigration rates) (Wilcove et al. 1986). Habitat fragmentation has been shown to alter avian species composition and distribution in southern California (e.g., Bolger et al. 1997a) and smaller habitat fragments may lose native species assemblages across taxa (e.g., Bolger et al. 1997b). The mechanisms for these changes are several, and include differential responses by species to edge effects, isolation of habitat fragments by intervening land uses that species cannot cross (e.g., some small mammals and reptiles will not cross roads) or distances that are beyond their dispersal capabilities, increased predation by mesopredators, and other sources of mortality (e.g., vehicle collisions).

The main goal of the Adaptive Management Program concerning habitat connectivity is to ensure that habitat linkages and wildlife corridors connecting large habitat blocks in the RMV Open Space function as designed (see General Policies 3 and 4 described in the Draft NCCP Guidelines) by managing "live-in" and dispersal habitat. Specific objectives to achieve this goal are to:

- Determine an appropriate suite of "focal species" for monitoring the use of habitat linkages and wildlife corridors (see discussion of "focal species" in *Section 8.2.1.c*).

- Monitor the use of key identified habitat linkages and wildlife corridors (as discussed in the existing biological conditions section of the GPA/ZC EIR and illustrated in Figure 13) by selected focal species. Monitoring sites would be selected based on their risk of being affected by existing or future development (e.g., areas where the habitat linkage or wildlife corridor narrows down to less than 1,000 feet or is crossed by an arterial roadway). Sites would be monitored through various methods as appropriate, including transects, track stations, and remote cameras.

- Identify and measure any ongoing stressors on wildlife such as harassment, lighting, noise, vehicle collisions based on monitoring data at key linkages and corridors. In some cases the stressor may be immediately apparent (e.g., a roadkill hotspot), but in other cases the stressor may be more subtle (e.g., interspecific competition for resources) and several years of monitoring may be required to detect a negative trend (e.g., a decline in tracks or scat of a species at a particular location).

- Identify and implement feasible remedial actions, to improve the function of the habitat linkage/wildlife corridor to an acceptable level (e.g., measurable reduction in vehicle collisions, increase in tracks or scat), such as restoring habitat to improve cover for refugia, placing fencing along roads to funnel wildlife and reduce vehicle collisions, erecting sound walls (as feasible), or redirecting lighting.

4. Edge Effects and Encroachment

Edge effects and encroachment into habitat areas are in large part related to, and exacerbated, by habitat fragmentation. Edge effects may be directly human-caused, such as lighting, noise, increased moisture, invasive plants, pesticides and pollutants, pets and feral animals, recreational activities, species collections, trash dumping, etc., or related to natural distributions of species (e.g., edge vs. interior species). Argentine ants, which rely on moist conditions, may invade naturally xeric areas along habitat edges where there is urban runoff or irrigation for landscaping or agriculture. Fuel modification zones (FMZ) may be considered edge areas because the natural vegetation composition and cover is altered to reduce fire loads. Longcore (2000), for example, observed effects on the coastal sage scrub arthropod community in FMZs, including an increase in the Argentine ant and other exotic arthropod species (European earwigs, pillbugs and sowbugs, and the sowbug killer) and a concomitant in decline predator species such as scorpians and trap-door spiders.

Edge effects also may be abiotic in origin, but have their effects on biological resources. Examples of abiotic edge effects are increased exposure to sun and wind and changes in soil ecology, with consequent effects on the microclimate at the edge of the habitat area (Lovejoy et al. 1989).

Fire also is an edge effect in the sense that human-caused fires (either accidental or deliberate ignitions) are most likely to occur along edges of roads (e.g., cigarettes, exhaust sparks or catalytic converter combustions, and arson) or at the urban-wildland interface (e.g., sparks from lawnmowers, rototillers, accidental or intentional ignitions by children, etc.), but because of the potential for spread of a wildfire, its impacts may be much greater than other types of edge effects that have more discrete and linear incursions into habitat ranging from a few to hundreds of feet (e.g., lighting, noise, urban run-off).

Human encroachment also may go beyond simple edge effects, and can include unauthorized public access into sensitive areas, illegal trails, and other activities within reserve areas that may have negative effects on biological resources.

General Policy 5 (Draft NCCP Guidelines) addresses long-term indirect impacts which can be applied to the RMV Open Space. Broad objectives of the Adaptive Management Program concerning edge effects and encroachment are stated below, along with specific objectives designed to meet the broad objective.

- Control invasion of the RMV Open Space by exotic plants and animals.
  - Prohibit plants identified by the California Exotic Plant Pest Control as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve.
  - Create fuel management zones combining irrigated and non-irrigated native plantings separating the RMV Open Space from adjacent urban uses.
  - Provide barriers, fencing and walls to control access to the RMV Open Space by domestic animals.
  - Implement the Invasive Species Control Plan throughout the RMV Open Space where pest plant and wildlife species are a demonstrated problem. The Invasive Species Control Plan (described in detail in *Section 8.10*) addresses invasive riparian plants (giant reed, pampas grass, tamarisk, castor bean, tobacco tree, and Spanish sunflower), invasive upland species (artichoke thistle), and invasive

animals (bullfrog, brown-headed cowbird, Argentine ant, and red fire imported ant).

- Control potential edge impacts such as lighting, increased moisture, pollutants and pesticides.

    - Shield and/or direct lighting away from habitat areas through the use of low-sodium or similar intensity lights, light shields, native shrubs, berms and other shielding methods.

    - Manage pesticide and herbicide use and fertilizer application techniques in landscaped areas, including golf courses, located adjacent to the RMV Open Space or preserved wetlands and provide comprehensive water quality treatment, which may include, but not be limited to, the use of natural treatment systems, prior to discharge of urban runoff into the RMV Open Space.

- Protect sensitive resource areas from unauthorized public access and associated impacts such as off-road vehicles (including motorized vehicles and mountain bikes), trampling of vegetation, and harassment and collection of native species.

        - Prohibit collection or removal of any native plant, animal or microorganism;
        - Prohibit the introduction of any non-native plant, animal or microorganism;
        - Prohibit firearms, weapons, and fireworks;
        - Restrict vehicle operations to designated roads.
        - Restrict hiking, mountain biking and equestrian uses to designated trails; and
        - Restrict pets to designated locations and trails and restraint of pets by leash at all times.

Wildfire control and fuel modification zones and treatments are addressed through the Fire Management Plan, as described below in *Section 8.7*.

b. Major Vegetation Communities

Appendix J

As stated above, the purpose of the Adaptive Management Program is to maintain and, where feasible, enhance the long-term net habitat value within the RMV Open Space. Habitat value may be defined as the ability (quality, suitability or functional level) of a unit area to support a particular organism. Simply put, if a unit of habitat is reduced in quality and is less capable of supporting a particular organism (i.e., the carrying capacity of the area has declined), its habitat value for that organism has declined. Likewise, if a species assemblage is diminished within a habitat area, its net habitat value has declined. With the recognition that habitat systems are dynamic, implementation of the Adaptive Management Program is an essential element in contributing to assuring no net long-term loss of habitat value in the subregion. The Adaptive Management Program contributes to maintaining net long-term habitat value in the RMV Open Space in two fundamental ways.

- Existing habitat value in the RMV Open Space is conserved through implementation of the Adaptive Management Program.

- Through restoration activities, the Adaptive Management Program provides opportunities for increasing habitat value in areas with lesser existing habitat value such that long-term net habitat value in the RMV Open Space is increased over current conditions.

The Adaptive Management Program addresses the five major vegetation communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. Overall goals and associated management objectives/actions of the Adaptive Management Program concerning vegetation communities and net habitat value are stated below. It is important to note that the application and timing of management actions to achieve these goals would be tied to specific environmental stressors that are known or suspected to be operating in the Habitat Reserve, management priorities, and available funding. Goals and management objectives specific to each of the five major vegetation communities are set forth in *Section 1.4*.

- Maintain major vegetation communities and associated species and species assemblages, with the recognition that acreages and net habitat values for a particular community will oscillate in relation to natural events (e.g., flood, fire, drought).

    - Establish the "baseline condition" of existing vegetation communities through aerial mapping of the entire RMV Open Space.

- o Conduct periodic (e.g., every 5 years) landscape-level vegetation monitoring using remote sensing methods to identify significant disturbances to vegetation communities. Determine whether disturbance is of natural or human-caused origin.

- o Periodically (e.g., every 5 years) quantify the acreage of five major vegetation communities. The RMV Open Space acreages among the major native vegetation communities would be allowed to vary such that net acreage of native vegetation communities remains relatively constant (e.g., coastal sage scrub converts to chaparral, or either converts to woodland) unless it is clear that *major* or *important populations* of Identified Species in *key locations* are being adversely affected, in which case a management action may be required (e.g., prescribed burn). If annual grassland increases more than 10 percent in areas formerly supporting coastal sage scrub or chaparral, a restoration action may be warranted (e.g., managed grazing, prescribed fire, or revegetation). If the increased grassland is native grassland, no management intervention would be required.

- o Conduct annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space. Selection of plots would be based on a stratified pseudorandom sampling procedure to ensure a representative sample of the RMV Open Space, including both interior and edge areas adjacent to urban development (the interior areas serve as controls for edge areas).

- o Focus restoration activities in areas where, due to either human-caused or natural disturbances, the area would continue to degrade without management intervention (e.g., repeated fire in a coastal sage scrub area may require active restoration to avoid type-conversion to annual grassland).

- Contribute to the ability of the subregion to support populations of Identified Species.

  - o Conduct monitoring of habitats supporting Identified Species, with a focus on stressors in selected areas in the RMV Open Space identified as supporting *major* or *important populations* in *key locations*.

  - o Implement management activities in any areas where habitat degradation has been determined to adversely affect habitat use by Identified Species **and** it is unlikely that the area would naturally regenerate without management intervention; e.g., where giant reed invades arroyo toad breeding habitat.

- Maintain and, where feasible, enhance long-term net habitat value in order to mitigate for proposed Incidental Take and to contribute to recovery of listed Identified Species in the subregion. Note that initial habitat restoration and invasive species control activities to address the most of the following objectives have been identified and are described in their respective plans.

  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges to improve habitat connectivity and carrying capacity for the California gnatcatcher.

  - Conduct restoration of native grasslands in designated areas of upper Cristianitos Canyon to improve habitat quality for thread-leaved brodiaea.

  - Manage native grasslands in areas supporting thread-leaved brodiaea through timed-grazing, prescribed burning, and/or selective weeding.

  - Implement invasive plant and animal species control plans along San Juan and Cristianitos creeks to improve breeding habitat for the arroyo toad and least Bell's vireo.

  - Maintain flow characteristics of episodic events and assure water quality in drainages supporting the arroyo toad.

  - Protect existing habitat in Gobernadora Creek (GERA) through management and restoration actions.

- Identify and restore existing areas with little or no habitat value to increase long-term net habitat value.

  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges and in Sulphur Canyon to improve habitat connectivity and carrying capacity for the California gnatcatcher and other sage scrub species.

- o Conduct restoration of native grasslands and coastal sage scrub/native grassland mix in designated areas such as Chiquita Ridge, upper Cristianitos Canyon, and upper Gabino canyon to improve habitat quality for grassland species such as the grasshopper sparrow.

- As opportunities arise in the future, use restoration to increase long-term net habitat value in the Habitat Reserve.

c. Wildlife Species

The Adaptive Management Program addresses two general classes of wildlife species: **(1)** Identified Species; and **(2)** “focal species.”

1. Identified Species

The Conservation Strategy is designed in part to conserve a suite of Identified Species and associated habitats. The Adaptive Management Program component of the Conservation Strategy is designed to help ensure that habitats supporting Identified Species are sustained and, in so doing, would “ contribute to recovery” of Identified Species on a subregional basis. Management and monitoring of Identified Species would occur at the habitat landscape level (e.g., Science Advisors Group 2 species) or at the site- and/or species-specific level (e.g., Science Advisors Group 3 species).

Two main goals of the Adaptive Management Program concerning Identified Species are:

1. **Maintain conditions that will allow for normal evolutionary processes and genetic integrity and exchange through management of functional open space, including functioning vegetation communities, habitat linkages and wildlife corridors.**

   This goal generally would be achieved by meeting the objectives stated above for habitat connectivity, edge effects and encroachment, and major vegetation communities (as well as specific goals and management objectives for each of the five major vegetation communities set forth in *Section 1.4*) because they all address the long-term function of the RMV Open Space for Identified Species and associated habitats

2. **Manage habitat and populations of Identified Species to ensure that Identified Species are sustained, and in so doing “contribute to recovery” of Identified Species on a subregional basis.**

Objectives designed to achieve this goal are to:

- Monitor populations of selected Identified Species and/or their habitats to detect population trends in relation to environmental stressors and management issues. Monitoring would focus on *major* and *important populations* and *key locations* of Identified Species where possible.

- Implement appropriate management actions, as necessary, to stabilize or enhance populations of Identified Species, such as habitat restoration, and pest controls (e.g., cowbird trapping, invasive species control).

All Identified Species would be managed and monitored at some level, either as an integral aspect of the program or through data gathered through specific monitoring efforts.

2. Focal Species

a) Methods for Selecting Focal Species

The focal species approach assumes that only a limited number of species can be effectively and practically monitored and managed because of the need to focus on species that provide feedback for management decision-making and the finite resources typically available for programs. Murphy, Noon and Collopy (2003) provide a practical and logical method for selecting focal species. This method is essentially a step-down, filtering approach whereby a "long list" of focal species candidates is enumerated and progressively subjected to a series of questions pertaining to their suitability as focal species. Ideally, the selection process identifies a set of species that represent the various taxonomic groups and the relevant aspects of the ecological system being monitored.

The method described here to select focal species is a slight modification of the method suggested by Murphy et al. (2003) and uses the currently available Science Advisors species groupings (i.e., Group 1, 2, or 3) described the GPA/ZC EIR Biological Resources Section as the foundation for a "long list" of candidate focal species. The definitions of these three groups are restated in the context of the Adaptive Management Program.

Group 1 species require minimal conservation or management action. Their conservation would be minimally affected by management based on the following criteria:

- Management would have a very limited impact on the species;
- The species is not found or is insignificant in the study area; and/or
- The species has very high population numbers in the study area.

Based on these criteria, and particularly the first bullet, no Group 1 species would be selected as focal species.

Group 2 species are best conserved by protecting habitats at a landscape level through general NCCP/HCP reserve design tenets and through adaptive management. Their conservation can be inferred from a well-planned and managed network of protected open space in a functioning landscape. Criteria for Group 2 species include one or more of the following:

- The species is relatively widespread in the study area;
- The species occurs in relatively robust populations within the study area and possibly elsewhere;
- Life history characteristics respond to habitat/landscape-level conservation;
- Detailed surveys or inventories are not crucial in order to conserve the species;
- The species is known to, or likely to, respond well to habitat management;
- The species is locally genetically indistinct; or
- No individual action is needed other than habitat conservation and management.

Group 2 species exhibit several characteristics that are desirable in focal species, and in particular, they are common enough to be effectively monitored and that they may respond well to management actions.

Group 3 species are best conserved at the species-specific level. They require one or more of three types of conservation action: **(1)** fine-tuning of protected open space or specific management activities; **(2)** reintroduction and/or specific enhancement; or **(3)** additional data and research are necessary to determine basic needs. Criteria for Group 3 species include one or more of the following:

- The species is known or predicted to occur in extremely low populations;
- The species is narrowly endemic in the study area;

- The species has highly specialized life history requirements;
- The study area is known to be crucial to the survival of the entire species;
- The species is known or suspected to respond poorly to management;
- The species is highly sensitive to small changes in the landscape or habitat;
- The species is dependent on intensive conservation activities; or
- The species is widespread, but extremely uncommon.

The conservation and adaptive management requirements for Group 3 species are site-specific and species-specific. By definition, regulatory coverage for these species would involve monitoring the status of these species, or a selected subset of species, to ensure their persistence in the study area. In some cases, Group 3 species such as arroyo toad or least Bell's vireo may be valuable focal species because they are sensitive to environmental stressors known or likely to affect other species (e.g., altered hydrology and exotic species). Other Group 3 species, such as San Diego and Riverside fairy shrimp, may not be useful focal species because their habitat requirements and life-history characteristics are more unique (however, they would be managed and monitored as Identified Species).

In addition to using the Group 2 and 3 species as a basis for the "long list" of candidate focal species, umbrella species and other species considered by the Science Advisors to be "indicative of the quality of select habitat-types" also were included. Finally, several invasive species (e.g., brown-headed cowbird, bullfrog) and indicators of disturbance or declining habitat quality, such as "edge-enhanced" species (e.g., Anna's hummingbird, mockingbird; see study on habitat fragments in urban environments by Bolger et al. 1997a) were added to the list. Monitoring these potential "early warning" indicator species may be valuable for detecting negative trends in RMV Open Space function and Identified Species populations. Species that do not rely on one of the five major vegetation communities – coastal sage scrub, chaparral, grassland, riparian and wetland, and oak woodland – were removed from the list (e.g., open water species such as American white pelican, double-crested cormorant, etc.). This vetting process resulted in the "long list" of 70 candidate focal species shown in Table 1-1.

Following Murphy et al. (2003), a selection filter was applied to the species on the long list that consists of seven questions:

a. Does the species have an unambiguous taxonomy (i.e., are there species or sub-species naming issues)?

b. Is the biology and life history of the species reasonably well known?

c. Is the species "easy" to detect and measure?

d. Does the species exhibit low sampling variability (consistent and high detectability)?

e. Does the species exhibit low demographic and genetic variability?

f. Does the species exhibit detectable trends in occurrence and population size?

g. Are there known relationships between occurrence, population size, and stressors or ecosystem processes?

Appendix J

TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
Arroyo Toad	Yes	Yes	Yes	No	?	Possible	Yes	EW
Bullfrog	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
California Slender Salamander	Yes	?	?	?	?	?	?	Rejected
California Treefrog	Yes	Yes	?	?	?	?	No	Rejected
Pacific Chorus Frog	Yes	Yes	Yes	?	?	?	No	Rejected
Western Spadefoot Toad	Yes	No	No	No	?	?	No	Rejected
Acorn Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Anna's Hummingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Ash-throated Flycatcher	Yes	Yes	Yes	?	?	?	Yes	EW
Barn Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Black-chinned Sparrow	?	No	No	?	?	No	Yes	Rejected
Brown-headed Cowbird	Yes	Yes	Yes	?	?	Yes	Yes	EW
Burrowing Owl	Yes	Yes	No	?	?	No	Yes	Rejected
Cactus Wren	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
California Gnatcatcher	Yes	Yes	Yes	No	No	Yes	Yes	EW
California Horned Lark	?	Yes	Yes	No	?	No	Yes	Rejected
California Thrasher	Yes	Yes	Yes	?	?	?	Yes	BI
Common Yellowthroat	Yes	Yes	Yes	Yes	?	?	No	Rejected
Cooper's Hawk	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Costa's Hummingbird	Yes	Yes	Yes	?	?	?	Yes	EW, BI
European Starling	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Golden Eagle	Yes	Yes	No	No	?	No	Yes	Rejected
Grasshopper Sparrow	Yes	Yes	Yes	No	No	Possible	Yes	BI
Great Horned Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Greater Roadrunner	Yes	Yes	No	?	?	?	Yes	Rejected

Appendix J

TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
House Finch	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Lark Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW
Least Bell's Vireo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Loggerhead Shrike	Yes	Yes	Yes	?	?	?	Yes	Rejected
Long-eared Owl	Yes	Yes	Yes	?	?	?	Yes	Rejected
Northern Mockingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Nuttall's Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Red-shouldered Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Red-tailed Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Red-winged Blackbird	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Rufous-crowned Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Savannah Sparrow	Yes	Yes	?	?	?	?	No	Rejected
Snowy Egret	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Sora	Yes	No	No	?	?	?	Yes	Rejected
Southwestern Willow Flycatcher	No	Yes	?	No	?	No	Yes	Rejected
Spotted Towhee	Yes	Yes	Yes	?	?	?	No	Rejected
Swainson's Thrush	Yes	Yes	?	?	?	?	No	Rejected
Tricolored Blackbird	Yes	Yes	Yes	No	No	No	Yes	Rejected
Western Screech Owl	Yes	Yes	No	?	?	?	Yes	Rejected
White-tailed Kite	?	Yes	Yes	No	No	No	Yes	Rejected
Wrentit	Yes	Yes	Yes	Yes	?	?	Yes	BI
Yellow Warbler	No	Yes	Yes	?	?	?	Yes	EW, BI
Yellow-breasted Chat	?	No	Yes	?	?	?	?	Rejected
Northern Red-diamond Rattlesnake	No	No	No	No	?	No	Yes	Rejected
Orange-throated Whiptail	Yes	Yes	Yes	?	?	?	Yes	EW
Rosy Boa	No	No	No	?	?	?	?	Rejected

Appendix J

TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
San Diego Horned Lizard	No	Yes	Yes	?	?	?	Yes	EW, BI
Silvery Legless Lizard	No	No	No	?	?	?	No	Rejected
Southwestern Pond Turtle	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Spotted Night Snake	Yes	No	No	No	?	No	No	Rejected
Two-striped Garter Snake	Yes	No	No	No	?	?	No	Rejected
Bobcat	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Coyote	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Dulzura California Pocket Mouse	No	Yes	Yes	Yes	?	Yes	No	Rejected
Dulzura Kangaroo Rat	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Gray Fox	Yes	Yes	Yes	?	?	?	No	Rejected
Mountain Lion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Mule deer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Arroyo Chub	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Threespine Stickleback	No	No	Yes	?	?	?	Yes	Rejected
Argentine Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Behr's Metalmark	?	?	?	?	?	?	?	Rejected
Imported Fire Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Riverside Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected
San Diego Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected

EW – Early warning indicator; BI – Biodiversity Indicator

Appendix J

Questions "d-f" require more explanation to understand the importance of these issues in selecting focal species. Generally these questions relate to the issues of species *generation times* and *population sampling*.

Generation Times

Generation times are the species' average life cycle time between birth and death. Species with very long generation times (e.g., decades) may not be suitable for monitoring because population turnover may too slow to detect population changes in relation to environmental stressors until its too late to reverse the trend. This problem may be overcome to some extent by closely monitoring demographic factors such as age-group distributions, recruitment, etc., but in some long-lived species with low reproductive rates, significant demographic changes may be undetectable for long periods. On the other hand, species with short generation times and highly volatile reproductive cycles also may not be suitable focal species because apparent extirpations, leading to management actions, may simply be part of the natural population oscillation (i.e., *intrinsic driver*) exhibited by the species, and it may be difficult to separate the human-induced stressor component (i.e., *extrinsic driver*) from the natural oscillations because of the high variability. If the population oscillations primarily are caused by intrinsic natural factors and are self-regulating, management would not be warranted and would be wasteful of management and monitoring resources. Ideally, focal species will have generation times that are significantly correlated with the environmental stressors operating in the RMV Open Space so that if a population decline is detected, it can be clearly tied to the stressor; e.g., the lag time between the observed stressor and population response it short enough to correlate the two variables and separate out natural causes of population oscillations. While some causal relationships between stressors and the species' response may be obvious (e.g., cowbird parasitism on native passerines), some experimentation may be required to demonstrate causality between the stressor and species response and the efficacy of a management action. In response to information compiled over time, thresholds for triggering management actions would be established and refined.

Population Sampling

In order for management and monitoring to proceed efficiently and for trends and causal relationships to be detectable in relation to stressors, the focal species must be amenable to reasonable sampling regimes. If a species is so rare or occurs in low densities over a wide distribution such that it is rarely encountered, even with effective detection methods, its use as a focal species would be limited. For example, rare winter migrant birds would make poor focal species because their occurrence is sporadic and linking their presence or absence to environmental stressors would be virtually impossible. That is, the noise (*intrinsic driver*) to signal (*extrinsic driver*) ratio is too large to reliably or practicably measure the signal component. Gibbs (2000) estimated the necessary sampling intensities (i.e., the number of sample plots related to the number of samples per year) that would provide the statistical power for reliably detecting certain population changes (e.g., 10, 25, or 50 percent population reduction) in different taxonomic groups (e.g., large mammals, small-bodied birds). The statistical power of the monitoring program is closely related to the variability of the population index used (e.g., how much does the population vary from year-to-year?). The power to detect a trend is inversely related to the magnitude of index variability; the more variable a population is, the more power the monitoring program has to have. For small-bodied birds, for example, which have moderately high population variability, Gibbs estimated that 30 plots sampled four times per year for 10 years would be required to detect a 25 percent change in the population. To detect a 10 percent change would require 130 plots sampled four times per year for 10 years; i.e., as the change threshold becomes finer-grained, the sampling intensity is magnified for species with high index variability. In contrast, for large mammals that have relatively low variability, Gibbs estimated that only 10 plots sampled four times per year for 10 years would be needed to detect a 10 percent change; i.e., the large mammals are more amenable to statistically reliable sampling with less effort than small-bodied birds because they have lower population variability.

The selection of focal species will need to consider the amount of effort needed to establish population trends for the focal species (i.e., question “f”). Species that exhibit high variability indices may not be suitable focal species if an adequate sampling effort cannot be made with the available management funding and resources.

Known Environmental Stressors and Ecosystem Processes

A key question for selecting focal species is whether there are known relationships between occurrence, population size, and stressors or ecosystem processes (i.e., question ‘g”). Some species already have a demonstrated sensitivity to certain stressors, and, in some cases, a demonstrated positive response to management; these would be useful focal species. Known and possible stressors on Identified Species, and positive management actions, if known, are summarized in the Species Accounts (Section 4 Draft NCCP Guidelines), and are reflected in the management and restoration objectives for each of the vegetation communities. For example, the least Bell’s vireo is nest-parasitized by the brown-headed cowbird. Cowbird trapping has been accepted as an effective management technique and appears to be a primary factor in the rebound of the vireo population in southern California (USFWS 1998). Likewise, the bullfrog is a documented predator on arroyo toads in general (USFWS 1999) and on RMV (Ramirez 2003), as well as the California red-legged frog (e.g., Kiesecker 1998; Lawler et al. 1999). Control of bullfrogs therefore would be an important tool for managing the arroyo toad, and possibly western spadefoot toad, but it would be important to demonstrate a positive response to bullfrog control and to determine what kinds of controls techniques are most effective.

The relationship between ecosystem processes and species occurrence and population size also is reasonably well known for some species. Again, using the arroyo toad as an example, it is known that arroyo toad breeding success depends on breeding pools persisting into May and June to allow sufficient time for metamorphosis from larvae to juvenile age class. Hydrology, therefore, is a well-understood component of arroyo toad biology.

An example of an analysis of a species as a potential focal species for coastal sage scrub is a study by Chase et al. (1998) on the California gnatcatcher, where the research question was whether sites that supported gnatcatchers also supported significantly more other species than sites without gnatcatchers; i.e., is the gnatcatcher an indicator of coastal sage scrub species richness. If it could be shown that gnatcatcher presence is positively correlated with bird-species richness, the species could be a valuable habitat indicator. Bird-species richness was evaluated at 17 sites Riverside, San Diego and Orange counties where gnatcatchers were both present and absent. Although there were slightly more species of birds at sites where gnatcatchers were present, the difference was small and not statistically significant; i.e., the gnatcatcher was not a good indicator or predictor of bird-species richness. This finding is not surprising given that gnatcatchers appear to persist in relatively small, highly fragmented habitat patches (e.g., Dudek 2003) and may occur where overall species richness is relatively low (Chase et al. 1998). It is likely that several species, ultimately at different trophic levels (i.e., level in the food chain), would need to be monitored to ensure that the diversity and dynamics of the coastal sage scrub system are being successfully monitored and managed.

b) Selection of Candidate Focal Species

Table 1-2 presents the results of this filtering process for selecting a "short list" of candidate focal species from the 70 species on the "long list." With regard to taxonomy and life history questions (i.e., questions "a" and "b"), the California Wildlife Habitat Relationships database was consulted where other information was not readily available. The answers to the questions of whether the species is easy to detect and whether there is low sampling variability primarily relied on local professional experience or published and/or generally accepted species survey protocols (e.g., for California gnatcatcher, least Bell's vireo, arroyo toad, pond turtle, etc.). The answers to whether the species exhibits low demographic and genetic variability and whether it exhibits detectable trends in occurrence and population size are the two most difficult questions to answer with any certainty because of the general lack of information. In most cases, these questions were answered with a "?" indicating that the adequate information is unavailable. It should be noted, however, that in some cases, we may not know the demographic and genetic variability of the species. If such a species is a high priority for monitoring, the monitoring effort may need to be adjusted to collect adequate data. An important consideration for selecting a focal species thus is the tradeoff between the value of the monitoring data to the overall Adaptive Management Program and the effort required to collect the data.

The answer to whether there are known relationships between environmental stressors, and population size and occurrence is based on published and anecdotal reports of threats to species. For example, too frequent fire is reported to be a threat to gnatcatchers, bullfrogs are known predators of arroyo toads, etc. For the invasive species on the lists, such as brown-headed cowbird, starling, mockingbird, etc., they are either the direct environmental stressor (e.g., cowbirds are nest parasites and European starlings potentially compete with native species for nesting cavities [see Koenig 2003 for caveats in drawing inferences about the effects of invasive species]) or possibly indicators of degraded edge habitat (e.g., mockingbirds are common along the urban-wildland interface). In many cases causal relationships underlying the presence of an invasive species, and the decline or absence of a native species are not known; i.e., the observation is correlational. It may be unclear, for example, whether the invasive species actively displaces the native species (e.g., starlings outcompeting native species for nest cavities), directly reduces reproductive success of the native species (e.g., nest parasitism by brown-headed cowbirds), or, on the other hand, more passively colonizes available habitat because the native species has declined or disappeared for some other unrelated reason.

Generally, if a species could not be tied to a specific environmental stressor or ecosystem process or characteristic (e.g., habitat quality), it was rejected as a potential focal species. In addition, if the answers regarding taxonomy, biology and life history, ease of detection and measurement, and low sampling variability were consistently "No," the species was rejected for further consideration. For example, reptiles such as the rosy boa typically are little known and hard to reliably detect, and thus are poor candidates as focal species. In most cases, the answer to whether the species has low demographic or genetic variability is unknown, so this factor was not considered as strongly in whether the species was rejected or not as a potential focal species.

The initial filtering process using the seven questions posed above narrowed the species list to 32 candidate focal species, including 20 birds, two amphibians, three reptiles, four mammals, one fish and two invertebrates (*Table 1-2*). Species that passed the first filter and were retained as potential focal species for further consideration were assigned to one or more of the focal species categories described above. For potential umbrella species, the recommendations of the Science

Advisors were followed. For indicator species, two types of indicators were identified: early warning and biodiversity indicators. As used here, early warning indicators included species that are known or strongly suspected to be sensitive to environmental stressors that have broad implications for habitat integrity and other species. For example, arroyo toad is designated an early warning indicator because it vulnerable invasions by exotic plants such as giant reed and tamarisk and to bullfrog predation, which in turn affect the entire riparian/wetland ecosystem. Coyote also was designated an early warning indicator because their absence from habitat patches is related to "mesopredator release" and loss of small native species (Crooks and Soule 1998). Edge-enhanced species (see Bolger et al. 1997a), such as the Anna's hummingbird and mockingbird, also are designated as early warning indicators because their presence indicates habitat degradation and potential competition with native species vulnerable to edge effects. The grasshopper sparrow is designated a biodiversity indicator because it is associated with structurally diverse grassland habitats, which presumably would support a more diverse species assemblage than a monotypic grassland. It should be kept in mind, however, that these assignments reflect hypothesized relationships based on the best science available, rather than empirically validated relationships. Thus, they are only a starting point for the Adaptive Management Program and would be adjusted as new information becomes available.

TABLE 1-2
CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)
Birds			
California Gnatcatcher	Coastal sage scrub	Early warning indicator	Fire, drought, cowbirds
Least Bell's Vireo	Riparian	Early warning and biodiversity indicator	Flood regime, invasive species, mesopredators, over-grazing, noise
Cactus Wren	Coastal sage scrub	Early warning indicator	Fire, mesopredators
Grasshopper Sparrow	Grassland	Biodiversity indicator	Loss of structural habitat diversity, mesopredators, cowbirds
Yellow Warbler	Riparian	Early warning and biodiversity indicator	Flood regime, exotic species, mesopredators, over-grazing
Acorn Woodpecker	Oak woodland	Early warning and biodiversity indicator	Invasive species, low acorn productivity, acorn and nest competitors
Anna's Hummingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Ash-throated Flycatcher	Oak woodland	Biodiversity indicator	Nest competitors
Barn Owl	Grassland, riparian, woodland	Umbrella species	

Appendix J

TABLE 1-2 CANDIDATE FOCAL SPECIES			
Common Name	**Vegetation Type(s)**	**Focal Species Category**	**Environmental Stressor(s)**
Brown-headed Cowbird	All types (?)	Early warning indicator	Nest parasite of native passerines
California Thrasher	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
European Starling	Riparian and oak woodland	Early warning indicator	Edge-enhanced species and nest competitor. Indicator of habitat degradation
Great Horned Owl	All types	Umbrella species	
House Finch	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Lark Sparrow	Grassland, oak woodland	Early warning and biodiversity indicator	Edge-reduced species
Northern Mockingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Red-tailed Hawk	All types	Umbrella species	
Rufous-crowned Sparrow	Coastal sage scrub	Biodiversity indicator	Edge-reduced species
Snowy Egret	Wetlands	Early warning and biodiversity indicator	Sensitive to human disturbance
Wrentit	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
Amphibians and Reptiles			
Arroyo Toad	Riparian and wetlands	Early warning indicator	Flood regimes, water quality, invasive species, over-grazing, road kill
Bullfrog	Riparian and wetlands	Early warning indicator	Predator of several native species
Orange-throated Whiptail	Coastal sage scrub, chaparral, woodland	Early warning indicator	Frequent fire, Argentine ants, over-grazing
San Diego Horned Lizard	Coastal sage scrub, chaparral	Early warning and biodiversity indicator	Frequent fire, Argentine ants, over-grazing, collection
Southwestern Pond Turtle	Riparian and wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs, mesopredators, over-grazing, collection
Mammals			
Bobcat	Chaparral, riparian, woodland	Umbrella species	
Coyote	All types	Early warning	Absence from habitat patches indicates potential mesopredator release and loss of native species
Mountain Lion	Chaparral, riparian, woodland	Umbrella species	
Mule Deer	Coastal sage scrub,	Umbrella species	

Appendix J

TABLE 1-2 CANDIDATE FOCAL SPECIES			
Common Name	**Vegetation Type(s)**	**Focal Species Category**	**Environmental Stressor(s)**
	chaparral, riparian, woodland		
Fish			
Arroyo Chub	Wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs and exotic fish, invasive plants
Invertebrates			
Argentine Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives
Imported Fire Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives

A summary by focal species types, vegetation community and taxonomic group is provided in *Table 1-3.*

TABLE 18-3 SUMMARY OF CANDIDATE FOCAL SPECIES BY TYPE AND VEGETATION COMMUNITY					
Taxonomic Group	**Vegetation Community**				
	Coastal Sage Scrub	**Chaparral**	**Grassland**	**Riparian and Wetland**	**Oak Woodland**
Birds					
Early Warning	California Gnatcatcher Cactus Wren Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Lark Sparrow Mockingbird	Least Bell's Vireo Yellow Warbler Anna's Hummingbird Brown-headed Cowbird European Starling House Finch Mockingbird Snowy Egret	Acorn Woodpecker Anna's Hummingbird European Starling House Finch Lark Sparrow Mockingbird
Biodiversity	California Thrasher Rufous-crowned Sparrow Wrentit	California Thrasher Wrentit	Grasshopper Sparrow Lark Sparrow	Least Bell's Vireo Yellow Warbler Snowy Egret	Acorn Woodpecker Ash-throated Flycatcher Lark Sparrow
Umbrella	Great Horned Owl	Great Horned Owl	Barn Owl	Barn Owl	Barn Owl

Appendix J

TABLE 18-3 SUMMARY OF CANDIDATE FOCAL SPECIES BY TYPE AND VEGETATION COMMUNITY					
Taxonomic Group	Vegetation Community				
	Coastal Sage Scrub	Chaparral	Grassland	Riparian and Wetland	Oak Woodland
	Red-tailed Hawk	Red-tailed Hawk	Great Horned Owl Red-tailed Hawk	Great Horned Owl Red-tailed Hawk	Great Horned Owl Red-tailed Hawk
Amphibians					
Early Warning				Arroyo Toad Bullfrog	
Biodiversity					
Umbrella					
Reptiles					
Early Warning	Orange-throated Whiptail San Diego horned Lizard	Orange-throated Whiptail San Diego horned Lizard		Southwestern Pond Turtle	Orange-throated Whiptail
Biodiversity	San Diego Horned Lizard	San Diego Horned Lizard		Southwestern Pond Turtle	
Umbrella					
Mammals					
Early Warning	Coyote	Coyote	Coyote	Coyote	Coyote
Biodiversity					
Umbrella	Mule deer	Bobcat Mountain Lion Mule Deer		Bobcat Mountain Lion Mule Deer	Bobcat Mountain Lion Mule Deer
Fish					
Early Warning				Arroyo Chub	
Biodiversity				Arroyo Chub	
Umbrella					
Invertebrates					
Early Warning	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant
Biodiversity					
Umbrella					
Total					
Early Warning	10	8	7	15	10
Biodiversity	4	4	2	5	3
Umbrella	3	5	3	6	6

Focal species from *Table 1-3* that would also be managed and monitored as Identified Species include:

Appendix J

- California gnatcatcher
- Cactus wren
- Yellow warbler
- Least Bell's vireo
- Arroyo toad
- Orange-throated whiptail
- San Diego horned lizard
- Southwestern pond turtle
- Arroyo chub

To select the remaining species, one or more of the following criteria were considered applicable:

1. The species fill a unique management and monitoring niche
2. The species poses a substantial direct threat to the structure and function of the RMV Open Space and native species
3. The species is a demonstrated edge-enhanced species.
4. The species is particularly sensitive to environmental stressors (e.g., edge effects).
5. The species can be cost-effectively managed and monitored through standard survey techniques

Based on these selection criteria, of the remaining candidate focal species, the following are recommended as focal species.

Species that fill a unique management and monitoring niche:

- Acorn woodpecker
- Lark sparrow
- Wrentit

Species that are particularly sensitive to environmental stressors:

- Snowy egret
- Rufous-crowned sparrow

Species that are demonstrated edge-enhanced species:

- Anna's hummingbird
- House finch
- Northern mockingbird

Appendix J

Species that may pose a substantial threat to the RMV Open Space and native species:

- Brown-headed cowbird
- European starling
- Bullfrog
- Argentine ant
- Imported fire ant

Species that can be easily and cost-effectively managed and monitored through standard survey techniques:

- Coyote
- Mountain lion
- Bobcat
- Mule deer
- Red-tailed hawk

Species that appear to be redundant with 28 focal species identified above and thus would not be recommended as focal species are:

- California thrasher
- Ash-throated flycatcher
- Great horned owl
- Barn owl

Table 1-4 summarizes the characteristics of the selected focal species.

TABLE 1-4
SUMMARY OF SELECTED FOCAL SPECIES

Focal Species	Identified Species	Other Focal Species	Focal Species Type		
			Early Warning	Biodiversity	Umbrella
Birds					
Acorn Woodpecker		?	?	?	
Anna's Hummingbird		?	?		
Brown-headed Cowbird		?	?		
Cactus Wren	?		?		
California Gnatcatcher	?		?		
European Starling		?	?		
Grasshopper Sparrow	?			?	
House Finch		?	?		

Appendix J

Lark Sparrow		?	?	?	
Least Bell's Vireo	?		?	?	
Northern Mockingbird		?	?		
Red-tailed Hawk		?			?
Rufous-crowned Sparrow		?		?	
Snowy Egret		?	?	?	
Wrentit		?		?	
Yellow Warbler	?		?	?	
Amphibians					
Arroyo Toad	?		?		
Bullfrog		?	?		
Reptiles					
Orange-throated Whiptail	?		?		
San Diego Horned Lizard	?		?	?	
Southwestern Pond Turtle	?		?	?	
Mammals					
Bobcat		?			?
Coyote		?	?		
Mountain Lion		?			?
Mule Deer		?			?
Fish					
Arroyo Chub	?		?	?	
Invertebrates					
Argentine Ant		?	?		
Imported Fire Ant		?	?		

.

Appendix J

Table 1-5 summarizes the distribution of focal species by taxonomic group and focal species type; i.e., early warning indicator, biodiversity indicator or umbrella species.

TABLE 1-5
DISTRIBUTION OF SELECTED FOCAL SPECIES BY TAXONOMIC GROUP AND FOCAL SPECIES TYPE

	Vegetation Community				
	Coastal Sage Scrub	Chaparral	Grassland	Riparian and Wetland	Oak Woodland
Taxonomic Groups					
Birds	8	5	7	9	7
Amphibians	0	0	0	2	0
Reptiles	2	2	0	1	1
Mammals	2	4	1	4	4
Fish	0	0	0	1	0
Invertebrates	2	2	2	2	2
Focal Species Types					
Early Warning	10	9	7	16	10
Biodiversity	3	2	2	5	2
Umbrella	2	4	2	4	4

Table 1-5 shows that the majority of the selected focal species are early warning species, which is consistent with the focus of the Adaptive Management Program on environmental stressors; i.e., the selection of species was skewed toward those species that are known or strongly suspected to be sensitive to specific stressors.

1.3 Elements Of The RMV Open Space Adaptive Management Program

The Adaptive Management Program provides the technical and institutional framework for monitoring and undertaking management actions necessary or helpful to sustain and facilitate recovery of Identified Species and their habitats over the long-term, while adapting management actions to new information and changing habitat conditions.

Appendix J

The USFWS provides a general definition of adaptive management in the "five-point policy" as a final addendum to the HCP Handbook.

> *Adaptive management is an integrated method for addressing uncertainty in natural resource management (Holling 1978, Walters 1986, Gundersen 1999). It also refers to a structured process for learning by doing. … Therefore, we are defining adaptive management broadly as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.*

As part of the "five-point policy" the USFWS distinguishes between two types of monitoring:

> *(1) Compliance monitoring, which monitors the permittee's implementation of the requirements of the HCP, permit, and/or IA; and (2) effects and effectiveness monitoring, which investigates the impacts of the authorized take and the operating conservation program implemented to verify progress toward the biological goals and objectives. A monitoring program should incorporate both types in order to examine effectively all aspects of an HCP, and ensure the ultimate success of the HCP.*

The USFWS goes on to say:

> *Monitoring measures should be commensurate with the scope and duration of the project and the biological significance of its effects. The monitoring program should be flexible so that it can be modified, if necessary, based on the need for additional information.*
>
> (Addendum to the HCP Handbook, USFWS, May 2000)

"Compliance monitoring" includes specific actions required by the Section 10(a) permit and/or the IA, such as monitoring the Incidental Take and conservation of acreage, types and locations of habitat, Incidental Take and conservation of Identified Species, and implementation of mitigation requirements. Compliance monitoring ensures that the permittee is implementing the NCPP/HCP according to the terms and conditions of the IA.

The "effects and effectiveness monitoring" referred to in the USFWS Addendum is an important part of the Adaptive Management Program that ensures that the overall long-term goals and objectives of the NCCP/HCP are being met and that impacts subject to the requirements of CEQA are addressed. Effects and effectiveness monitoring relate both to permit compliance monitoring and long-term viability and function of the Habitat Reserve. Needs revising to fit GPA approach

1.3.1 Adaptive Management Program

This section describes how the Adaptive Management Program would address the three previously stated broad goals of the program:

- Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.
- Restore or enhance the quality of degraded vegetation communities and other habitat types.
- Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The Adaptive Management Program includes two main types of management activities to address these three broad goals:

1. Passive management
2. Active management
   (a) Routine management
   (b) Experimental management

"Passive management" does not involve direct and active manipulation of resources. If through the 5-year vegetation assessment and annual monitoring of the sample plots, areas in the RMV Open Space are determined to be functioning well without intervention, no management actions would be taken.

"Active management" would be the second tier of management. In the case where routine monitoring reveals a declining trend in coastal sage scrub amount or quality in an area, either as a result of natural or human-caused disturbances, direct management actions may be warranted. The key issue in implementing active management is what is the threshold or trigger for a direct management action? In some cases, the need for direct management is obvious, such as an area heavily infested with exotic species or exhibiting extreme erosion. However, in most cases the decline in habitat value is subtle or insidious and cumulative, such that it often is not easy to detect the change until its too late to reverse the trend. The monitoring program would need to be sensitive to early warning signs that an adverse trend is occurring and that active management is needed. A key to the adaptive management program is collecting the appropriate data for teasing out natural habitat oscillations from stressor-induced negative trends in habitat quality such that warning signs can be identified.

Active management is further divided into "routine management" and "experimental management."

"Routine management" includes management actions that have been identified as necessary components of the Adaptive Management Program based on known environmental stressors. For example, brown-headed cowbird and bullfrog controls would be implemented as a pre-defined, standard management action because of the known adverse effects of these exotic species on native species.

Experimental management is a subset of active management and is comprised of two elements:

1. *A priori* (pre-defined) management experiments that inform the management of the overall Habitat Reserve; and

2. Opportunistic or *ad hoc* (after the fact) experimental management actions that are implemented in response to a natural or human-caused disturbance event that provide an opportunity for applying different management treatments.

"*A priori*" management experiments may be conducted within the RMV Open Space, in another area within the South Coast Ecoregion with comparable ecological conditions, or within a controlled laboratory setting. It is anticipated that ongoing management experiments may be conducted in the RMV Open Space by independent scientists not directly affiliated with the management of the RMV Open Space. However, independent studies must be authorized by RMV. Such studies also must be coordinated and consistent with the ongoing adaptive management goals and objectives of the RMV Open Space.

"Opportunistic or *ad hoc*" experimental management actions in response to natural or human-caused disturbances provide a "natural laboratory" to conduct management and are a bridge between management experiments conducted under highly controlled conditions and management in the real world. As an example, the conceptual stressor model for coastal sage scrub considers the interactive effects of fire and grazing (Figure 3). This conceptual model leads to the experimental management hypotheses that were listed previously. For example, based on this model, one could hypothesize that an established (late successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. If a wildfire burns an established stand of coastal sage scrub, part of which has been grazed and part of which has not, a component of the adaptive management of these areas would be to establish study plots in the grazed and ungrazed burn areas and monitor post-burn species diversity during the recovery of the study plots. If the grazed plots show lower post-burn diversity the hypothesis has been confirmed. As a follow-up study to this finding, an experimental management action could be to enhance some grazed areas post-burn through seeding while other burned control plots are not seeded. If the seeded plots show greater long-term diversity than the unseeded plots, the practice of seeding grazed areas of coastal sage scrub post-burn would become a standard management action to "jump start" the recovery of the site.

The distinction between "routine management" and "experimental management" as described here is sometimes blurred. In some cases management actions may be clear or obvious and thus are implemented as routine management; experimental manipulation would not be needed. In other cases, there may be no clear or obvious management action and experimental testing of several management methods may needed to determine the most effective alternative. However, whatever form of management action is taken (i.e., routine or experimental), monitoring the results of the action would be important to determine whether the action was effective and how, if necessary, it could be modified to make it more effective. For example, a routine management action that was thought to be effective may be found to not work very well, thus triggering the need to conduct experimental management.

Thus, the Adaptive Management Program cannot be designed to anticipate all the possible scenarios or opportunities for adaptive management, but rather is the framework for employing the adaptive management strategies.

The proposed management approach to the three broad goals of the program are described in detail below.

a. Ensure the Persistence of a Native-dominated Vegetation Mosaic in the RMV Open Space.

The Adaptive Management Program would achieve this goal through periodic management and monitoring of the five major native-dominated vegetation communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian/wetlands, and woodlands. The general approach to monitoring and managing native-dominated vegetation communities is described in this section and the detailed programmatic approach for specific communities and associated focal species is described below in *Section 1.4.*

Appendix J

What specifically is monitored and why it is being monitored would be tied to hypotheses generated by the conceptual environmental stressors models described in *Section 8.2.1*. As stated by the Science Advisors,

> *The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program.*
> (Science Advisors, Principles for Adaptive Management, pg. 4)

As discussed in *Section 1.2.1,* conceptual stressor models are useful tools for providing a framework and focus for management actions. They provide a synthesis of current scientific understanding, field observation, and professional judgement. Models may range from relatively simple unidirectional models to extremely complex, interactive and quantitative ecosystem models. The conceptual models recommended for the Adaptive Management Program are qualitative, relatively simple and pragmatic top down "environmental stressor" models that reflect possible broad cause-and-effect relationships between natural and human-induced stressors and effects on ecosystem processes, vegetation communities and species. For example, short fire intervals in coastal sage scrub promotes the proliferation of non-native invasive species.

The monitoring program is structured such that the monitoring information allows hypotheses generated by the conceptual models to be tested and refined. In some cases the monitoring would be routine and passive (as described below). In other cases, the monitoring would be tied specifically to ongoing management programs (e.g., fire, grazing, exotics control, etc.). The various management programs would be integrated with the conceptual environmental stressor models so that "field experiments" can be conducted in a more rigorous and systematic scientific manner; typically on relatively small experimental plots where a defined variable or set of variables (i.e., the independent variables) can be manipulated, while controlling other extraneous variables. In addition, large-scale natural disturbances (e.g., a 10-year flood) create "natural field laboratories" for opportunistically conducting studies on both a local habitat and landscape level and allow managers and scientists to study processes that cannot be completely understood working at a small scale on experimental plots with a limited set of independent variables.

The Adaptive Management Program is comprised of four steps to ensure the persistence of a native-dominated vegetation mosaic in the planning area: **(1)** preparation of conceptual stressor models and conceptual management plans for vegetation communities; **(2)** periodic assessment of the status of the vegetation communities; **(3)** management of the vegetation communities; and **(4)** evaluation of the effect of the management actions.

- This chapter includes draft conceptual stressor models for the five major vegetation communities in the RMV Open Space (Figures 3 though 7). These conceptual models are based on the best scientific information available and depict known and hypothesized relationships between environmental stressors and vegetation community responses. They also help to identify uncertainties and knowledge gaps in our understanding of these complex relationships. In conjunction with the conceptual stressor models, conceptual management plans keyed to these stressors have been prepared to address fire, grazing, habitat restoration, invasive species and water quality. These management plans reflect the most current understanding of how a particular vegetation community functions and responds to environmental stressors and management actions. The information gained through implementation of the management plans would be used to modify and refine the conceptual stressor models, which, in turn, would be used to generate new adaptive management actions and hypotheses.

- An assessment of vegetation communities throughout the entire RMV Open Space would be conducted at a minimum of five (5) year intervals. These assessments would consist of: **(1)** aerial photograph interpretation (i.e., remote sensing) of vegetation conditions throughout the RMV Open Space to detect any coarse, landscape changes in the vegetation mosaic (e.g., are large areas of coastal sage scrub converting to grasslands?); and **(2)** permanent sample transects established using GPS within representative plots within the vegetation mosaic. For example, several plots within coastal sage scrub, chaparral, native grassland, oak woodland, etc. that represent the physiographic gradients within the RMV Open Space (elevation, slope, distance from coast, etc.) would be established. The precise number, distribution and site-specific features of the sample plots would need to be established and would be based on the requirements for cost-effective, but statistically valid sample regimes (i.e., sampling methods that are feasible and practical and achieve acceptable statistical power for detecting trends [in statistics power refers to the probability of actually detecting a trend that exists, or in the parlance of statistics, it is the probability of correctly concluding that the null hypothesis that no trend exists is wrong]).

- Based on the results of the vegetation monitoring, two courses of action can be taken:

    1. Passive or "hands-off" management whereby nature is allowed to take its course. Because the southern California ecosystem presumably is adapted to natural

events such as drought cycles and periodic wildfires (e.g., Keeley 1986, 1992; Keeley and Fotheringham 2001a,b; Minnich 2001), passive management would be the default initial approach to such natural, periodic perturbances or disturbances of vegetation communities. In most cases, vegetation changes over time following the natural disturbance would be expected to reflect the natural successional stages of the adaptive ecosystem (e.g., flooding may cause destruction of riparian forest, that over time comes back as mule fat scrub, southern willow scrub, and ultimately riparian forest as the climax community). Attempting to actively manage a natural successional system would be wasteful of valuable management resources and could result in more harm than good if the natural successional trajectory of the system is altered. However, in the case of a severe wildfire (or a too frequent series of wildfires) or major flood event, more frequent monitoring than the standard 5-year interval may be warranted on a case-by-case basis to ensure that irreversible adverse changes in the vegetation community do not occur (e.g., a state-transition from coastal sage scrub to grassland as a result of too frequent fire or invasion of a recovering riparian area by giant reed).

2. Active or "hands on" management whereby direct active manipulation is required to maintain net habitat value of the vegetation community or the ecosystem at a broader scale. Active management would occur where, based on the monitoring program, it is clear that a vegetation community is becoming degraded and no longer responding naturally (e.g., converting irreversibly to another vegetation type or being overrun by invasive species). Depending on the cause of the impact, active management can include a variety of actions, such as specific fire management actions (e.g., prescribed burns or suppression), grazing management (e.g., increased, reduced or timed grazing), exotics control (e.g., mechanical or hand-labor weeding) and restoration (e.g., seeding and planting of native species).

- Evaluation of both routine monitoring and passive and active management actions would be conducted to determine whether the monitoring regime is adequate and whether management actions had the desired outcome. What is learned from the monitoring results and management action would be used to improve the management and monitoring program. Evaluating the monitoring program and the effects of management actions is a crucial stage of the overall Adaptive Management Program because it completes the information feedback loop necessary to reassess the conceptual model, make adjustments, generate new or revised hypotheses for testing, and revise the management actions based on the new or revised hypotheses (i.e., it is the definitive step of adaptive management). Over time, the knowledge base and the management actions would be systematically improved and better able to achieve the overall conservation and adaptive management goals of the RMV Open Space.

b. Restore the Quality of Degraded Vegetation Communities and Other Habitat Types.

Habitat restoration is broadly defined as the process of intentionally altering a degraded habitat area or creating new habitat to re-establish a defined pre-existing habitat or ecosystem or enhance function of a degraded habitat or ecosystem. The goal of restoration is to emulate the structure, function, diversity and dynamics of the habitat or ecosystem. This goal generally would be achieved through implementation of several coordinated/integrated restoration plans and related management plans, including:

- A coastal sage scrub and valley needlegrass grassland (CSS/VGL) restoration plan;
- A wetland and riparian restoration plan focusing initially on Gobernadora and San Juan creeks.
- A Fire Management Plan
- A Grazing Management Plan
- An Invasive Species Control Plan

As the Adaptive Management Program progresses, other habitats may be identified for restoration, such as oak woodland and chaparral.

The above plans generally would be guided by the following policies:

- Restoration will be defined to include all activities and measures in this chapter that are designed to maintain and improve net habitat value over the long-term, including, but not limited to the control of invasive and exotic species, reseeding or planting with native species, fire management, grazing and other agricultural management, and controlling public access. Restoration permitted within the RMV Open Space would include the full range of habitats occurring within the RMV Open Space.

- Restoration will be important to the long-term viability and function of the RMV Open Space and would be implemented to contribute to overall biological diversity and productivity in the RMV Open Space in a manner consistent with the broad NCCP Planning Guidelines and the more detailed Draft NCCP Guidelines.

- Phased implementation of the plans will reflect the available funding, locations and kinds of species and habitat impacts, and initial priorities.

- RMV would target areas for restoration and set revised priorities over time. RMV would review restoration priorities for consistency with the overall goals and objectives of the Adaptive Management Program. This review would consider the restoration priorities in the context of existing and changing conditions (e.g., habitat or species trends) in the RMV Open Space, as well as the availability of funding for the restoration activity.

- The restoration activities would be implemented in a manner that facilitates the Adaptive Management Approach. These projects would be planned to yield systematic data that can be used to test experimental management hypotheses to the extent possible, including establishing adequate experimental and control plots, different treatment regimes, rigorous data collection, etc. RMV should confer with outside scientists to the extent necessary to ensure that scientifically-justified and sound methods are used.

- Enhancement and restoration activities would be monitored as part of the Adaptive Management Program to evaluate effect, effectiveness and progress. Ongoing monitoring would also identify new enhancement and restoration opportunities/priorities within the RMV Open Space.

c. Maintain and Restore Abiotic Natural Processes, at All Identified Scales, Capable of Supporting the Habitat Reserve.

The Science Advisors fashioned a new tenet of reserve design – Tenet 7 – to focus on maintaining ecosystem processes and structure, with a particular emphasis on fire and on hydrologic/erosional processes. The objectives of the Adaptive Management Program for fire were listed in above in *Section 1.2.2a.1.* For hydrologic/erosional processes, the objectives of the Adaptive Management Program were listed in *Section 1.2.2.a.2.*

1.4 Major Vegetation Communities and Associated Species

Appendix J

This section describes the programmatic approach for the adaptive management of major vegetation communities and associated species. The five major vegetation communities addressed by the Adaptive Management Program are:

- Coastal sage scrub
- Chaparral
- Grassland
- Riparian/wetland
- Woodlands

Adaptive management of the above major vegetation communities, and their function as habitat for species, is an essential element to receiving regulatory coverage for the Identified Species. As discussed in detail in *Section 1.2*, adaptive management would address Identified Species' habitat needs as they evolve over time in response to natural and human-induced environmental stressors. An example of adaptive management for the habitat needs of specific species is the proposed invasive species control program directed toward benefiting specific aquatic species such as the arroyo toad and the least Bell's vireo within the mainstem channel of San Juan Creek.

Consistent with the concept of natural communities planning, however, vegetation communities would also be managed as broad scale habitat systems functioning within watershed level hydrologic and geomorphic influences and other "process" influences such as fire regimes. Restoration programs such as those proposed for native grasslands and management programs such as grazing management and fire management would be undertaken within the context of goals and objectives for habitat systems at a sub-basin, watershed and planning area scale.

Species Monitoring

Species monitoring would be provided for Identified Species either through monitoring directed at individual species or for broader groupings of species that can be effectively monitored collectively at a habitat scale. As discussed in *Section 1.2.2.c*, several Identified Species also may be valuable "focal species" for the purposes of applying management actions at the broad scale of habitat systems. However, not all Identified Species are useful as focal species for management purposes; for instance, some Identified Species may be too rare or difficult to monitor or an Identified Species may simply not be a good indicator of changes in large-scale habitat systems or of the various factors that influence habitats (see Table 1-1 for selection criteria to identify potential focal species). Likewise, the Identified Species that are suitable as focal species may not adequately cover all the management issues. Consequently, it will be important to assess the characteristics of other focal species that are not Identified Species, but that can be used as additional focal species for RMV Open Space management purposes. Taken together, those Identified Species that are good focal species and the additional focal species listed in Table 1-4 (or other species selected over time) would serve as the initial suite of focal species for management and monitoring purposes at the broad "habitat systems" scale. For purposes of adaptive management of major vegetation communities, "species monitoring" thus may be grouped as follows:

- *Identified Species Monitoring* – the monitoring of species "identified" for regulatory coverage in order to: (a) assess and gain a greater understanding of population trends and other conditions affecting Identified Species; and (b) provide feedback from specific habitat restoration or management initiatives into the broader, habitat-scale management of the RMV Open Space System.

- *Focal Species Monitoring* – the monitoring of those Identified Species that serve as good focal species for habitat-scale management of the RMV Open Space and other focal species that serve as surrogates for the same purposes.

Focal species monitoring would provide a vehicle to address the management needs of several Identified Species. Other Identified Species with very site-specific habitat characteristics or specific management needs (e.g., fairy shrimp) will be addressed through individually tailored management and monitoring efforts and are addressed in *Section 1.5.*

Vegetation Communities Monitoring

Management and monitoring of vegetation communities is focused on understanding vegetation changes and the influences of natural and human-induced factors on the functioning of habitat systems over time. Vegetation transect surveys, monitoring of hydrologic regimes such as groundwater, and tracking wildlife movement are examples of monitoring tools available for assessing physical changes to habitat systems. Such measures would be coupled with the different types of species monitoring summarized above to assess enhancement/restoration undertakings, adaptive management experiments and large-scale habitat management decision-making. Monitoring would thus emphasize measuring physical conditions so that management can be adapted over time. Basic research would be encouraged through cooperation with research scientists, but the fundamental emphasis of the Adaptive Management Program would be on generating information that can be used for adaptive management purposes within the RMV Open Space. The various techniques potentially available for assessing physical changes to habitat systems over time are reviewed in conjunction with the topical review of each of the five vegetation communities in sections *1.4.3* through *1.5.7*

Appendix J

The following section applies the environmental stressor approach to prioritizing immediate and near-term management and monitoring actions in the RMV Open Space.

1.4.1 Prioritization of Vegetation Communities for Management and Monitoring

Prioritization of management and monitoring actions is crucial to the success of the Adaptive Management Program. The Adaptive Management Program described herein in provides a comprehensive “tool box” for data acquisition, analytic methods, and adaptive management actions that can be used over time to inform the long-term management of the Habitat Reserve. However, given the stressor focus of the Adaptive Management Program, only those tools appropriate to a particular management action would be employed at that point in time. With diverse vegetation communities and widely varying existing conditions, an objective method to rank monitoring/management needs of the RMV Open Space was developed to help prioritize and guide management actions. The goal of the ranking outcome, therefore, is to develop a method that allows the reserve owner/managers to allocate available management resources for the greatest net benefit to the RMV Open Space. This approach also provides a framework for establishing an initial set of management and monitoring priorities. It is anticipated that as monitoring and adaptive management proceeds, and as more empirical information is incorporated, these initial rankings would be revised.

Given the stressor approach of the Adaptive Management Program and finite management resources, it is important to identify those vegetation communities that should be the focus of initial adaptive management activities. For this reason, the conceptual stressor models were used to rank and prioritize the vegetation communities for the initial management and monitoring efforts. For example, a vegetation community that has high ecological importance for the RMV Open Space and is highly sensitive to stressors would have a high priority ranking. Alternatively, a community may have high ecological value, but is not as sensitive to existing stressors in the RMV Open Space. This community would have a lower management and monitoring priority.

The rankings were applied at the level of vegetation communities to be consistent with the community-level focus of the Adaptive Management Program. The rankings are based on two key indices: (1) the **Importance Value** of the vegetation community; and (2) the **Index of Disturbance** of the vegetation community. **Importance Value** generally is defined here as the sum of *species richness* and *species uniqueness* of a particular vegetation community. Rather than enumerating the total or absolute species richness of a particular community (i.e., alpha diversity), which both in theory and practice is difficult, species richness as used here is based on the number of Group 2, Group 3 and Umbrella Species defined by the Science Advisors, as well a few additional species since identified as potential conservation issues (e.g., red racer), that use the major vegetation communities in the subregion. Using this set of species as a surrogate for species richness is justified in this case because the purpose of the Importance Value index is to rank management priorities. For example, 36 of 70 wildlife species on this list use coastal sage scrub, while 19 use oak woodland, so coastal sage scrub would be considered to have higher species richness than oak woodland. *Species uniqueness* is simply the number of species from the Group 2, Group 3, and Umbrella Species list that exclusively (or almost exclusively) occur in a single vegetation community. For example, the California gnatcatcher is considered an "obligate" coastal sage scrub species while the least Bell's vireo is an obligate riparian habitat species. Although both species may occasionally use other vegetation communities, their occurrence depends on the presence of the obligate habitat.

The **Index of Disturbance** reflects the vulnerability of different vegetation communities to various human-caused and natural environmental stressors. The models for the environmental stressor-community responses for the five major vegetation communities are depicted in Figures 3-7, respectively. For example, fire is a key stressor on coastal sage scrub; frequent fire can result in type-conversion of coastal sage scrub to non-native grassland (Figure 5). Likewise, altered hydrology is a stressor on riparian systems; too much or too little water can significantly alter the composition, structure and function of a riparian system. The Index of Disturbance of a vegetation community is a composite index score for the effects of stressors that is generated by summing the individual index scores of various stressors on the vegetation community.

In a next step, **Importance Value** and **Index of Disturbance** are multiplied to yield a **Vegetation Community Ranking**, or **R**. It is important to combine these two indices because a vegetation community that scores high in Importance Value but low in Index of Disturbance may not need much management. Likewise, a vegetation community that scores high in Index of Disturbance, but low in Importance Value would not be a high management priority. Vegetation communities that have both a high Importance Value and a high Index of Disturbance would receive the highest management priority ranking.

The methods used to develop the Importance Value, Index of Disturbance and Vegetation Community Rankings are described below, followed by the results of the analysis.

Selection and Community Assignment of Species

Appendix J

The *species richness* and *species uniqueness* variables were parameterized by using the Science Advisors' list of Group 2, Group 3 and Umbrella Species, as well as a few additional species that since have been identified as potential conservation issues (e.g., red racer). These species were used because they include many of the species that the original NCCP Stakeholder Working Group and the wildlife agencies were considering for conservation. They include listed species, state Species of Special Concern, state Protected Species, U.S. Forest Service Species, USFWS Species of Management Concern, Migratory Nongame Birds of Management Concern, and non-sensitive species that may provide "focal species" value. The Science Advisors Group 1 species were not included because the overall Conservation Strategy, including adaptive management activities, would have little or no impact on these species. Thus, including these species potentially could skew the ranking results toward communities supporting species that would be unaffected by management actions, and, conversely, away from communities that support species that could benefit from management.

The original Science Advisors list of Group 2 and Group 3 species included species that do not use, or do not depend on, at least one of the five major vegetation communities: coastal sage scrub, chaparral, grassland, riparian/wetland, and oak woodland. Open water species such as American white pelican, black skimmer and double-crested cormorant thus were deleted from the list. Likewise, species that have narrow microhabitat requirements, such as fairy shrimp, were deleted because their conservation and management would be site-specific rather than at a vegetation community level. Analyses also were run with and without sensitive plants, which in some cases can be addressed at a community level, while others may require site-species conservation and management. The lists of species selected for the analysis and their vegetation community associations are shown in *Table 1-6*.

TABLE 1-6
SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES

Common Name	Coastal Sage Scrub	Chaparral	Grassland	Riparian/ Wetland	Oak Woodland
Barn Owl			?	?	?
Bell's Sage Sparrow	?	?			
Bewick's Wren	?	?		?	?
Burrowing Owl	?		?		
Cactus Wren	?				
California Gnatcatcher	?				
California Horned Lark			?		?

Appendix J

TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
California Thrasher	?	?			
Cooper's Hawk				?	?
Ferruginous Hawk			?		
Golden Eagle	?	?	?		
Grasshopper Sparrow			?		
Lark Sparrow			?		?
Lawrence's Goldfinch	?	?			
Least Bell's Vireo				?	
Loggerhead Shrike	?	?	?		
Long-eared Owl				?	?
Merlin			?		
Mountain Plover			?		
Northern Harrier	?		?	?	
Pacific Slope Flycatcher		?			?
Prairie Falcon			?		
Red-breasted Sapsucker					?
Red-shouldered Hawk				?	?
Rough-legged Hawk			?		
Rufous-crowned Sparrow	?				
Sharp-shinned Hawk	?		?		?
Short-eared Owl			?		
Southwestern Willow Flycatcher				?	
Swainson's Hawk			?		
Tricolored Blackbird			?	?	
Western Yellow-billed Cckoo				?	
White-tailed Kte	?		?	?	?
Yellow-breasted Cat				?	
Yellow Warbler				?	
Arboreal Salamander		?			?
Arroyo Toad				?	
California Glossy Snake	?	?	?		

Appendix J

TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Coast patch-nosed Snake	?	?	?		
Coast Range Newt	?	?			
Coastal Rosy Boa	?	?			
Coastal Western Whiptail	?				
Northern Red-diamond Rattlesnake	?	?	?		
Orange-throated Whiptail	?	?			?
Red Racer (coachwhip)	?	?	?		
San Diego Banded Gecko	?				
San Diego Horned Lizard	?	?			
San Diego Mountain Kingsnake		?			
San Diego Ringneck Snake		?		?	?
Silvery Legless Lizard	?	?		?	
Southwestern Pond Turtle				?	
Two-striped Garter Snake				?	
Western Skink	?	?	?		
Western Spadefoot Toad	?	?	?		
American Badger	?		?		
Dulzura California Pocket Mouse	?	?			
Gray Fox	?	?		?	
Long-legged Myotis				?	?
Mountain Lion	?	?		?	?
Northwestern San Diego Pocket Mouse	?				
Pallid Bat	?	?			?
San Diego Black-tailed Jackrabbit	?	?	?		
San Diego Desert Woodrat	?				
Southern Grasshopper Mouse	?		?		
Southern Mule Deer	?	?			?
Spotted Bat				?	
Townsend's Big-eared Bat			?		?
Arroyo Chub				?	
Threespine Stickleback				?	

Appendix J

TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Catalina Mariposa Lily	?	?	?		
Chaparral Beargrass	?	?			
Coulter's Matalija Poppy	?	?			
Coulter's Saltbush			?		
Curving Tarweed	?	?	?		?
Heart-leaved Pitcher Sage		?			
Many-stemmed Dudleya	?	?	?		
Mud Nama				?	
Ocellated Humboldt Lily					?
Palmer's Grapplinghook	?		?		
Parish' Saltbush			?		
Parry's Tetracoccus	?	?			
Prostrate Spineflower	?	?	?		
Rayless Ragwort	?				?
Salt Spring Checkerbloom				?	
San Miguel Savory		?			?
Southern Tarplant			?		
Summer-holly		?			
Thread-leaved Brodiaea	?	?	?	?	
Western Dichondra	?	?			
Wildlife and Plants Combined					
Species Richness	**49**	**41**	**38**	**27**	**23**
Relative Species Richness	**0.27**	**0.23**	**0.21**	**0.15**	**0.13**
Species Uniqueness	**6**	**3**	**11**	**13**	**2**
Relative Species Uniqueness	**0.17**	**0.09**	**0.31**	**0.37**	**0.06**
Importance Value	**0.44**	**0.32**	**0.52**	**0.52**	**0.19**
Wildlife Only					
Species Richness	**36**	**27**	**28**	**24**	**19**

Appendix J

TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Relative Species Richness	**0.27**	**0.20**	**0.21**	**0.18**	**0.14**
Species Uniqueness	**6**	**1**	**8**	**11**	**1**
Relative Species Uniqueness	**0.22**	**0.04**	**0.30**	**0.41**	**0.04**
Importance Value	**0.49**	**0.24**	**0.51**	**0.59**	**0.18**

Species Richness and Uniqueness Indices

Species richness for a particular vegetation community was calculated by summing the number of species that use that community. Assigning species' use of vegetation communities is based on the California Wildlife Habitat Relationships System (WHR) (Zeiner et al. 1990), as well as other scientific literature and local biological expertise. Species richness in vegetation community type *j* (s_j , where j = 1, …, 5) is simply expressed as:

$$s_j = \sum_{1}^{S} x_i$$

Where $x_i = 1$ if species *i* occurs in vegetation community type *j*, and $x_i = 0$ otherwise, and *S* is the number of unique species expected to occur across all five vegetation community types.

Based on the species richness value, a relative species richness index was calculated by dividing the species richness value for each vegetation community by the total species richness value summed across the five vegetation communities. Relative species richness rs_j of vegetation community *j* can be expressed as:

$$rs_j = \frac{s_j}{S}$$

The relative species richness index indicates the extent to which a single vegetation community represents the richness of all five vegetation communities. Note that

$$\sum_{1}^{S} rs_j = 1.0$$

Appendix J

Species uniqueness for a particular vegetation community was calculated by summing the number of species that "exclusively" use that community. Because virtually all of the species on the list sometimes use other vegetation communities at least opportunistically some time in their life cycle (e.g., gnatcatchers dispersing through riparian), exclusivity of use is operationally defined here as a vegetation community that is necessary for the presence of the species. For example, California gnatcatchers require coastal sage scrub; therefore coastal sage scrub is a unique vegetation community for this species. The loss of coastal sage scrub equates to the loss of California gnatcatchers. Unique species richness of vegetation community *j* (us_j) can be expressed as:

$$us_j = \sum_{1}^{S} x_i$$

Where $x_i = 1$ if species *i* occurs **only** in vegetation community type *j*, and $x_i = 0$ otherwise, and S is the number of unique species expected to occur across all five vegetation communities.

Relative species uniqueness of a vegetation community can be expressed as:

$$rus_j = \frac{us_j}{S}$$

Relative species uniqueness measures the proportion of the total species richness represented by vegetation community *j* **alone**. If this community type were lost from the landscape, the species that contribute to rus_j would be missing. Note that

$$\sum_{1}^{S} rus_j = 1.0$$

Importance Value for vegetation community *j* (I_j) is simply the sum of the species richness and species uniqueness values for that vegetation community, expressed as:

$$I_j = rs_j + rus_j$$

It should be noted that *I*, as calculated here, gives equal weighting to species richness and species uniqueness, and thus they are simply additive. Different weightings could be given to these two variables if one was considered relatively more important than the other.

Index of Disturbance

Appendix J

Six general environmental stressors were used to calculate the **Index of Disturbance**: too frequent/too infrequent fire, over-grazing, exotics, altered hydrology, altered geomorphologic processes, and drought. These six stressors where chosen based on their demonstrated or hypothesized impacts on one or more of the five vegetation communities and as illustrated in the environmental stressor models for each community (Figures 3-7).

For each environmental stressor/community response combination (e.g., fire/coastal sage scrub), a scale value ranging from 1 to 5 was assigned to the combination, using the following definitions:

1 = not a stressor or a very low stressor
2 = low stressor
3 = moderate stressor
4 = high stressor
5 = very high stressor

Because the purpose of the analysis is to rank the relative importance of management and monitoring of the six vegetation communities, the value assigned to each stressor/community combination primarily reflects the relative impact of the stressor on a vegetation community compared to another community. For example, as shown in Table 1-7, hydrologic stressors such as dewatering have a relatively greater impact on riparian systems (rated 5) than upland systems such as coastal sage scrub or grassland (rated 1's). Coarse-grain rankings of the stressor impacts in most cases are fairly straightforward, but, for example, whether fire is a "high" stressor versus a "very high" stressor on chaparral is somewhat subjective. In this case chaparral was assigned a "high" rating (4), while coastal sage scrub was assigned a "very high" rating (5), because coastal sage scrub is more likely than chaparral to type-convert to grassland with frequent, short-interval fires. In any case, this analysis reflects a first attempt to quantify the stressors and rank vegetation communities and is subject to revision based on additional information.[3]

As shown in Table 1-7, each raw score was converted to an index score using the following formula:

$$(x_s - x_{min})/(x_{max} - x_{min})$$

[3] A more fine-grained Index of Disturbance can be calculated using several variables of disturbance, including frequency, extent, magnitude, selectivity, and variability of the stressor. Values for each of these variables would be assigned to each stressor to generate a composite score for the stressor. This method would allow a more precise estimate of the absolute impact of the stressor, but requires substantial information to generate the value assigned to each variable. As new information becomes available through the Adaptive Management Program or the scientific literature, the Index of Disturbance may be refined.

where

x_s = the value for the stressor/vegetation community combination
x_{min} = the minimum value for the rating scale (1), and
x_{max} = maximum value for the rating scale (5).

The composite Index of Disturbance (ID) score is the sum of the individual index scores, or

$$ID = ?\ ((x_s - x_{min})/(x_{max} - x_{min}))$$

as shown in *Table 1-7*.

Vegetation Community Ranking

The **Vegetation Community Ranking** score (R) was calculated by taking the product of the IV and the ID, expressed as

$$R = (IV)(ID)$$

The R values are shown in *Tables 8-8a* (including plants) and *8-8b* (excluding plants).

Table 1-6 presents the results of species richness and species uniqueness analyses for both wildlife and plant species combined and for wildlife species alone. Including both wildlife and plants, coastal sage scrub has the highest relative species richness (0.27) and oak woodland has the lowest relative species richness (0.13). In contrast, riparian/wetland has the highest relative species uniqueness (0.37), with 13 species only occurring in riparian/wetland; compared to oak woodland which has only two species unique to the community and a score of 0.06. Summing the relative species richness and species uniqueness indices results in a ranking of Importance Value (IV) as follows:

1. Riparian/wetland and Grassland (tie)
3. Coastal sage scrub
4. Chaparral
5. Oak woodland

Appendix J

TABLE 1-7
INDEX OF DISTURBANCE FOR MAJOR VEGETATION COMMUNITIES

	Coastal Sage Scrub		Chaparral		Grassland		Riparian/Wetland		Oak Woodland	
Stressor	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**
Too Frequent/ Too Infrequent Fire	5	1.00	4	0.75	2	0.25	4	0.75	4	0.75
Over-grazing	3	0.50	2	0.25	4	0.75	2	0.25	4	0.75
Exotics	4	0.75	2	0.25	5	1.00	5	1.00	4	0.75
Altered Hydrology	1	0.00	1	0.00	1	0.00	5	1.00	5	1.00
Altered Geomorphological Processes	1	0.00	1	0.00	3	0.50	5	1.00	1	0.00
Drought	3	0.50	3	0.50	2	0.25	5	1.00	4	0.75
Index of Disturbance		**2.75**		**1.75**		**2.75**		**5.00**		**4.00**

Appendix J

TABLE 1-8a
VEGETATION COMMUNITY RANKINGS WITH PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.44	0.32	0.52	0.52	0.19
Index of Disturbance	2.75	1.75	2.75	5.00	4.00
Ranking Score	**1.21**	**0.56**	**1.43**	**2.60**	**0.76**

TABLE 1-8b
VEGETATION COMMUNITY RANKINGS EXCLUDING PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.49	0.24	0.51	0.59	0.18
Index of Disturbance	2.75	1.75	2.75	5.00	4.00
Ranking Score	**1.35**	**0.42**	**1.40**	**2.95**	**0.72**

Appendix J

The tie between grassland and riparian/wetland for IV may seem counterintuitive, but the species list includes several raptors that depend on grassland foraging habitat. These raptors are considered highly sensitive by the resource agencies and conservation groups (e.g., Audubon), hence their relatively heavy weighting on the richness and uniqueness indices. Grasslands also score relatively high in uniqueness because several plants only occur in grassland areas, such as the saltbushes and southern tarplant.

Table 1-6 also shows the same analysis for wildlife species only. The relative IV's of the vegetation communities generally remain the same, but with the exclusion of plants, grassland drops to the number 2 ranking behind riparian/wetland, which has a substantially higher relative IV when only considering wildlife.

The results of the Index of Disturbance (ID) analysis are shown in *Table 8-7*. The vegetation community ranks on ID are:

1. Riparian/wetland
2. Oak woodland
3. Coastal sage scrub/grassland (tie)
4. Chaparral

Riparian/wetland has the highest ID rating, reflecting its high vulnerability to all of the stressors, except over-grazing (although over-grazing generally is cited as a major stressor of riparian systems, its impact on the Ranch is not severe). Oak woodland, in contrast to its relatively low IV, has a relatively high ID. The stressor scores for oak woodland primarily are based on the general scientific literature, however, and may not reflect existing conditions in oak woodlands on the Ranch. Field investigations would be required to determine the actual impact of these potential stressors. The three major upland vegetation communities have lower ID's, primarily because they are not affected to any great degree by altered hydrology and geomorphologic processes, except for moderate impacts of geomorphology on grasslands (e.g., erosion in upper Gabino and Cristianitos canyons).

The Vegetation Community Rankings (R) are shown in Table 8-8a (with plants) and Table 8-8b (excluding plants). With and without plants in the analysis the overall ranking of the vegetation communities is the same:

1. Riparian/wetland
2. Grassland
3. Coastal sage scrub
4. Oak woodland
5. Chaparral

The riparian/wetland system clearly has the highest priority for management, borne out by the fact that it is highly vulnerable to hydrologic and geomorphic alterations, such as flooding, dewatering, overwatering, sediment transport and deposition, etc. It also is highly vulnerable to invasion by exotic plants (e.g., giant reed, tamarisk, and pampas grass) and animals (e.g., brown-headed cowbirds, bullfrogs, and Argentine ants). These stressors are readily observed in the planning area. For example, giant reed is common in San Juan Creek below Bell Canyon and occurs to a lesser extent in Verdugo and lower Cristianitos Creek. Pampas grass is common in lower Cristianitos and present, but less common, , Chiquita, and San Juan creeks. Bullfrogs are found anywhere where there is adequate perennial water to support breeding populations (e.g., Calmat and lower Gabino reservoirs). Lack of adequate water in San Juan Creek is a possible contributing cause of limited arroyo toad reproduction below Bell Canyon. Erosion in upper Cristianitos and upper Gabino is a source of fine sediments that have adverse effects on downstream water and habitat quality. Substantial management and habitat restoration efforts (e.g., invasive species control) would be conducted in the RMV Open Space to address these stressors.

Coastal sage scrub and grasslands have similar R values, with and without plants included in the analysis. They both score relatively high on IV and ID because they are both rich in species and vulnerable to several stressors, as shown in Tables 1-8a and 1-8b. Both vegetation communities have been identified for substantial management and restoration efforts.

For coastal sage scrub, too frequent or infrequent fire, exotics, over-grazing and drought are key stressors. Fire and over-grazing would be addressed through the fire and grazing management plans. The Invasive Species Control Plan targets the artichoke thistle. Other invasive plants such as black mustard and annual grasses primarily would be addressed through fire and grazing management because these two stressors likely are causal factors in the proliferation of exotic plants in coastal sage scrub. Drought, as natural stressor, cannot be managed directly, but through appropriate fire and grazing management, its effects can be moderated. For example, during drought, fire control responses may need to be more aggressive to prevent catastrophic fire.

A goal of the Adaptive Management Program for grassland is to restore native grassland and enhance the quality of degraded existing native grassland in the Habitat Reserve. The key stressors on native grasslands are over-grazing, exotics (including non-native, annual grassland), and altered geomorphologic processes (primarily erosion). Although uncontrolled fire can be a stressor, generally fire would be a beneficial management tool because many plant and wildlife species respond positively to periodic fires that serve to remove dead thatch and control invasive species. Management of grassland stressors would include implementation of the fire and grazing management plans. In addition, artichoke thistle control would be a major component of grassland management. Finally, native grassland restoration would be implemented in upper Gabino and Cristianitos canyons to address the problems of erosion in those areas.

Chaparral and oak woodlands have relatively low R values. Overall, based on general observations, these vegetation communities in the planning area appear to be in good health. No specific active management and restoration activities are planned at this time. However, to ensure program flexibility and the ability to respond to unexpected changes, the general health of chaparral and oak woodlands would be monitored as part of the Adaptive Management Program. At such time as degradation of these vegetation communities becomes apparent, or unanticipated stressors are identified (e.g., Sudden Oak Death), active management actions would be developed and implemented.

1.4.2 Coastal Sage Scrub and Focal Species

This section addresses adaptive management of coastal sage scrub and associated focal species. Through the **Vegetation Community Ranking** process, coastal sage scrub was identified as a high priority vegetation community for management and monitoring based on its high **Importance Value** and relatively high **Index of Disturbance**.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for coastal sage scrub and associated focal species (Figures 8 and 12). The key stressors on the coastal sage scrub vegetation community are fire, over-grazing, and exotic species, and drought to a lesser extent (Figure 3). These stressors can result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary vegetation state-transitions at a moderate patch size scale in response to natural stressors such as fire and drought probably are normal and may reflect adaptations to these natural processes. Such temporary state-transitions actually may contribute to overall diversity of the ecosystem and reflect a healthy, dynamic system. On the other hand, permanent, large-scale state-transitions -- for example, resulting from frequent fire in association with over-grazing and/or invasions by exotic species -- are associated with loss of habitat value because of a decline of plant and wildlife abundance and diversity. The stressor model also shows interactions among the stressors and among the community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose coastal sage scrub to invasion by exotic plant species.

The stressor model for focal species (Figure 8) includes additional stressors that affect wildlife, such as mesopredators and pesticides. Mesopredators can act directly on species, such as increased predation on cactus wrens by domestic and feral cats, or indirectly if mesopredators are competing for resources used by native species.

As an example of how the conceptual stressor models can be used to guide adaptive management actions, several experimental hypotheses are identified, as well as possible ways to measure community responses. For example:

Hypothesis: Fire intervals of less than 10 years will result in a decrease in diversity of native species and an increase in the frequency of non-native grasses and forbs.

1. Conduct retrospective study of historic wildfire patterns in subregion and adjacent areas (e.g., Central/Coastal subregion and Camp Pendleton) to determine if areas with history of frequent burning show a decreased diversity of native species and increased frequency of non-native grasses and forbs (i.e., a retrospective study).

2. Conduct future studies of unplanned wildfires and prescribed burns in coastal sage scrub and measure return diversity of native species and frequency of non-native grasses and forbs (i.e., a prospective study). Prescribed burns may be conducted on small plots of varying age stands (i.e., time since last burn).

This hypothesis could be refined to include seasonal or grazing effects. For example, winter and spring burns will magnify the loss of native diversity and increase non-native grasses and forbs. Similarly, grazing in post-fire, early and mid-successional coastal sage scrub will result in decreased species diversity over time, or an established (late-successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. To test these more refined hypotheses, information about the season(s) in which burns occurred, or the grazing history of a burn site would be needed. A retrospective study likely would answer the hypothesis at a coarse scale, but additional prospective studies likely would be needed to test more refined hypotheses as variables such as differential season or grazing effects are added. Also, as variables are added a large data set (e.g., number of sample sites) would be necessary to maintain adequate statistical power greater.

Hypotheses also can be posed for relationships between stressors and focal species. For example, as described in *Section 1.2.2.a*, three recent fires in the Upper Chiquita Conservation Area would provide an opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Of particular interest would be the response of the 1997 fire area that was burned again in 2002. Also it was noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record, but these areas have been grazed in the meantime. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years and the presence of cattle grazing appears to not have been an adverse situation at least for this species. On the surface, this observation makes sense because gnatcatchers prefer habitat that is more open and with a broken canopy, and they tend to be absent or occur in low densities in scrub dominated by tall shrubs or with a closed canopy. In the absence of fire, if some level of grazing maintains low shrubs and an open canopy, the habitat may be more suitable for the gnatcatcher. This will be an important management issue because there are areas of coastal sage scrub in the RMV Open Space where prescribed burning would not be feasible and wildfires would be fought aggressively to protect the public and property. Some level of grazing may beneficial as a surrogate for fire.

Based on the anecdotal observation of a potential positive relationship between grazing and gnatcatcher habitat suitability, an adaptive management question is whether managed grazing by cattle (or goats) is an effective management tool for sustaining coastal sage scrub habitat quality for species such as the California gnatcatcher. This anecdotal observation can be used to state a hypothesis about the relationship between California gnatcatcher occurrence and populations and grazing.

> <u>Hypothesis</u>: In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains habitat structure and diversity suitable for the California gnatcatcher.

1. Conduct retrospective study of gnatcatcher occurrence in areas of coastal sage scrub in southern and central Orange County and San Diego County comparing areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed.

2. Conduct prospective study of gnatcatcher occurrence comparing areas where grazing is precluded in the future and where light to moderate grazing is allowed to continue.

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for coastal sage scrub and associated focal species:

- Maintain the physiographic diversity of coastal sage scrub and associated focal species in the RMV Open Space.

- Restore coastal sage scrub and enhance the quality of degraded existing coastal sage scrub in the RMV Open Space such that the net habitat value of the existing coastal sage scrub system is maintained.

- Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value:

- Conduct monitoring of coastal sage scrub and focal species to track the long-term habitat value of the coastal sage scrub system.

- Restore approximately 375 acres of coastal sage scrub in designated locations that currently are in agriculture, grazed or otherwise do not currently support coastal sage scrub to enhance habitat carrying capacity and connectivity (see Habitat Restoration Plan, Appendix X-2).

- Manage coastal sage scrub fire regimes such that a natural diversity of age-stands is maintained throughout the RMV Open Space.

- Manage cattle grazing to sustain net habitat value and diversity of coastal sage scrub.

- Control exotics invasions of coastal sage scrub, especially along the RMV Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

c. Monitoring of Coastal Sage Scrub and Focal Species

The monitoring program described here for coastal sage scrub, as well as the other vegetation communities discussions that follow, provides the conceptual approach to the monitoring program, along with a few examples of monitoring schemes to indicate the kinds of detail that would be necessary for the site-specific monitoring plans. The detailed monitoring plans for the Habitat Reserve, including specific monitoring locations (i.e., sample plots, transects, etc.), monitoring schemes and schedules, personnel, etc., would need to be developed once the institutional structure of the Adaptive Management Program is constituted. Accordingly, specific details of the management and monitoring program described below would be somewhat different from the examples presented here.

Coastal sage scrub would be monitored at the landscape, habitat and species levels. The routine passive, long-term monitoring of coastal sage scrub and focal species would include two main tasks:

1. Evaluation and update of the entire coastal sage scrub vegetation datebase at 5-year intervals using aerial photographs.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the RMV Open Space and in keys areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the vegetation database would allow RMV to track large-scale landscape changes in the vegetation communities in the RMV Open Space. Any adverse changes (e.g., type conversion of coastal sage scrub to grassland or exotic invasion) that may affect the integrity and function of the RMV Open Space would be documented and appropriate management actions would be taken.

Within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later, the RMV Open Space vegetation communities would be remapped in detail to establish a baseline for long-term tracking of the Open Space. This baseline mapping should use year 2007 color infrared aerial photography (digital orthophotos, 1-m resolution), or an available equivalent imagery. It is important that the entire RMV Open Space be mapped at the same time to create a seamless vegetation database, rather than at different times and cobbling together various maps with inherent conflicts along vegetation polygon boundaries (i.e., edge-matching). This mapping would include all major vegetation communities and would follow the Orange County vegetation classification system (Gray and Bramlet 1992), with modifications as may be required at the time of the mapping (e.g., the RMV Open Space may include mapping some classifications not described under the County system). Personnel responsible for the mapping would establish the appropriate mapping unit for each vegetation type to allow for tracking of any long-term trends in the vegetation communities. In addition, clearly-stated, objective protocols and decision rules for naming vegetation communities would be established for the baseline mapping so that future assessments against the baseline database can as precise and accurate as possible.

Following the initial baseline vegetation mapping, at 5-year intervals updated imagery of at least the same quality as the baseline imagery would be used to evaluate and update the vegetation database for the RMV Open Space. Although this assessment and update primarily would be based on remote interpretation of the imagery, areas that appear to have undergone substantial change in vegetation, and with no known or obvious natural causes of the change (e.g., wildfire or drought), would be field-checked to determine whether a change in the vegetation community has occurred and what the possible cause may have been (e.g., invasion by exotics).

Appendix J

In conjunction with landscape-scale habitat monitoring, regional climate, weather and air quality information would be collected in order to examine potential correlations between vegetation changes and these environmental variables.

Annual field studies within the designated plots would be conducted to monitor fine-grained changes within the coastal sage scrub community for at least the first five (5) years of the monitoring program. A set of permanent plots, each with several semi-permanent sample belt-transects, for example, would be established throughout the coastal sage scrub system in the RMV Open Space . The sample plots would be as regularly-shaped as possible (square to rectangular), given site conditions (topography, vegetation characteristics and survey logistics), in order to standardize the number of transects within a sample plot and allow for comparable data from different management areas. Baseline data for pre-established sample points for each transect would be recorded, such as dominant and sub-dominant associated species, visually-estimated percent cover, percent native and non-native plant species, slope, aspect, substrate/soils, and any disturbance conditions or possible threats. Photo-stations would be established at these sample locations along transects to capture the environmental diversity or gradient of the transect. Sample plots, transects, and sample points along each transect would be mapped using GPS accurate to the nearest 0.5-1.0 m (based on year 2003 available GPS technology).

Concurrent with focal species surveys (as described below), botanists would conduct annual floral surveys along the belt-transects in the coastal sage scrub sample plots, typically within the March-May timeframe, but at a time that maximizes the detection of perennial and especially annual plants in any given year. While many floral sampling regimes are possible (e.g., Elzinga et al. 1998), based on the sample plots and belt-transects established for wildlife monitoring, the following method is suggested.

Semi-permanent 25-m segments along the center of the belt transect would be established in a pseudo-random fashion. Based on the baseline data for the belt-transects, these segments would cover the diversity/gradient along the transect. Data would be collected by recording each species that intersects an imaginary vertical plane at each 0.5-m mark along the 25-m segment of the sample transect. All species present within a 5-m band centered on the transect line would be recorded. Relative species cover and species diversity would be derived from these data. Additional data collected for the sample transect include evidence of natural or human-induced stressor (e.g., drought, fire, grazing, off-road vehicles, unauthorized trails, trampling, trash, etc.). Each sample transect would be photographed to document the status of the vegetation at the site on an annual basis.

After the first five years of the Adaptive Management Program, RMV would assess the results of the monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the sample plots (e.g., numbers, locations, etc). These assessments and recommendations, as well as the sampling strategy for the upcoming five years would be included in the 5-year comprehensive report. The appropriate long-term monitoring interval would be based on the resources being managed and monitored and the time scale of potential adverse changes. For example, areas vulnerable to volatile edge effects (e.g., invasion by Argentine ants) probably need to be monitored more frequently than interior areas where adverse changes are more likely to occur, or only be detectable, over a longer time frame.

From a pure statistical perspective, sample plots, transects within the plots, and points within a transect, ideally would be randomly selected throughout the RMV Open Space to control for sample bias. Practically, however, the selection of sample areas (i.e., sample plots, transects, and points) should reflect the diversity of the RMV Open Space so that important or unique biological resources, as well as where environmental stressors are, or thought to be, operating, are not overlooked. Thus, the number and location of the sample plots within the Habitat Reserve, the number and locations of sample transects with a sample plot, and the number and locations of sample points along a transect would depend on landscape, habitat and species factors. At the landscape level, it would be important to monitor the physiographic diversity of the RMV Open Space such as the coastal-inland gradient and elevation. At the habitat level, it will be important to sample to the extent practical the diversity of microhabitats within coastal sage scrub such as different slopes, aspects, soils, plant and wildlife community structure, ecotones, proximity to water, and rock outcrops to the extent feasible. At the species level, it will be important to tie sample areas to representative populations of focal species (as described below). Although these three levels have somewhat different selection criteria, they also are interdependent in that an efficient monitoring program will maximize the relative number of sample areas that meet the selection criteria at all three levels. For example, selecting a location for monitoring habitat linkage function may include selection criteria such as: **(1)** provides a crucial linkage between two large habitat blocks (landscape level); **(2)** provides high quality "live-in" habitat for coastal sage scrub focal species (habitat level); and **(3)** supports an *important population* in a *key location* of an Identified Species (species level).

Although precise locations for sample plots cannot be specified here, areas supporting *major* and *important populations* of the California gnatcatcher and key habitat linkages can be identified and provide good indicators for selecting initial monitoring locations in coastal sage scrub. For example, a set of monitoring locations could be selected from the following areas over time:

- Chiquita Ridge south of Oso Parkway – *major gnatcatcher population* in *key location*, Linkage C

- Chiquita Ridge/San Juan Creek – *major gnatcatcher population* in *key location*, Linkages C and J
- Chiquadora Ridge - *major gnatcatcher population* in *key location*, Linkage G
- Chiquita Canyon north of wastewater treatment plant - *major gnatcatcher population* in *key location*, Linkage E
- Trampas Canyon *important gnatcatcher population* in *key location,* Linkage K
- Upper Cristianitos Canyon *important gnatcatcher population* in *key location*, Linkage N

The efficacy of these potential monitoring locations would need to be evaluated in the context of other landscape-, habitat- and focal species-level monitoring requirements discussed above in order to select the set of sample plots that provide an efficient information return on the monitoring effort. Initially, short-term studies to collect baseline information for focal species occupation and use would be conducted at selected monitoring sites prior to development. Initiation of long-term monitoring of the sample plots would be phased in concert with development that may affect the function of the habitat linkage or wildlife corridor; i.e., the long-term monitoring of the site would be linked to a potential constraint or stressor at the site.

2. Focal Species Monitoring

A suite of candidate focal species for coastal sage scrub was identified in *Section 1.2.2.c*, including ten (10) early warning indicators, four (4) biodiversity indicators, and three (3) umbrella species (*Table 1-9*).

TABLE 1-9
COASTAL SAGE SCRUB CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Cactus Wren	•		
California Gnatcatcher	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Rufous-crowned Sparrow		•	
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		

San Diego Horned Lizard	•	•	
Mammals			
Coyote	•		
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**4**	**3**

The cactus wren, California gnatcatcher, California thrasher, rufous-crowned sparrow, wrentit, orange-throated whiptail, and San Diego horned lizard all are general indicators of relatively high coastal sage scrub habitat quality; i.e.; their absence from a patch of coastal sage scrub (or southern cactus scrub for the cactus wren) may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The dynamic relationships between the "high habitat quality" indicators and edge-enhanced species (e.g., direct, interspecific competition or simply a negative correlation caused by some other factor) are not understood at this time. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined. Likewise, mule deer are still relatively common in the planning area and they are easy to detect. Their main value as an umbrella species likely would be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (e.g., bridges and culverts). In addition, as the main prey of mountain lions, their occurrence would be important for maintaining this species in the study area and in turn the Southern Subregion.

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of coastal sage scrub in the RMV Open Space. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

The survey methods used for focal species would need to be tailored to the species and management issue(s) being addressed in relation to the identified or potential environmental stressor. For example, several standard avian survey methods that provide different levels of information can be used. CalPIF (2002) described five standard methods ranging from the least labor-intensive to the most intensive:

1. **Area Search:** This is a habitat specific, time constraint census method to measure relative abundance and species composition. Can provide breeding status, but may not be as reliable as other more intensive methods. This is the standard method used for general presence/absence surveys and does not imply repeated samples over several years.

2. **Point Count:** This method specifically intended to monitor population changes of breeding birds at fixed points and spatial and temporal differences in species composition among habitat areas. This method is appropriate for monitoring bird populations over time.

3. **Mist Netting:** This method provides information about the health and demographics of a population because birds are directly handled. It provides valuable information about productivity, survivorship and recruitment and possible cause and effect relationships (e.g., effects of parasites on health).

4. **Territory Mapping:** This method provides information about spatiotemporal habitat use based on repeated observations of birds' locations. This method provides information about population densities and distributions and intraspecific (within species) and interspecific (between species) interactions. This method is very labor intensive and is very sensitive to the sampling protocol (e.g., number of visits, season, time of day, weather conditions, etc.). If this method is used, it is critical to carefully define the management question in order to develop the appropriate protocol.

5. **Nest Monitoring:** Similar to mist netting, this method provides information on health and demographics, particularly with regard to nesting activities and reproductive success, such as clutch size, number of broods, number of nesting attempts, etc. Because nests have to be located and frequently monitored, this method tends to be the most labor-intensive. In addition, this method poses the greatest risk to the monitored species because of the risk of causing nest failures of disruption essential activities.

As mentioned above, survey information should be relevant to the management and monitoring goals and issues (e.g., stressors) for the species. For example, if a study site is on the edge of the RMV Open Space adjacent to urban development, is it being colonized by mockingbirds or some other "edge-enhanced" species? An initial monitoring approach in Habitat Reserve-urban edge study areas may simply be to compile information about focal species composition using a relatively low-intensity method such as point counts. Generally, monitoring presence/absence of species through methods such as point counts limits inferences to correlational relationships and provides little cause-and-effect inferential information. However, if an increase in mockingbirds coincides temporally with a decline in California gnatcatchers, a potential cause-and-effect relationship may be operating and further study or an experimental action would be warranted. Correlational data can be used to generate testable alternative hypotheses that allow for "crucial experiments" of cause-and-effect relations; i.e., the classic "strong inference" model described by Platt (1964). For example, observations of antagonistic interactions between mockingbirds and gnatcatchers may suggest that mockingbirds are actively excluding gnatcatchers and that some type of experimental control of mockingbirds at selected sites along the Open Space-urban edge is warranted. On the other hand, if there is a time lag between the disappearance of gnatcatchers and the appearance of mockingbirds, some other factor may be responsible for the change (e.g., habitat degradation) and the mockingbird may simply be expanding into available habitat in the absence of the gnatcatcher.

As another example, the correlation observed between lack of fire, grazing and gnatcatcher occurrence in middle and lower Chiquita Canyon leads to the hypothesis that "In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains habitat structure and diversity suitable for the California gnatcatcher." Because this hypothesis questions the relationship between gnatcatcher occurrence, fire and grazing levels, an appropriate study would be to examine gnatcatcher occurrence in areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed. If grazing in the absence of fire is positively associated with gnatcatcher occurrence, one could then ask the question of how grazing affects coastal sage scrub structure such that it is suitable for gnatcatchers. However, the long-term value of this information for management of coastal sage scrub may not warrant the additional cost of conducting the study, or at least, it may have a low priority as part of the Adaptive Management Program.

In order to allocate funds in the most cost-effective and efficient manner, it will be critical to identify the appropriate level of monitoring for informing the Adaptive Management Program.

In addition to monitoring of focal species, experienced field biologists typically record every wildlife species they encounter in an area. Accordingly, the species data would not be limited to focal species and collection of presence/absence data for other species would be important. Species not considered here as focal species may prove to be valuable in the future and the monitoring program should maintain the flexibility of adding new focal species. Hence, it would be important for the monitoring biologists to record the number of individuals of each species they encounter or have some metric for estimating relative abundance. By having both the number of species and the abundance of each species, it would be possible to generate a diversity index, which in this case would be the number of species in the sample plot and their relative abundance. There are several standard diversity indices that can be used: Shannon-

Weiner index, richness index, Brillouin index, and Simpson index. The index or set of indices used would be determined by RMV in coordination with the Wildlife Agencies, but would need to be applicable across the RMV Open Space and be appropriate for the species assemblage. As the reserve owner/managers develop their survey protocols, they would need to coordinate the field data collection methods so that data are standardized and can be collated into a single database.

d. Management of Coastal Sage Scrub and Focal Species

The Adaptive Management Program for coastal sage scrub includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

The conceptual stressor model for coastal sage scrub focal species (Figure 8) depicts known and potential stressors of these species. These stressors also are summarized in Table 1-2. Stressors generally fall into two categories: **(1)** general, habitat-wide stressors; and **(2)** species-specific stressors. However, the distinction between the general and species-specific stressors often is blurred. For example, control of Argentine ants is specific to San Diego horned lizards because of specific impacts on their native prey base, but this problem is also more generic because the adverse impacts of Argentine ants on native habitats and species goes beyond the horned lizard.

e. Restoration of Coastal Sage Scrub

The Adaptive Management Program includes a coastal sage scrub restoration plan that would restore approximately 375 acres of coastal sage scrub and be comprised of two main components:

1. Restoration of pre-designated areas to mitigate over the near-term for authorized losses of coastal sage scrub to development and/or to increase net habitat value of the coastal sage scrub community; and

2. Case-by-case restoration opportunities undertaken during the course of long-term adaptive management of the RMV Open Space in response to changing conditions and emergencies.

The coastal sage scrub restoration plan is discussed in detail in the Habitat Restoration Plan.

Appendix J

The goal of the coastal sage scrub restoration plan is to establish coastal sage scrub in areas that would contribute habitat value to the RMV Open Space by increasing the carrying capacity for the California gnatcatcher and other sage scrub species. With this goal in mind, several areas have been tentatively identified for coastal sage scrub restoration (Figure 14).

- Sulphur Canyon in the Gobernadora sub-basin was identified for restoration to provide additional habitat and enhance connectivity between Chiquita Canyon and Wagon Wheel Canyon to the west and Gobernadora and Bell canyons to the east. Sulphur Canyon is currently characterized by coastal sage scrub on the slopes of the canyon and grazed annual grasses on the valley floor. Opportunities to improve "live-in" habitat and connectivity for California gnatcatchers through enhancement of existing coastal sage scrub will be identified.

- Several side canyons along Chiquita Ridge and adjacent to Chiquita Creek were identified for restoration. Restoration of the two large canyons just northwest and southwest of the "Narrows" would greatly improve the habitat integrity of Chiquita Ridge, which narrows to less than 2,000 feet in width at the top of these side canyons, and provide substantial "live-in" habitat for California gnatcatchers and other species, and improve the integrity of the reserve system.

Final selection of areas for restoration would require additional field study to determine the likelihood of a successful program, including analysis of factors such as soil conditions and presence of exotic species both within the restoration area and surrounding habitat. In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (e.g., gnatcatchers and grasshopper sparrows). These primarily are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino and in the Chiquita sub-basin in the area east of the Santa Margarita Water District wastewater treatment plant, the citrus groves west of Chiquita Creek and the disced areas west of the creek to the Chiquita ridgeline (Figure 14).

- Upper Gabino currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.

- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best suited for revegetation with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case active/experimental restoration of coastal sage scrub also would occur under the Adaptive Management Program as RMV identify further areas suitable for restoration. Instances that may warrant an active restoration include the following:

- Existing areas of degraded coastal sage scrub that are not naturally recovering through passive management;
- Areas that are degraded or disturbed by future natural events and that are unlikely to recover naturally (e.g., an area that has burned too frequently);
- Areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity; and
- Specific adaptive management research involving restoration treatments.

Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, the effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for coastal sage scrub and coastal sage scrub species. .

As discussed above, the Adaptive Management Program focus is on conducting restoration activities in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the coastal sage scrub restoration program are provided in the CSS/VGL Restoration Plan. The key management activities proposed by the plan are listed here:

- Identification of priority coastal sage scrub restoration areas (areas on RMV are described above);
- Revegetation of existing degraded habitat;
- Re-establishment of coastal sage scrub in areas that have been converted to annual grassland or disturbed habitat due to human activities or too frequent fires;
- Control of invasive or exotic plant and wildlife species, such as artichoke thistle, black mustard, Argentine ants, red imported fire ants, and brown-headed cowbirds;
- Fire management activities;
- Management of grazing and other agricultural activities that adversely affect habitat values and diversity; and
- Controlling public access and recreation to protect/enhance habitat values, including seasonal restrictions during nesting or temporary restrictions designed to provide opportunities for recovery of overused areas.

1.4.3 Chaparral and Focal Species

This section addresses adaptive management of chaparral and associated focal species. Chaparral is the lowest priority for management and monitoring because of its low **Vegetation Community Ranking** score relative to the other major vegetation communities addressed by the Adaptive Management Program (Tables 1-8a and 1-8b). For this reason, the primary focus of management and monitoring of chaparral would be passive management.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for chaparral and associated focal species (Figures 4 and 9). The main stressor on the chaparral vegetation community is fire. Over-grazing, exotic species, and drought also are identified as stressors, but their effects are considered to be significantly less important than fire. However, frequent fire can provide the opportunity for exotic plant species invasions and type conversion of chaparral to annual grassland. Conversely, infrequent fire can result in fuel buildups and, in combination with drought, result in extremely intense, devastating fires. In addition, lack of fire may result in type conversion of chaparral to oak woodland (e.g., Cooper 1922; Wells 1962), although this type of conversion would not necessarily be considered adverse or needing management. These stressors generally result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary state-transitions at a moderate patch size scale probably are normal and may reflect adaptations to the natural fire regime. Permanent state-transitions, on the other hand, may be associated with loss of habitat value because of a decline of plant and wildlife abundance and diversity. The stressor model also shows interactions among the stressors and among community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose chaparral to invasion by exotic plant species.

As noted above, fire appears to a key factor for chaparral based on the many adaptations of its characteristic species and its resilience[4] in form and composition to periodic burning (Keely 1986, 1992). Post-fire species composition, however, varies substantially in relation to fire frequency, season and intensity and other environmental variables. In particular, the life history characteristics of "resprouters" versus "obligate seeders" appear to be quite different in relation to fire intervals, xeric versus mesic slopes, and root systems (e.g., resprouters may be more resistant to drought than seeders because they have deeper tap roots) (Keeley 1986).

Several experimental hypotheses relevant to managing chaparral were identified based on this model and the scientific literature:

- Chaparral left undisturbed by fire will convert to oak woodland, especially in areas with well-developed soils, and exhibit a decrease in diversity.
- Fire intervals of less than 10 years will result in a decrease in a diversity of chaparral species in favor of "resprouters" compared to "obligate seeders" (e.g., Keely 1977, 1986; Zedler et al. 1983).
- Recovery of resprouters and obligate seeders varies in relation to mesic versus xeric slopes, with resprouters favoring mesic slopes and seeders favoring xeric slopes (Keeley 1986).
- Fire intervals of less than 10 years will result in type conversion of chaparral to coastal sage scrub and eventually grassland (e.g., Haidinger and Keeley 1993).
- Fire intervals of less than 10 years will result in recruitment of exotics species such as mustards and bromes (e.g., Haidinger and Keeley 1993).

[4] Resilience can be defined as a rapid return to pre-perturbation (equilibrium) state (Keeley 1986).

- Suppression of fire in a stand of coastal sage scrub will result in type-conversion to chaparral.

- Sustained drought will result in domination of chaparral by obligate resprouters such as scrub oak and facultative resprouters such as chamise (e.g., Keeley 2000).

- With over-grazing, chaparral will be invaded by exotics and type-convert to oak woodland.

These are just some examples of the many experimental management hypotheses that can be generated. The hypotheses to be tested in the RMV Open Space should be selected on the basis of their relevance to known or potential environmental stressors and to the long-term management of the Open Space.

The adaptive management issues for chaparral are similar to those for coastal sage scrub, although the state-transition pathways and relationships are somewhat different; e.g., a response to fire by chaparral is a possible transition to coastal sage scrub whereas as burned coastal sage scrub has a moderate probability of converting to grassland. In addition, according to the state-transition model and supporting scientific evidence, chaparral is fairly resilient to state-transitions unless burned frequently

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for chaparral and associated focal species:

- Maintain the physiographic diversity of chaparral and associated focal species in the RMV Open Space.

- In the event that existing chaparral in the RMV Open Space is degraded, restore and enhance the quality of future degraded chaparral in the RMV Open Space such that net habitat value of the existing chaparral system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of chaparral and focal species in manner that allows RMV to track the long-term habitat value of the chaparral system.

- Manage chaparral fire regimes such that a natural diversity of age-stands and resprouters/obligate seeders is maintained throughout the RMV Open Space and that existing chaparral stands do not irreversibly type-convert to grassland.

- Manage cattle grazing such that adverse impacts to chaparral are controlled to preserve net habitat value and that existing chaparral stands do not irreversibly type-convert to grassland.

- Control exotics invasions of chaparral, especially along the Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

Chaparral received a low **Vegetation Community Ranking** score relative to the other major vegetation communities and is a low priority for management and monitoring. The chaparral vegetation community in the RMV Open Space generally is healthy, and at this time no specific areas warranting restoration have been identified. Therefore, in contrast to coastal sage scrub, native grassland and riparian/wetland habitats (described below), a specific *a priori* restoration objective for chaparral has not been formulated, even though restoration of chaparral is a stated goal of the Adaptive Management Program. However, areas within the RMV Open Space requiring restoration may identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events (e.g., frequent wildfires).

c. Monitoring of Chaparral and Focal Species

The monitoring program for chaparral would use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program for chaparral are summarized here:

1. Evaluation and update of the entire chaparral vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the chaparral vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later.

- Evaluation and update of the vegetation map based on remote interpretation and spot field verification as part of the overall RMV Open Space 5-year mapping effort.

- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables.

- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program.

- Concurrent focal species surveys (as described below).

After the first five years of monitoring of chaparral, individual reserve owner/managers would assess the results of their individual monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the number of sample plots (e.g., numbers, locations, etc.).

2. Focal Species Monitoring

A suite of candidate focal species for chaparral was identified in *Section 1.2.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 1-10*).

The wrentit, California thrasher, San Diego horned lizard and orange-throated whiptail are indicators of high quality chaparral, and their absence may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined. Likewise, mule deer, bobcat and mountain lion are still relatively common in the planning area and they are easy to detect. Their main value as umbrella species likely will be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (e.g., bridges and culverts).

TABLE 1-10
CHAPARRAL CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		
San Diego Horned Lizard	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**8**	**3**	**5**

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of chaparral in the RMV Open Space. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

General sample methods for monitoring focal species are described above for coastal sage scrub.

d. Management of Chaparral and Focal Species

The Adaptive Management Program for coastal sage scrub includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because chaparral appears to be more resilient to state-transitions than coastal sage scrub, for example, it is anticipated that passive management would be the predominant management approach for this community within the Habitat Reserve. Furthermore, partly reflecting this greater resiliency and because it has a relatively low **Importance Value** score, chaparral received a low **Vegetation Community Ranking** score relative to the other major vegetation communities and is a low priority for management and monitoring.

The greatest risk to maintaining healthy stands of chaparral in the RMV Open Space appears to be too frequent fire. Short fire intervals (< 25 years) in chaparral may eliminate obligate seeding species in favor of resprouters and very frequent fires (1, 2 or 3 year intervals) may result in invasion by exotic weeds and annual grasses (e.g., *Brassic nigra*, *Bromus* spp., *Schismus barbatus*) (e.g., Haidinger and Keeley 1993; Keeley 1986; Zedler 1983). The fire management of chaparral is treated in detail in the Fire Management Plan. Although over-grazing also is a potential stressor, biologists familiar with the RMV property have not observed a significant adverse effect of grazing on chaparral. Grazing management is not anticipated to be a high priority for this community in the RMV Open Space.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of chaparral compared to coastal sage scrub, native grassland and riparian and wetland communities. Nonetheless, reserve owner/managers should take advantage of opportunities to conduct experimental management actions in chaparral in response to natural or human-induced disturbances such as fire.

The conceptual stressor model for chaparral focal species (Figure 9) depicts known and potential stressors. The stressors for chaparral focal species are essentially the same as for coastal sage scrub species because of the large overlap between the two lists.

e. Restoration of Chaparral

There is no identified need for restoring chaparral. The Adaptive Management Program includes as-needed, case-by-case restoration of chaparral undertaken during the course of long-term adaptive management of the RMV Open Space, with the overall goal of maintaining the existing diversity of chaparral in the RMV Open Space.

The objective of the chaparral restoration program is to restore chaparral in areas that are degraded or disturbed by future natural events and are unlikely to recover naturally (e.g., an area that has burned too frequently).

Restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. As documented in several studies noted above, frequent disturbances of chaparral (e.g., fire) can result in state-transition to annual grassland and weedy, disturbed habitats. Likewise, areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity may be at risk of long-term degradation. In such cases restoration may be required to re-establish chaparral to both maintain existing habitat value and protect adjacent areas from invasions by exotic species that could be established without intervention.

As part of the management of the RMV Open Space supporting chaparral, RMV would identify areas suitable or desirable for restoration. Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in an the effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for chaparral and chaparral species.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities will be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

1.4.4 Native Grassland and Focal Species

This section addresses adaptive management of native grasslands and associated focal species. Native grassland received a relatively high **Vegetation Community Ranking** score, primarily because of its high **Importance Value**, and thus has a high priority for management and monitoring.

a. Adaptive Management Issues

Adaptive management of grasslands in the RMV Open Space is complicated by the fact that the system supports both sensitive native grasslands and non-native annual grasslands. Although both types provide valuable habitat for many wildlife species, and annual grassland may be considered a “naturalized” vegetation community or a “new native” (Heady 1977), management and monitoring primarily is geared to native grasslands. Moreover, in some cases, the management of native grassland and other valuable uplands such as coastal sage scrub and chaparral would focus on converting annual grassland back to what was likely the native vegetation community on the site. Over time there likely would be a net loss of non-native annual grassland in favor of net increases in native habitats. The CSS/VGL restoration plan, for example, targets several areas of annual grassland.

The environmental stressor models for native grassland and associated focal species are presented in Figures 5 and 10. The primary stressor on native grassland is exotic annual grasses and weedy forbs that dominate much of the remaining native grassland in the planning area. Exotic species reduce nutrient cycling, affect structure and diversity of native species, promote state-transition to annual grassland and alter the natural prey base. Over-grazing is a significant stressor that can directly affect nutrient cycling, structure and diversity, promote state-transition from native to non-native grassland, and alter the food web, but also indirectly can facilitate invasions by exotic species. Native grasslands in upper Gabino Canyon, and upper Cristianitos Canyon to a lesser extent, also suffer from altered geomorphologic process (i.e., erosion) affecting clay soils that result in the generation of fine sediments. Finally, while periodic fire can favor native grasslands, too frequent fire can inhibit native grasses and forbs and favor invasion of non-native species.

Under undisturbed conditions, such as a lack of periodic fire, native and annual grasslands may convert to coastal sage scrub. However, this hypothesized relationship must be tempered with the observation that at least in some regions annual grasslands appear to have stabilized, perhaps due to permanent changes in soil nutrients and moisture regimes caused by the presence of exotic species (Heunneke and Mooney 1989) and air pollution (Allen et al. 1996; Padgett et al. 1999; Minnich and Dezzani 1998). Without intervention, such areas can no longer naturally convert to coastal sage scrub and, in fact, the presence of exotics adjacent to coastal sage scrub may cause continued degradation of sage scrub without management intervention.

The relationship between native grasslands and shrub habitats in the context of fire also is unclear. Some have suggested that the distribution of native grasses is related to a long history of burning by Native Americans (e.g., Sampson 1944; Bean and Lawton 1973; Timbrook et al. 1982), while others attribute the distribution of native grasses to lightning-caused fires (e.g., Heady 1977). Evidence supporting this assertion regarding the importance of fire includes the finding that more common native grassland dominants (*Nassella pulchra, N. lepida*) are adapted to fire by resprouting and producing greater volumes of seed following fire (Ahmed 1983; Keeley and Keeley 1984). Several field studies have reported an increased cover of *Nassella* spp. after burn treatments (Hatch et al. 1991; Dyer et al. 1996), while other studies have shown mixed effects of burning on species abundance (Hatch et al. 1999). Though research has demonstrated increased abundance of native grasses following fire, there is relatively little research describing the role of fire on maintaining other native species within valley and foothill grassland habitat. One example of a positive effect of fire (and grazing) management on native wildflowers is on The Nature Conservancy's Vina Plains Preserve in southern Tehama County (Griggs 2000).

The effects of grazing on valley and foothill grasslands also remain unclear. In spite of the fact that a long history of intensive grazing in California has been cited as one of the primary reasons for the demise of native grasslands (Burcham 1957; Dasmann 1966 as cited; Keeley 1990; Bartolome and Gemmill 1981), most research has found that some intensity of grazing is beneficial to, or at least does not negatively affect, native grasses (Huntsinger *et al.* 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over 20- to 40-year periods (White 1967; Bartolome and Gemmill 1981; Goode 1981). Heady (1968, 1977) suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports findings that some form of managed grazing may be useful as part of efforts to maintain or restore native grasses. Menke (1996) considers "Prescribed grazing to constitute the primary component of the first phase of a perennial grass restoration program." (pg. 23). Furthermore, as noted above, using grazing as a management tool on the Vina Plains Preserve to control non-native grasses has resulted in a greater abundance of native wildflowers on grazed sites (Griggs 2000).

Another management issue is maintaining the structural diversity of grasslands, whether they are native or non-native. Identified Species such as the grasshopper sparrow and white-tailed kite are sensitive to the structure of the grassland habitat as it relates to perching and foraging activity. For example, grasshopper sparrows require substantial vertical and horizontal structural diversity, with thick grasses and forbs for nest concealment, and tall forbs and grasses for perching, but also open, bare areas for foraging (Payne et al. 1998; Smith 1963; Vickery 1996; Zeiner et al. 1990). White-tailed kites forage preferentially for voles (*Microtus* spp.), which are limited to tall, dense grasses (Fanes and Howard 1987).

Fuhlendorf and Engle (2001) concluded that natural grassland heterogeneity in the Great Plains of North America reflects a grazing-fire interaction whereby fire and grazing disturbances distributed spatially and temporally over the landscape produce a heterogeneous shifting grassland mosaic that enhances biodiversity and enriches wildlife habitat. The native valley and foothill grasslands of California appear to have been subject to an analogous fire-grazing evolutionary history. The grassland management program therefore should emulate the natural heterogeneity of the grassland ecosystem to promote diversity and enhance wildlife habitat value.

As shown in the conceptual stressor model for native grassland (Figure 10), invasive exotics and over-grazing are the key stressors of the native grassland ecosystem in the Southern Subregion. While fire would be a management tool to control invasives, it is not depicted in the model as a significant current direct stressor of native grassland.

Erosion is a management issue for native grasslands in upper Gabino and Cristianitos canyons.

For annual grasslands, management issues generally are related to maintaining the highest wildlife habitat value of the existing grasslands. A significant management issue for annual grasslands within the RMV Open Space would be controlling the proliferation of artichoke thistle. Mustards and sweet fennel also are herbaceous species that can dominate grassland habitats and reduce their value for wildlife species.

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for grasslands and associated focal species:

- Ensure the persistence of the physiographic diversity of native and annual grasslands and associated focal species in the RMV Open Space.

- Restore native grassland and enhance the quality of degraded existing native grassland in the RMV Open Space such that net habitat value of the existing grassland system is maintained.

- Improve the quality of annual grasslands as wildlife habitat (e.g., through artichoke thistle control).

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of grassland and focal species in manner that allows reserve owner/managers to track the long-term habitat value of the grassland system.

- Restore __ acres of native grassland to maintain and enhance habitat quality, diversity, and connectivity over the long-term.

- Manage native grassland fire regimes such that germination of native grasses (*Nasella* spp.) is enhanced

- Manage cattle grazing to facilitate restoration of existing areas of native grassland.

- Control invasions of herbaceous exotic species in both native and annual grasslands, including cardoon, mustards and sweet fennel.

c. Monitoring of Grassland and Focal Species

The monitoring program for grasslands would use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire grassland vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Period evaluation and update of the grassland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later;

- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;

- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;

- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and

- Concurrent focal species surveys (as described below).

After the first five years of monitoring of grasslands, individual reserve owner/managers would assess the results of their individual monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the number of sample plots (e.g., numbers, locations, etc.).

3. Focal Species Monitoring

A suite of candidate focal species for grasslands was identified in *Section 1.2.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 1-11*).

TABLE 1-11
GRASSLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Grasshopper Sparrow		•	
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Coyote	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**7**	**2**	**3**

The grasshopper sparrow and lark sparrow are indicators of high quality grassland, and their absence may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl, barn owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined.

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of grassland in the Habitat Reserve. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

Sample methods for monitoring focal species in general are described above for coastal sage scrub.

d. Management of Grasslands and Focal Species

The Adaptive Management Program for grasslands includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because the management issues related to annual and native grasslands are quite different, they are discussed separately.

1. Annual Grassland

For the most part management of annual grasslands would be passive, except for the control of artichoke thistle. This species readily invades disturbed annual grassland and is especially pernicious in southern Orange County where control programs are absent. On RMV ongoing control efforts over the past 30 years have limited the occurrence and spread of artichoke thistle. The control of artichoke thistle is discussed in the Invasive Species Control Plan. Other common exotic species such as black mustard and sweet fennel may be kept in check by fire and grazing management.

Much of the management related to annual grasslands would be directed toward limiting the conversion of other upland native communities (coastal sage scrub, chaparral, oak woodland, and native grassland) to annual grassland so that the long-term net habitat value of these native communities in the RMV Open Space is not diminished. From the perspective of habitat value, passive conversion of annual grassland to native grassland and shrub habitats in the RMV Open Space is not considered an adverse effect that would require management.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of annual grassland compared to coastal sage scrub. As with coastal sage scrub, reserve owner/managers should take advantage of opportunities to conduct experimental management actions in grassland in response to natural or human-caused disturbances. In these cases, experimental management actions probably would focus on how to re-establish native habitats in areas at risk of converting to annual grasslands or what are the stabilizing factors that prevent annual grasslands from converting to native habitats.

The Adaptive Management Program must retain the flexibility to respond to future management issues for annual grassland that arise through the monitoring program or independent research on the grassland ecosystem.

2. Native Grassland

The primary management approaches to native grasslands would be active and experimental. Existing native grasslands in the RMV Open Space likely would require substantial active management because they are subject to invasions by annual grasses and other exotic forbs. For example, of the approximately 1,020 acres of valley needlegrass grasslands mapped by Dudek on RMV in 2001, or included from other mapping efforts, only 17 acres (2 percent) were mapped as high quality (> 25 percent cover of needlegrass), 580 acres (57 percent) were medium quality (10-25 percent cover), 294 acres (29 percent) were low quality (~10 percent cover), and 128 acres (12 percent) had no rating (these areas were from previous mapping efforts that did not quantify native grassland quality). All native grasslands in the RMV Open Space have a substantial non-native component that likely would need to be actively managed to sustain and enhance the quality of the existing native grassland. Common non-native species observed by Dudek in native grasslands include filarees (*Erodium* spp.), bromes (*Bromus hordaceous*, *B. diandrus*, *B. madritensis*), wild oat (*Avena* spp.), black mustard (*Brassica* nigra), tocalote (*Centaurea* melitensis), smooth cat's-ear (*Hypochoeris glabra*), common catchfly (*Silene gallica*), bristly ox-tongue (*Picris echiodes*), and Russian-thistle (*Salsola tragus*). As stated by Menke (1996):

> *Introduced, alien grasses and forbs native to southern France, Spain and Portugal present a formidable obstacle to restoration and enhancement of native perennial grass populations in California foothill and valley grasslands. … Their diverse set of plant growth forms and phonologies cause fierce resource competition for light and water beginning soon after fall germination and often continue for the entire growing season.* (page 22)

Appendix J

Another management issue for native grasslands, even in the relative absence of non-natives, is the buildup of thatch (dead culm-base of native grass) that affects the vigor of the plant. To remain healthy the plants require the removal of the upper portions of the leaves and reproductive culms by grazing, clipping or burning to stimulate new growth (Menke 1991).

Based on the existing habitat quality, the objective for active management would be to maintain existing grasslands at a level of at least medium quality (i.e., greater that 10 percent cover by native grasses. Considering that at present only 2 percent of the native grasses mapped on RMV have a high quality rating (>25 percent cover), and the difficulties inherent in native grassland restoration, setting a "higher quality" objective for native grassland may be unrealistic and would be a lower priority than riparian/wetland, coastal sage scrub, and oak woodland areas.

Management of native grasslands would be achieved by two primary methods:

1. Grazing management
2. Fire management

Grazing would be the preferred management technique in the RMV Open Space because it meshes well with the existing and future cattle operations on the Ranch. Also, as suggested by Menke (1991), grazing is a primary component of native grassland restoration and management, with fire as a secondary component. Appropriately timed grazing can have several beneficial effects on the vigor native grasslands:

- Removal of litter and thatch
- Recyling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses

Fire can also have beneficial effects on native grassland, especially with regard to reducing litter and thatch and alien species, but frequent burning can damage native grasses. Menke (1991) recommends that burning be used every third or fourth year. In addition, burning may be an effective management tool for native grasslands in conjunction with managing coastal sage scrub and chaparral. In natural mosaics of shrublands, openings often support small patches of native grassland. Periodic burning of sage scrub and chaparral likely would help maintain these native grassland patches and enhance biodiversity and habitat value in these areas.

The Grazing Management Plan provides more detail on the role of grazing management on maintaining native grasslands in the RMV Open Space. A key part of grazing management, in the context of the overall Adaptive Management Program, would be developing a grazing management plan that supports the Ranch's cattle operation while providing adequate management of native grasslands, as well as other native habitats. It is anticipated that experimental range management would be a component of the Grazing Management Plan to determine the most appropriate grazing system for the RMV Open Space within the framework of the ongoing cattle operation. Experimental management actions may include the timing and density of cattle on a pasture. For example, is short, intense grazing more effective in enhancing the sustainability of native grasslands than long-term, moderate grazing densities?

e. Restoration of Native Grassland

The Adaptive Management Program includes a native grassland restoration plan comprised of three main components:

1. Pre-designated restoration of areas with native grassland to mitigate for authorized losses to development;

2. Pre-designated restoration of coastal sage scrub/grassland; and

3. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The native grassland restoration plan in discussed in detail in the Habitat Restoration Plan (Appendix X-2).

The main goals of the native grassland restoration program are to: **(1)** enhance native grasslands in selected areas that currently support low quality grasslands (i.e., less than 10 percent cover of native grass); **(2)** restore native grasslands in appropriate areas that currently support annual grasslands; and **(3)** restore a mix of coastal sage scrub and native grassland in appropriate areas.

With these goals in mind, several areas have been tentatively identified for native grassland restoration or CSS/VGL restoration (see Figure 12). Final selection of areas for enhancement/revegetation would require additional field study to determine the likelihood of a successful restoration program, including factors such as soil conditions and presence of exotic species both within the restoration area and surrounding habitat.

Areas identified for potential native grassland restoration include areas that **(1)** currently support annual grasses, but have suitable soils and are adjacent to existing VGL; **(2)** currently support low quality grassland; and **(3)** would contribute to an overall native grasslands ecosystem (i.e., small, isolated patches of native grasslands would not be considered valuable to the overall system). Because establishing a functioning native grassland system is a goal of the restoration program, impacts to native grasslands in a particular sub-basin may be mitigated in another sub-basin to achieve greater value for the overall open space. Upper Cristianitos and portions of Blind Canyon mesa are targeted for native grassland restoration, with the ability to conduct future restoration in Blind Canyon dependent upon the ultimate configuration of the RMV Open Space.

- Upper Cristianitos is targeted for restoration in order to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes areas of annual grassland underlain by clay soils suitable for revegetation and low quality native grassland suitable for enhancement. These areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration.

- Portions of Blind Canyon mesa are targeted for grassland restoration. This area has at least one patch of annual grassland suitable for revegetation and possibly two patches of low quality native grassland suitable for enhancement. These areas are adjacent to existing medium quality native grassland, suggesting a high likelihood of successful restoration. Additional fieldwork in the area may reveal additional restoration opportunities. The ability to conduct restoration in Blind Canyon, however, is dependent on the ultimate configuration of the RMV Open Space.

In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (e.g., gnatcatchers and grasshopper sparrows). These generally are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino Canyon and in the Chiquita sub-basin in the area east of the Santa Margarita Water District wastewater treatment plant; the citrus groves west of Chiquita Creek; and the disced areas west of the creek to the Chiquita ridgeline (Figure 12).

- Upper Gabino Canyon currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.

- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best revegetated with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case restoration of native grassland also may occur under the Adaptive Management Program. As part of the management of the RMV Open Space, RMV may identify further areas suitable or desirable for restoration. Instances that may warrant active restoration consist of the following:

- Existing areas of degraded or low quality native grassland that are not naturally recovering through passive management;
- Areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (e.g., an area that has burned too frequently or is infested with exotic species);
- Areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity; and
- Specific adaptive management research involving restoration treatments.

Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. These decisions would, in large part, be based on information from the previous year's annual report and would consider the overall budget available for restoration activities in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in anthe effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for grassland and grassland species.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities would be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the native grassland restoration program are provided in the CSS/VGL Restoration Plan (Appendix X-2). The key management activities of the plan are listed here:

- Identification of priority native grassland restoration areas (areas on RMV are described above);
- Revegetation of existing degraded habitat;
- Re-establishment of native grassland in selected areas in upper Cristianitos Canyon that currently support annual grassland;
- Grazing management;
- Fire management; and
- Control of invasive or exotic plants such as non-native grasses (bromes, wild oats, wild rye), artichoke thistle, black mustard, and other non-native forbs.

1.4.5 Riparian/Wetland and Focal Species

This section addresses the adaptive management of riparian/wetland resources within the RMV Open Space. Resources addressed here include riparian/wetland habitats and watercourses. Vernal pools and vernal pools species are treated separately in *Section 1.5* because they addressed on a site-specific basis.

Through the **Vegetation Community Ranking** process, riparian/wetland was identified as a high priority vegetation community for management and monitoring because of its high **Importance Value** and high **Index of Disturbance**.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for riparian/wetland vegetation and associated focal species (Figures 7 and 12). The key stressors on the riparian/wetland vegetation communities are altered hydrology, altered geomorphologic processes, exotic species and drought. These stressors are related to a broad range of adverse community responses, such as reduced community size and distribution, altered flow rates, altered water quality, altered natural stand dynamics, and an altered food web. In addition, as depicted in Figure 12, specific impacts on focal species are related to these broad environmental stressors (e.g., changes in habitat structure) as well as species-specific stressors such as predation of native species by bullfrogs.

As illustrated in the conceptual model for focal species (Figure 12), direct and interactive effects of the stressors can be quite complex. For example, the least Bell's vireo is thought to be affected by several stressors, including too infrequent flood regime, upstream diversion and/or ground water extraction, prolonged drought, exotic plant invasions (giant reed and tamarisk), exotic wildlife invasions (cowbird parasitism, possibly Argentine ants, feral cats, etc.), and human harassment (e.g., noise). Likewise, the model shows the factors which have the broadest impacts on a range of species. For example, upstream water diversions and/or ground water extraction and exotic plants directly cause reduced habitat size, and/or vigor, less surface water and soil moisture, altered flow rates and seasonality and water quality, which, in turn, adversely affects all riparian/wetland focal species; i.e., arroyo toad, snowy egret, least Bell's vireo, southwestern pond turtle and arroyo chub. A management action, for example, would be to control exotic plant invasions, with the goal of maintaining or enhancing habitat quality for all of the native riparian/wetland focal species.

As with the uplands conceptual models, this model would allow RMV to develop experimental management hypotheses. It also would allow RMV to weigh tradeoffs in management actions. For example, different species probably will respond differently to episodic events. While arroyo toads and least Bell's vireo are hypothesized to benefit from periodic flooding, red-tailed hawks and great horned owls may benefit more from maintaining mature riparian woodlands through less frequent flooding.

b. Adaptive Management Goals and Objectives

The Science Advisors conservation goals for vegetation communities and the Southern NCCP/HCP Guidelines can be restated in the context of adaptive management for riparian/wetland habitats and associated focal species:

- Ensure the persistence of the physiographic diversity of riparian/wetland habitats and associated focal species in the RMV Open Space.

- Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the RMV Open Space such that the net habitat value of the existing riparian/wetland habitat system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value of the riparian/wetland habitat system in the RMV Open

Space. These primary objectives are captured by the SAMP tenets (Draft Watershed Principles) and restated here:

1. *No net loss of acreage and functions of the waters of the U.S./State*
2. *Maintain/restore riparian ecosystem integrity*
3. *Protect headwaters*
4. *Maintain/protect/restore riparian corridors*
5. *Maintain and/or restore floodplain connection*
6. *Maintain and/or restore sediment sources and transport equilibrium*
7. *Maintain adequate buffer for protection of riparian corridors*
8. *Protect riparian areas and associated habitats of listed and sensitive species.*

With respect to objective number 8, the "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" document was prepared in support of the NCCP/HCP and SAMP/MSAA process and is used here to provide information on the physical processes that significantly affect structural habitat and life history requirements of listed riparian/wetland species in the planning area – arroyo toad, least Bell's vireo and southwestern willow flycatcher.

The relationship of the Draft Watershed Principles to the SAMP tenets is such that a direct translation to appropriate management actions can be made. As an example, Tenet 1 of no net loss of acreage and functions of the waters of the U.S./State is related to the following Watershed Planning Principles:

- Principle 2: emulate existing runoff/infiltration patterns
- Principle 3: address potential effects of future land uses on hydrology
- Principle 5: maintain geomorphic structure of major tributaries/floodplains
- Principle 8: protect existing groundwater recharge areas.

Although these are stated as "planning principles," they are also adaptive management principles because their function would have to be monitored and potentially managed over the long term. The reader is directed to Draft Watershed Principles for a full treatment of the planning principles in relation to the SAMP tenets.

c. Monitoring of Riparian/Wetland and Focal Species

The monitoring program for riparian/wetland habitats would use the same general approach described above for upland habitats. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire riparian/wetland vegetation database as part of the RMV Open Space 5-year mapping.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., downstream of development areas and along the Open Space-development edge).

1. Vegetation and Abiotic Systems Monitoring

Periodic evaluation and update of the riparian/wetland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described for coastal sage scrub. However, riparian/wetland systems pose a more complex monitoring challenge than uplands because of the number of interacting processes, including geomorphology, hydrology and biology. Consequently the monitoring program for riparian/wetland habitats also would include monitoring channel morphology and hydrology. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later;
- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program (as described below);
- Monitoring of channel morphology (as described below); and
- Monitoring of stream and groundwater hydrology (as described below).

Channel morphology would be monitored by using transect lines for measuring cross-sectional profiles to monitor sediment movement (transport and deposition), peak discharges, and changes in stream morphology. Selection of transect line areas would be based on stressor-related management issues within the Habitat Reserve, such as areas adjacent to, or downstream of, urban development. Selection of specific transect lines within an area would be based on a sampling for various factors such as existing channel pattern characteristics, instream riparian/wetland communities and adjacent upland vegetation communities, and adjacent land uses or extent of human-caused disturbances. Variables to be measured include elevations, breaks of slope in the channel, active floodplain, bankfull elevations, and stream terraces. Permanent endpoints of the transect locations would be recorded using GPS.

Stream hydrology would be monitored through stream gauges placed at representative sites in major drainages, or other locations determined to relevant to management of the Habitat Reserve. These data would be used to monitor long-term water supplies and changes in streamflow characteristics in relation to the health of the riparian/wetland system.

Groundwater monitoring would be accomplished through collection of well data where groundwater plays a significant role in streamcourse hydrology. Long-term information on subsurface water fluctuations is key to understanding discharge/recharge cycles in relation to natural wet/dry cycles and development-related influences (e.g., extractions, urban runoff, etc.), and to determine whether groundwater levels are in disequilibrium.

Riparian/wetland plant community monitoring would be conducted in tandem with the channel morphology monitoring along the transects described above. Because riparian systems are long and narrow, sample areas will be perpendicular to the channel transects and generally will be rectangular in shape, following the natural shape of the riparian system. The Orange County vegetation classification system would be used (Gray and Bramlet 1992). Functional variables that would be measured within the riparian/wetland community include species composition and heterogeneity (abundance and richness), native recruitment, density, trunk diameter, plant roughness, coarse woody debris, surfaces suitable for microbial activity, aerial net primary productivity, and percent vegetative cover in each strata. To the extent feasible, sample plots would be within homogeneous plant communities and ecotones would be avoided to reduce the influence of adjacent plant communities.

2. Focal Species Monitoring

A suite of candidate focal species for riparian/wetland habitats was identified in *Section 1.2.2.c*, including 14 early warning indicators, five (5) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 1-12*.

TABLE 1-12
RIPARIAN/WETLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Brown-headed Cowbird	•		
European Starling	•		
Great Horned Owl			•
House Finch	•		
Least Bell's Vireo	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Snowy Egret	•	•	
Yellow Warbler	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Amphibians			
Arroyo Toad	•		
Bullfrog			
Reptiles			
Southwestern Pond Turtle	•	•	
Fish			
Arroyo Chub	•	•	
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**14**	**5**	**6**

T*able 1-2* summarizes the stressor known or expected to act on these focal species. For example, the least Bell's vireo, yellow warbler and snowy egret, as avian indicators of high riparian/wetland habitat quality, also are sensitive to various kinds of stressors and thus may serve as valuable early warning indicators. The vireo and warbler are sensitive to flood regimes and nest predation by the brown-headed cowbird. The snowy egret nests in ponds and slowmoving streams with dense emergent wetlands and reportedly is extremely sensitive to pesticides and human disturbance (Zeiner et al. 1990).

In addition to these focal species, the southwestern willow flycatcher, as a listed Identified Species, would be specifically monitored.

Although the specific monitoring sites for riparian/wetland species have not been selected, and additional field studies would need to be conducted to select the most appropriate sites, several areas for monitoring the three listed species – least Bell's vireo, southwestern willow flycatcher, and arroyo toad – are identified, along with the species occurring in the area.

1. GERA – *important populations/key locations* of least Bell's vireo and southwestern willow flycatcher
2. San Juan Creek between Antonio and RMV boundary – *major population* of arroyo toad
3. Upper San Juan Creek – *major population/key location* of arroyo toad
4.
5. Talega Canyon – *major population/key location* of arroyo toad
6. Lower Gabino Canyon – *important population/key location* of arroyo toad
7. Lower Cristianitos Canyon – *important population/key location* of arroyo toad

As with the California gnatcatcher, survey methods that are appropriate for avian species in relation to the specific management issues being addressed would need to be developed, including the number of surveys per breeding season and whether surveys entail area search, point counts, mist netting and/or territory mapping (e.g., CalPIF 2002). Typically surveys for vireos and flycatchers, as well as many other riparian species such as yellow warbler, can be conducted concurrently.

The survey methods employed for the arroyo toad likewise should be tailored to the kinds of management questions being asked. For example, the number of calling males is the question, surveys would occur early in the breeding season on nights conducive to high activity levels, as noted below. Likewise, studies of breeding pool persistence and local recruitment may focus on periods later in the breeding seasons. The timing of surveys for the arroyo toad is complicated by the fact that toad activity during the breeding season can be variable, with some nights having little activity and others having high activity in relation to factors such as air and water temperature, cloud cover, moonlight and other factors.

d. Management of Riparian/Wetland and Focal Species

Appendix J

The Adaptive Management Program for riparian/wetland habitats includes the two types of management described above in *Section 8.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

These general approaches are described in detail above for coastal sage scrub. However, the riparian/wetland systems are often much more complex than the upland systems, probably more sensitive to biotic and abiotic stressors (e.g., giant reed or tamarisk invasion, surface flow and ground water levels, sedimentation, water quality, etc.), and likely would require more active long-term management than the upland systems.

The "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" summarizes the landscape processes and specific habitat requirement for listed riparian species that occur in the RMV Open Space- arroyo toad, least Bell's vireo and southwestern willow flycatcher. General issues that likely would require near-term active management at a landscape watershed and sub-basin level, include:

- Emulating natural flood regimes to maintain coarse sediment yields, storage and transport processes.

- Emulating, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground covers.

- Emulating natural timing of peak flows of each sub-basin relative to mainstem creeks.

- Managing existing groundwater recharge areas supporting riparian zones and maximize groundwater recharge of alluvial aquifers to the extent consistent with aquifer capacity and habitat management goals.

- Managing water quality through various strategies, with an emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices.

These management principles are explained in more detail in the Draft Watershed Principles.

Issues that likely would require near-term active management at a site-specific, vegetation community level include:

- Management of excessive surface and subsurface water flows and sediment in Gobernadora Creek.

- Potential changes in water supplies to San Juan Creek.

- Control of invasive exotic plant species such as giant reed, tamarisk, and pampas grass in riparian zones, particularly in San Juan and lower Cristianitos creeks.

- Management of ponds and other open waters with lacustrine and fresh emergent vegetation.

- Grazing management.

- Fire control.

.

- Control of human access and recreational activities in riparian/wetland habitat areas.

- Management of sand and gravel mining operations.

Issues that likely would require near-term active management at the focal species level include:

- Control of brown-headed cowbirds.
- Control of Argentine and imported red fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the RMV Open Space.
- Control of exotic aquatic predators (bullfrogs and possibly crayfish and introduced fishes)
- Control of terrestrial mesopredators (feral cats, dogs, skunks, raccoons, opossums)
- Control of collections and harassment by humans.
- Provision of adequate wildlife crossings/habitat linkages and fences along roadways at key crossing locations.
- Control of artificial lighting and noise.

As emphasized above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A substantial amount of baseline work has already been completed regarding the hydrology, geomorphology and biology of RMV aquatic systems that would provide a basis for experimental management hypotheses. For example, the document "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" provides information on the physical processes that significantly affect structural and life history requirements on listed riparian/wetland habitat species. Other documents that provide valuable background information for the Adaptive Management Program are the "Baseline Geomorphic and Hydrologic Conditions," the Watershed Planning Principles, and the Southern NCCP/HCP Guidelines.

A number of management hypotheses can be generated from the stressor models illustrated in Figures 7 and 12. Some of these hypotheses could be examined opportunistically in response to natural events at a watershed or sub-basin level. For example:

- Frequent floods resulting in scouring of mature vegetation and replacement by younger stands causes a temporary decline in suitable raptor nest sites.

- Infrequent flood regimes result in maturation of the riparian zone and cause the decline of species dependent upon periodic flooding, including least Bell's vireo, southwestern willow flycatcher, yellow warbler, and arroyo toad.

Tracking the change in habitat composition and quality and associated species composition following disturbance events should be included in the monitoring program. For example, after a significant flood event or wildfire, what is the temporal pattern of species use in relation to riparian stand recovery and age?

Other experimental management hypotheses were identified to be tested in an *a priori* fashion by setting up experimental and control study plots: For example:

- Control of bullfrogs from Calmat Lake will increase the arroyo toad and southwestern pond turtle populations.

- Control of giant reed in San Juan Creek below the RMV boundary will increase the local arroyo toad population and nesting habitat for species such as least Bell's vireo, southwestern willow flycatcher, yellow warbler and southwestern pond turtle. Initiation of such a control program should only be undertaken in coordination with the upstream landowners (i.e., County of Orange as landowner of Casper's Regional Park) to provide for a reasonable likelihood of a successful control program.

- Increasing spring stormwater flows into San Juan Creek will increase breeding habitat quality for the arroyo toad by providing breeding pools that persist longer and support toad metamorphosis.

- Control of Argentine ants will increase the reproductive success of least Bell's vireo, southwestern willow flycatcher, and yellow warbler.

Appendix J

To illustrate how the Adaptive Management Program would address the management and monitoring of a riparian system and associated focal species using the environmental stressor approach, an example using the arroyo toad population in San Juan Creek is provided here.

Information on the autecology of the arroyo toad, as summarized in the "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" document, provides the scientific foundation for the management and monitoring approach. This document summarizes the key arroyo toad habitat components, including:

- Low-gradient streams with periodic scouring and filling regimes characterized by features such as late season or near perennial flow, shallow pools persisting until at least midsummer, open streamside sand/gravel flats, and sparsely vegetated low sandy benches within the channel and along shoreline.
- Sandy and loamy sand soils in both riparian and adjacent upland zones suitable for burrowing.
- Breeding pool substrates of sand or well-sorted fine gravel.
- Adjacent riparian habitats extending up to 100 meters from stream channel, supporting sycamores, cottonwoods, oaks, and willows, with understories of mule fat, short grasses, herbs, leaf litter and patches of bare ground.
- Floodplain connectivity allowing free access between estivation areas and breeding pools.
- Adjacent upland habitat that may be outside 100-year floodplain and used for foraging and estivation. Characterized by friable soils for burrowing and stabilized by brush and trees.
- Periodic and unpredictable hydrology (probably < 10 year cycle) that alters channels, breeding pool locations, sand deposition and vegetation.
- Ponded areas fed by surface flows that persist for a least a few months of the year and have low surface area to volume ratios to prevent premature evaporation.

The known or highly likely "extrinsic" stressors (now and in the future) in San Juan Creek are:

- Bullfrog (there may be other exotic predators on RMV, but bullfrog is clearest problem)

- Giant reed
- Lack of adequate surface water to support breeding pools for duration of season (probably exacerbated by giant reed infestation)
- Groundwater pumping
- Human activities (to a lesser degree)

Based on these habitat requirements and identified stressors, several hypotheses that could be tested through management and monitoring are listed below, along with experimental approaches to test the hypothesis.

- Initial elimination/control of giant reed will increase surface and subsurface water flows and provide for natural regeneration of suitable arroyo toad habitat.

    1. Remove giant reed from RMV property within San Juan Creek and concurrently monitor groundwater and surface flows.

    2. Take cross-sectional profiles to measure sediment transport, peak discharges, changes in stream morphology and changes in vegetation characteristics.

    3. Monitor colonization of restored areas by arroyo toad.

- Timed-grazing will keep giant reed proliferation in check.

    1. Allow cattle into selected areas where mature stands of giant reed have been removed but new growth is appearing; i.e., will the cattle eat the giant reed shoots? Compare with control areas where cattle are excluded.

- Elimination/control of bullfrogs will increase productivity of arroyo toad populations.

    1. Establish arroyo toad baseline population levels at experimental bullfrog elimination/control locations (e.g., Calmat lake and elsewhere they are found within San Juan Creek on RMV property) and at control sites that support toads but do not have a bullfrog problem (e.g., upper San Juan Creek or Bell Canyon).

    2. Eliminate/control bullfrogs at experimental sites.

    3. Monitor reproduction of arroyo toads (e.g., numbers of adult toads, metamorph survival) in proximity to bullfrog locations and at control sites to control for natural variation on toad populations.

- Changes in land uses, such as removal of nursery and agricultural operations for development, may change groundwater and surface flows and affect arroyo toad populations.

    1. Monitor groundwater and surface flows in areas likely to be affected by land use changes and control sites in order to control for short-term weather and long-term climatic variation.

    2. Monitor reproduction of arroyo toads (e.g., numbers of adult toads, metamorph survival) in areas likely to be affected by land use changes and at control sites.

e. Restoration of Riparian/Wetland

The Adaptive Management Program includes a riparian/wetland restoration plan comprised of two main components:

1. Pre-designated enhancement and revegetation areas; and

2. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The riparian/wetland restoration plan is intended to complement and supplement the protection and management measures for the riparian/wetland ecosystem in the Habitat Reserve. The goals of this integrated protection and restoration program are to:

- Maintain and restore riparian ecosystem integrity; and.

- Maintain/protect/restore riparian corridors.

To achieve these goals, restoration is recommended for middle San Juan Creek, Gobernadora Creek, upper Gabino Creek, and lower Cristianitos Creek. Identification of these areas for restoration is based on riparian system invasive species mapping completed by PCR (2002) and GLA (2003) as well as the Draft Watershed Principles.

- Middle San Juan Creek between the creek crossing south of the Colorspot Nursery and the RMV boundary near Bell Canyon supports abundant giant reed and scattered locations of pampas grass and tamarisk. This reach of San Juan Creek supports a *major population* of the arroyo toad and an *important population* of the yellow warbler.

- Gobernadora Creek is targeted for riparian/wetland restoration to address: **(1)** the historic meander conditions; and **(2)** excessive sediment input resulting from upstream land uses. Restoration may include the construction of a detention/water quality basin below Coto de Caza. There are at least four scattered locations of giant reed in Gobernadora Creek, two in the reach just south of Coto de Caza and two in GERA. The GERA portion of the creek supports *important populations* of the least Bell's vireo, southwestern willow flycatcher, and yellow warbler. Creation of wetland breeding habitat for an Identified Species, the tricolored blackbird, should be considered a priority in the Gobernadora area because breeding populations have regularly occurred in the ponds in southern Coto de Caza. Northward extension of riparian habitats from GERA also would provide additional breeding habitats for Least Bell's vireo, southwester willow flycatcher, and yellow warbler, as well as raptors and other riparian/wetland species such as yellow-breasted chat and two-striped garter snake.

- Upper Gabino Creek currently generates fine sediments due to extensive gully formation in the headwaters area. To address this excessive sediment generation and reduce downstream impacts, both upland and riparian/wetland habitat restoration is recommended. Depending on the type of riparian/wetland restoration in upper Gabino Canyon, various riparian/wetland species could benefit, including focal species such as the yellow warbler and southwestern pond turtle, Identified Species such as the tricolored blackbird, and other riparian/wetland species such as the yellow-breasted chat and two-striped garter snake.

- Lower Cristianitos Creek supports patches of tamarisk near the confluence and giant reed and pampas grass west of the TRW facility south to the RMV boundary. This reach support an *important population* of the arroyo toad, a well as several nest sites for least Bell's vireo and other riparian species such as yellow-breasted chat. Restoration in this area also would benefit several listed species downstream of the RMV boundary Cristianitos and San Mateo creeks: least Bell's vireo, southwestern willow flycatcher, tidewater goby and southern steelhead.

In addition to habitat restoration focused on the control of invasive exotic species, several smaller scale creek stabilizations are recommended to address locally-induced headcuts in Chiquita Creek and upper Cristianitos Creek.

Locally-induced headcuts (as contrasted with valley deepening reflecting longer-term sea level change and geologic processes) are present in Chiquita Creek and Upper Cristianitos Creek. Some headcuts in Chiquita Creek and upper Gabino Creek are caused by the placement of road crossings or other human-induced causes. Headcuts in Cristianitos Creek may have a similar origin but may also be strongly influenced by long-term geologic processes. Further investigations of the causes of the

Cristianitos Creek headcuts, as well as monitoring the results of native grassland restoration in upper Cristianitos Canyon, would be necessary before identifying a specific restoration approach.

The reader is directed to the Habitat Restoration Plan (Appendix X-2) for the details of the riparian/wetland restoration approach.

Riparian/wetland restoration also would be conducted on a case-by-case basis over the long-term management and monitoring of the RMV Open Space. Through periodic monitoring of the overall vegetation communities and focused frequent monitoring of potential exotics hotspots, RMV would target areas for local enhancement and restoration. Because the invasion of the riparian/wetland areas by giant reed, tamarisk and pampas grass is related to dynamic and unpredictable natural events, RMV would need to develop protocols for checking areas susceptible to invasions.

As discussed above for upland habitats, case-by-case restoration actions primarily would be the decision of RMV consistent with the goals and objectives of the Adaptive Management Program. For example, because exotic species invasions of riparian/wetland systems have profound implications for downstream resources, it would be crucial for RMV to coordinate with upstream landowners. Restoration in a downstream location within the RMV ownership would have little long-term beneficial effect if upstream sources of invasives also are not controlled. Generally, restoration should start in the upstream locations and work downstream.

Experimental restoration projects (e.g., testing different methods of control) would be conducted in a manner that the specific management action can be rigorously tested.

1.4.6 Woodlands and Focal Species

This section addresses the adaptive management of woodlands resources within and focal species. Woodlands in the RMV Open Space encompass coast live oak woodland, coast like oak savanna, coast live oak forest and canyon live oak forest. For the purposes of the management and monitoring program, these woodlands are considered upland habitats, as distinct from riparian woodlands and forests. Oak woodland is a lower priority for management and monitoring because of its low **Vegetation Community Ranking** score relative to the other major vegetation communities addressed by the Adaptive Management Program (Tables 1-8a and 1-8b).

a. Adaptive Management Issues

As illustrated in the conceptual stressors models (Figures 6 and 11) a number of natural and human-induced factors have been recognized as important for the conservation and management of oak woodlands in California.

A major stressor of oak woodlands is altered hydrology. Subsurface de-watering or prolonged drought may affect the viability of mature coast live oak that are thought to utilize the water table in some areas by developing deep taproots (Callaway 1990). Loss of available surface water has a detrimental effect on the sprouting of seedlings (Stephenson and Calcarone 1999). Alternatively, over-watering resulting from urban run-off and summer irrigation can make oaks more susceptible to various oak root diseases resulting from water mold fungi such as *Phytopthora* (Raabe 1990).

Fire also is a key stressor of oak woodlands. Oaks are adapted to wildfires and oak recruitment appears to depend on relatively frequent fires (e.g., McClaran and Bartolome 1989). Although fire can kill the tops of seedlings and saplings, they can resprout in the first year after a fire. In addition, Fry (2002) found that scorching of oaks was positively correlated with the crown damage and the likelihood of resprouting. On the other hand, a high intensity fire can severely damage or kill mature trees. Fires that cause trunk scars can make the tree more susceptible to disease (Fry 2002). Also, if fires occur too frequently, ground cover can become dominated by annual grasses that compete for available surface water and affect acorn recruitment and growth.

Grazing and browsing can have both detrimental and beneficial effects on oak woodlands. On the one hand, cattle and mule deer browse on seedlings and saplings, and thus depress oak recruitment. In addition, trampling of soils in the winter results in soil compaction that reduces their ability to absorb water or seeds. On the other hand, managed grazing can control the proliferation of annual grasses and invasive weeds that compete with oak seedlings and saplings for available surface water and soil nutrients, as well as reduce the risk of "laddering" fires than can kill oaks.

Predation on acorns, seedlings, and saplings can have substantial effects on oak woodlands. For example, ground squirrels, deer mice, scrub jays, and acorn woodpeckers prey on acorns, while pocket gophers, cattle, and deer consume seedlings and saplings. Although most of these predators are native species, and presumably oaks have evolved in their presence (i.e., these native predators are examples of *intrinsic drivers*), in combination with non-native predators such as cattle, and other *extrinsic drivers* such as exotics, altered hydrology, and short fire intervals and/or intense fire, the predation pressure on acorns, seedlings and saplings may exceed the ability of the oak woodland system to withstand these stressors. That is, the system may be pushed beyond its natural resilience.

b. Adaptive Management Goals and Objectives

Appendix J

The Science Advisors' conservation goals for vegetation communities and those of the Southern NCCP/HCP Guidelines can be restated in the context of adaptive management for oak woodland habitats and associated focal species:

- Maintain the physiographic diversity of oak woodland habitats and associated focal species in the RMV Open Space.

- Restore oak woodland habitats and enhance the quality of oak woodland habitats in the RMV Open Space such that the net habitat value of the existing oak woodland system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value of the oak woodland habitat system in the RMV Open Space.

- Conduct monitoring of oak woodlands and focal species to track the long-term habitat value of the oak woodland system.

- Maintain appropriate subsurface hydrology to avoid under- and over-watering.

- Manage fire regimes in oak woodlands such that a natural diversity and balance of age-stands are maintained throughout the RMV Open Space; i.e., there is an appropriate mix of mature trees and recruitment of new trees.

- Manage cattle grazing such that adverse impacts to oak woodlands are controlled to preserve net habitat value.

- Control exotics invasions of oak woodlands, especially along the Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

- Maintain suitable nesting habitat in oak woodlands, and specifically potential nest cavities in snags, dead or decaying limbs, and hollow trunks for acorn woodpecker. (As a primary cavity nester (i.e., species that excavate their own holes for nests), acorn woodpeckers may be a keystone species for secondary cavity nesters that utilize abandoned holes. Other native cavity nesters that would benefit from management and monitoring of acorn woodpecker include ash-throated flycatcher, Nuttall's woodpecker and western screech owl.)

- Retain large oaks (greater than 50 in. dbh) to the maximum extent possible to provide granaries for acorn woodpeckers.

- Identify trees with high acorn productivity.

- Maintain acorn production and protect seedlings and saplings to support establishment of new trees. Management would entail addressing the following issues:

  - Maintain acorn production to provide forage for native wildlife such as acorn woodpeckers, scrub jays, squirrels, mice and mule deer. (It is important to maintain native predators of acorns, seedlings and saplings because they may be important components of the oak woodland ecosystem, especially in regard to dispersal of acorns or mycorrhizal fungi. Acorn predators such as mice also provide food for other oak woodland species such as Cooper's hawk and white-tailed kite. The challenge is to balance these natural predators with viable oak woodland systems that can naturally regenerate.)

  - Protect seedlings and saplings in stands of oak woodlands in the RMV Open Space where predation by native and non-native species is excessive, including by the use of protective structures where necessary.

- Maintain the complex understory of shrubs, grasses annual forbs, leaf litter and downed woody debris that provide habitat for the lark sparrow and orange-throated whiptail, as well as variety of other wildlife species.

- Maintain native habitats adjacent to oak woodlands in the RMV Open Space to the extent possible to preserve the landscape mosaic.

- Protect habitat supporting upper trophic predators such as bobcats and coyotes within oak woodlands to control native and non-native mesopredators.

- Restore oak woodlands in areas that currently support stands that are damaged or stressed by natural or human-induced factors, and where the adverse impact may not be naturally reversible (e.g., irrigation of drought-stressed trees). (Note that a specific *a priori* restoration objective for oak woodlands has not been formulated, even though restoration of oak woodland is a stated goal of the Adaptive Management Program because at this time specific areas warranting restoration of oak woodlands have not been identified. However, areas within the RMV Open Space requiring restoration may be identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events.)

- Conduct management activities (e.g,, prescribed fire, discing, mowing, timed grazing) in a manner that minimizes impacts oak woodland wildlife species to the extent feasible. It should be noted that some management activities, that over the long-term benefit oak woodlands and associated species (e.g., controlling exotics to enhance seedling and sapling viability or reduce fire intensity) may temporarily affect focal species such as lark sparrow and orange-throated whiptail. These short-term impacts are considered acceptable in the interest of long-term benefits.

c. Monitoring of Woodlands and Focal Species

The monitoring program for oak woodland habitats (including coast live oak woodland and coast live oak forest) would use the same general approach described above for other upland habitats. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire oak woodland vegetation database as part the overall RMV Open Space 5-year mapping effort.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the oak woodland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever comes later;
- Evaluation and update of the baseline vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and
- Concurrent focal species surveys (as described below).

Selection of specific monitoring locations for oak woodlands would require additional field work, but would be selected to provide physiographic representation within the Habitat Reserve. Areas with substantial stands of oak woodlands that should be considered for monitoring include:

- Lower Gabino Canyon
- La Paz Canyon
- Upper Gobernadora Canyon
- Lower Cristianitos Canyon
- Blind Canyon
- Donna O'Neill Land Conservancy at Rancho Mission Viejo
- Wagon Wheel Canyon
- The "Narrows" area of Chiquita Canyon
- Lower Chiquita Canyon

Monitoring of oak woodlands would be drawn from the following methods:

- Establish pseudo-randomized plots around stands. Sample plots should include the range of existing habitat conditions within the RMV Open Space, including elevation, slope and aspect, proximity to roads and urban development, and uses within the RMV Open Space(e.g., recreation, grazing, fully protected areas, etc.). Exclude plots with less than 10 percent cover and less than at least three oak trees that meet or exceed 4 in dbh (diameter at breast height, or 4.5 ft from the ground).
- Tag trees and record species, tag number, dbh (in), height (ft) and dominance (i.e., is the tree in the canopy of another tree or does it form the canopy?). Note slope and aspect of each tree, understory species (including proportion of natives to exotics), presence of debris and litter, soil type, depth, and parent material and elevation.
- Assess the status of trees as stressed or dead by examination of bark and small branches for dryness and brittleness. Trees would be classified as "healthy" if less than 50 percent brown and leafless, "partially dead" if at least 50 percent brown and leafless, and "dead" of entire tree appears brown and leafless (following Tietje et al., UC Cooperative Extension, Integrated Hardwood Management Program).
- Assess acorn production.
- Create oak tree database through the use of software specially developed to track discrete resources (e.g., TreePro software that links the database to GIS mapping capabilities).

2. Focal Species Monitoring

Appendix J

A suite of candidate focal species for oak woodlands was identified in *Section 1.2.2.c*, including ten (10) early warning indicators, three (3) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 1-13*.

TABLE 1-13
OAK WOODLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Acorn Woodpecker	•	•	
Anna's Hummingbird	•		
Ash-throated Flycatcher		•	•
Barn Owl			•
European Starling	•		
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Reptiles			
Orange-throated Whiptail	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**3**	**6**

Table 8-2 summarizes the stressor(s) known or expected to act on these focal species. The acorn woodpecker, in particular, should be an extremely valuable early warning and biodiversity indicator. As stated in the "Oak Woodland Bird Conservation Plan (CalPIF 2002),

> *Of all the birds that rely upon California's oaks, the Acorn Woodpecker is the one most intimately linked to the habitat.* (page 45)

The acorn woodpecker is highly dependent on acorn production and a reduction in oaks and acorns production may cause a decline of this species in an area. Furthermore, as a primary cavity nester, it excavates its own cavities and provides potential nest sites for secondary cavity nesters such as ash-throated flycatcher and western screech owl.

Both the lark sparrow and orange-throated whiptail use the understory litter and debris associated with oak woodlands. Both species are likely to be sensitive to invasions of the oak understory by non-native annual grasses and weedy forbs, as well as over-grazing and frequent burning. In addition, the orange-throated whiptail is sensitive to invasions by Argentine and red imported fire ants that displace native prey.

Oak woodlands also provide potential nesting and roosting habitat for the three avian umbrella species: red-tailed hawk, great horned owl and barn owl.

d. Management of Woodlands and Focal Species

The Adaptive Management Program for woodlands includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Issues that likely would require active management at a habitat level include:

- Control of invasive exotic plant species, especially annual grasses.
- Management of surface and subsurface hydrology to avoid both over- and under-watering.
- Grazing management.
- Fire management.
- Control of predation on seedlings and saplings.
- Maintain snags, decaying wood, and dead limbs to provide nesting habitat for primary and secondary nesting-cavity focal species; i.e., acorn woodpecker and ash-throated flycatcher.
- Maintain understory litter and debris to provide habitat for understory focal species; i.e., orange-throated whiptail, and lark sparrow.

Issues that likely would require active management at the focal species level include:

- Control of Argentine and red imported fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the RMV Open Space.
- Control of terrestrial mesopredators (feral cats, dogs, skunks, raccoons, opossums)

- Control of artificial lighting and noise.

As stressed above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A number of management hypotheses can be generated from the stressor models illustrated in Figure 6 and 11. Some examples of management hypotheses that were identified for oak woodlands incude:

1. Managed grazing that reduces the cover of annual grasses and weedy forbs while also protecting seedlings and saplings and soils from cattle (i.e., exclosures) will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.

2. Managed fire regimes that reduce the cover of annual grasses and forbs will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.

3. The abundance of starlings (i.e., cavity nesters) in stands of oak woodland will be inversely related to the abundance of native cavity nesting species.

4. Presence/absence of dead standing trees and limbs, snags, decaying woodland will be correlated with the abundance of cavity nesting species.

5. Presence/absence of understory debris and litter will be correlated with the abundance of understory species.

e. Restoration of Woodlands

The Adaptive Management Program provides for case-by-case restoration of oak woodlands undertaken during the course of long-term adaptive management of the Habitat Reserve, with the overall goal of maintaining the existing diversity and habitat value of oak woodlands in the RMV Open Space.

The two main objectives of the oak woodlands restoration program are:

1. To restore oak woodlands in areas that support existing mature trees, but where recruitment and regeneration are being inhibited by factors such as exotic weeds and annual grasses or over-grazing.

2. To restore oak woodlands in areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (e.g., an area that has burned too frequently);

The first objective of restoring oak woodlands would be achieved by (a) identifying any degraded oak woodlands, and (b) focusing the restoration effort in degraded areas adjacent to healthy stands of oak woodland to the extent possible. A near-term management task would be to identify any such areas in the Habitat Reserve. Following management recommendations of CalPIF (2002), sites identified for restoration should then be prioritized on basis of their proximity to high quality sites and their likely success of regeneration and transplanted oak viability. Restoration of sites in close proximity to existing high quality sites have a better chance of being colonized by oak woodland species.

The second objective of restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. For example, sites that currently support high quality oak woodlands but are damaged by a high intensity fire or several fires at short intervals may be identified for restoration.

As part of the management of the various lands in the RMV Open Space supporting oak woodlands, RMV would identify areas suitable or desirable for restoration. Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in an effort to provide the greatest net benefit for oak woodlands and oak woodland species.

Restoration sites would be evaluated for their suitability including water table and soil conditions. Merrick et al. (1999) describe a knowledge-based model to evaluate sites for restoration suitability for valley oak (*Q. lobata*). If oaks currently are present or the site supported oaks in the recent past, it is considered to be suitable. If the site is not currently occupied by oaks, but has high soil water holding capacity, a high water table and loam soils, it is considered favorable for restoration.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities would be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

8.5 Adaptive Management Of Site-Specific Resources

This section addresses the monitoring and Adaptive Management Program for site-specific resources, including vernal pools and associated species and plants that are Identified Species.

1.5.1 Vernal Pools and Associated Species

The RMV Open Space supports two main areas of vernal pools. The Dudek/PCR study conducted in 2001 mapped three pools on Chiquita Ridge and three pools on the Radio Tower Road mesa located between Highway 74 and Trampas Canyon (Figure 15). Both areas supporting the vernal pools are characterized by native and non-native grasslands. The Chiquita Ridge area formerly was used for cattle grazing but is now in the Ladera Open Space and cattle have been excluded from the area. The Radio Tower Road area currently is grazed, generally from October through May, and planned for continued grazing as part of long-term cattle ranch operations.

The large pool on Chiquita Ridge (pool 4) supports both the Riverside and San Diego fairy shrimp and a smaller pool (pool 3) supports only the San Diego fairy shrimp. Two of the three pools on the Radio Tower Road mesa (pools 2 and 7) support both species and the third (pool 1) supports only the San Diego fairy shrimp).

Notably only one special status plant species – the CNPS List 2 mud nama – is known from the vernal pools in the RMV Open Space. Because mud nama is not state- or federally-listed and no impacts related to development are anticipated, this species is not an Identified Species for regulatory coverage.

a. Adaptive Management Issues

Five main issues typically are considered in the management of the vernal pools and associated species:

1. Hydrology
2. Water quality
3. Grazing
4. Invasive exotic species
5. Human disturbance

Hydrology is a key management issue because the flora and fauna of the vernal pools have evolved adaptations to the unique hydrological conditions of vernal pools. Although dramatic year-to-year variations in rainfall occur, and vernal pools species are well-adapted to this variation, over the long term too little inundation may not support the full life cycle of the vernal pool species and extended inundation may lead to mortality of the species that are not truly adapted to an aquatic existence (Barry 1998; USFWS 1998). Extended runoff from developed areas can be a substantial problem for vernal pools (e.g., Clark et al. 1998). Hydrological alterations of the vernal pools in the RMV Open Space due to direct disturbance of the local contributing watershed (e.g., from grading) or increased urban runoff, are not anticipated to be management issues because existing and planned development areas are at least 1,000 ft from the vernal pools and at lower elevations. However, effects of cattle grazing and exotic species on hydrology are considered to be important management issues and, thus, are addressed below.

The Radio Tower Road vernal pools are located in an active pasture and grazing is planned in this area in the future as part of planned long-term cattle operations. Grazing can have both positive and negative impacts on vernal pools and associated species. Grazing can help control the proliferation of invasive exotics species such as annual grasses that choke out native plants and alter the natural hydrology of the pool and local contributing watershed (e.g., Barry 1998), but poorly timed grazing can result in trampling of fairly shrimp cysts and hatchlings, as well as increase water turbidity. As stressed by Barry (1998), "When resource managers and landowners develop plans to conserve vernal pool habitats, it is imperative they recognize that the current vernal pool landscape has been altered with the proliferation of exotic plant species and the impact of livestock grazing." (pg. 237).

In addition to increasing water turbidity, cattle may have other negative impacts on water quality. Vernal pool species have adapted to specific water quality tolerances, and alterations in pH, and water temperature may have significant impacts on these species (Simovitch et al. 1996). Cattle are potential sources of nutrients such as phosphorus and nitrogen, as well as organic wastes (manure and urine), that may trigger rapid growth of microorganisms (and thus increased biochemical oxygen demand) and/or aquatic macrophytes (e.g., algae) (Bowling and Jones 2003).

The management issue for the Radio Tower Road pools thus is timing grazing in way that helps control non-native plants, but does not interfere with the functions and values of the vernal pools, most importantly, the reproductive cycle of vernal pool plant and animal species. Lis and Eggeman (2000) describe an adaptive management study where a combination of grazing and burning was used to control invasive species in vernal pools in the Dales Lake Ecological Reserve in Tehama County, California. They found that carefully timed grazing did not interfere with fairy shrimp reproduction or cause any immediate negative effects on rare plants. They concluded that while grazing "may not return the vernal pool landscape to its condition five hundred years ago…it is likely to move the landscape in that direction." (pg. 23)[5].

[5] Lis and Eggeman (2000) also found that vernal pools burned during a wildfire on the Hog Lake Plateau, resulting in the burning of dense mats of dried spikerush, had no apparent adverse effect on the hatching of fairy shrimp. The

As described above, invasive exotic species threaten vernal pools because they compete with and displace native plants, and they also interfere with normal surface runoff patterns in the local contributing watershed essential for sustaining vernal pool hydrology (e.g., Barry 1998). The problem with most non-natives occurs in drier years when moisture conditions are conducive to annual grasses such as bromes (*Bromus* spp.) and wild oats (*Avena* spp.) (USFWS 1998). During wetter years these annual grasses are reduced, but several other non-native species such as rabbit's-foot grass (*Polypogon monspeliensis*), wild rye (*Lolium* spp.) and brass-buttons (*Cotula coronopifolia*) still can dominate vernal pools (USFWS 1998). As discussed above, grazing, and possibly prescribed burns, may be used to control exotic species at the Radio Tower Road pools, but other control methods would be required at the Chiquita Ridge pools because cattle are excluded from the area and prescribed burns may not be feasible so close to residential development.

Human disturbances, primarily trampling and vehicular impacts on species and soils, are ongoing threats to vernal pools throughout the state. Because the vernal pools in both the Chiquita Ridge and Radio Tower Road areas are at least 1,000 ft from the nearest residential development, human disturbance may be less of a long-term problem in the RMV Open Space than typically observed elsewhere. Nonetheless human activities would have to be addressed in the Adaptive Management Program.

b. Adaptive Management Goals and Objectives

The overall goal of the Adaptive Management Program for vernal pools and associated species is to maintain existing vernal pools and associated species that occur in the pools within the RMV Open Space (see Vernal Pool Assessment, PCR 2003). The management objectives designed to meet this goal are to:

- Conduct monitoring of vernal pools and associated species in a manner that allows reserve owner/managers to track the long-term status of the vernal pools and species.

- Manage the hydrological regime of the pools by maintaining the existing local contributing hydrological sources (i.e., the local contributing watershed of the vernal pool).

---

study is ongoing, but Lis and Eggeman suggest that timed grazing and prescribed burning may be effective management tools to control non-natives in vernal pools. Prescribed burning as a management tool for grasslands generally, and for vernal pools specifically, also is recommended by Pollack and Kan (1998) based on studies on the Jepson Prairie Preserve showing that late-spring burning reduces non-native grasses and increases the dominance of native species. They also suggest that a combined burning-grazing regime can be used to reduce fire intensity.

- Eliminate or control any identified existing threats to existing vernal pools, including poorly-timed grazing and invasion of pools and the local contributing watershed by non-native species.

- Develop management tools to control the proliferation of non-native species, including time-grazing, prescribed burns, mowing and selective weeding.

- Manage water quality to emulate baselines conditions in the vernal pools in the RMV Open Space known to support the Riverside and San Diego fairy shrimp.

- Control public access to vernal pools.

c. Monitoring of Vernal Pools and Associated Species

Each vernal pool in the RMV Open Space would be assigned a unique identifying code. GPS locations have already been recorded for the vernal pools on Chiquita Ridge and the Radio Tower Road mesa.

A pre-established monitoring schedule for vernal pools has not been set. The monitoring schedule needs to be flexibly tied to local climatic conditions. All vernal pools would be evaluated within two (2) years of executing the IA by recording variables as described below. This evaluation would include an assessment of existing habitat quality and the need for specific management actions. For pools that do not warrant immediate management, periodic monitoring would take place on a schedule dictated by predicted climatic conditions for a particular year. In conjunction with predicted climatic patterns, at minimum, pools would be monitored at least three (3) times per decade. The years selected for monitoring would be tied to the predicted rainfall patterns for the year. Pools would be monitored at least once each decade during a year with predicted high (e.g., El Nino), normal, and low (e.g., La Nina) rainfall in order to collect information in relation to variable amounts of rain. Pools subjected to a specific management actions (e.g., grazing, prescribed burning, mowing, weeding, etc.) would be monitored more frequently, as appropriate to the management action(s) (e.g., for three consecutive years following a management action). Monitoring may also occur more frequently in certain pools if discrete field studies by outside scientists are being conducted. Any outside scientist proposing to conduct a study of vernal pools within the RMV Open Space would be required to submit a detailed proposal outlining the work program to RMV, who would then evaluate the proposal and ensure that the study is compatible with the goals and objectives for managing the vernal pool resources.[6]

[6] Such studies also would require the researcher to obtain a separate Incidental Take permit for the study.

Typical hydrology and water quality variables to be measured include time from inundation to dehydration, periodicity of pool, size of pool, depth, water temperature, pH, dissolved oxygen, specific conductance and salinity. Having baseline measurements for these variables would be essential for detecting any cause and effect relationships between characteristics of the vernal pools and changes in Riverside and/or San Diego fairy shrimp, and, in turn, identifying the cause of any declining trends in these species.

The floral characteristics of vernal pools also would be monitored. Species presence and relative cover would be monitored for each pool. An example of a standard monitoring protocol is described here. Two line transect locations in each of the pools are established with rebar stakes. Species presence and frequency on the transect, species present within the pool but not on the transect and relative cover of each species are recorded. A 50-meter tape is be strung tightly between the two rebar stakes at either end of the transect, and all measurements are taken along a pre-determined side of this line at two decimeter (dm) intervals. A wire, square decimeter is placed on the ground and all species present within the square, as well as their percent cover, are recorded.

The status of the Riverside fairy shrimp and San Diego fairy shrimp, as well as other animal species (to measure species richness or diversity), would be monitored in both pools known to support the shrimp and pools where the shrimp were absent in Year 2001 surveys. During the aquatic phase of the pools, pole-mounted dip-nets can be used to sample the basins for tadpoles, ostracods, branchiopods and cladocerans. Representative species lists of plants should be recorded at each pool within 45 days of the dissipation of standing water. Permanent photo stations should be established for each of the pools and color images should be taken throughout the monitoring period in accordance with the following schedule:

- After the first heavy rain;
- After three weeks of standing water, or, if standing water is not present for this period continuously, after the wettest period of the season, to reveal mortality of upland plants;
- After storm events that generate greater than two (2) inches of precipitation;
- After water levels fall; and
- During the dormant season.

d. Management of Vernal Pools and Associated Species

Appendix J

The Adaptive Management Program for vernal pools and associated species includes three types of management activities:

1. Passive management
2. Active management
3. Experimental management

The general approaches to these three types of management are explained above in the discussion for coastal sage scrub in *Section 1.4.2*. The primary management approach for vernal pools in the RMV Open Space would be passive. These pools are unlikely to be exposed to the same "edge" disturbances characteristic of preserved pool complexes situated in close proximity to urban development, such as increased runoff, pesticides, trampling by the public, off-road vehicles, trash dumping, and pets and feral animals. The Chiquita Ridge pools are located in the Ladera Open Space approximately 1,000 feet east of the Ladera Ranch development. The Radio Tower Road pools are located approximately 1,000 feet west of planned development in Trampas Canyon and approximately 3,500 feet southeast of planned Ortega Gateway development. The Ladera, Trampas Canyon, and Ortega Gateway developments have no connection to the local contributing watersheds of the vernal pools and thus no direct, development-induced impacts on hydrology or water quality are anticipated. Furthermore, the vernal pools are located far enough away from development, that trespass by the public into vernal pools areas should be minimal.

For the Radio Tower Road pools, the primary management action would be timed-grazing to take advantage of grazing for exotic species control while protecting pools from impacts by cattle during the fairy shrimp reproductive season; i.e., from inundation to dehydration. During the 2001 fairy shrimp surveys these pools showed evidence of grazing impacts, including trampling and feces in the pools. Grazing prior to the onset of the rainy season would be allowed, but once significant rainfall occurs, pools would be protected by exclosures or by excluding cattle altogether from pastures supporting vernal pools until pools dry. The Grazing Management Plan provides more detail on the timing of grazing in relation to these vernal pools. Prescribed burning, in conjunction with grazing, also may be tested at these vernal pools if grazing alone does not appear to be effective in controlling exotics. Prescribed burning should be given a high priority as a supplemental or replacement management tool because, in combination with herbivory, it probably best emulates the natural disturbance regime in which vernal pool systems evolved (see Lis and Eggeman 2000 and Pollack and Kan 1998). Any areas of artichoke thistle would be treated with herbicides as part of the overall thistle control program on RMV.

Control of exotic plant species also would be a focus of active management at the Chiquita Ridge pools. Because cattle are excluded from this area and prescribed burning may not be feasible, mowing and selective weeding are two potential management actions to control exotic species at these sites.

Control of human activities may be needed at the Chiquita Ridge site because it is located in Ladera Open Space. The vernal pools should be identified as sensitive resources with interpretive signs that indicate prohibited activities within or in proximity to pools that could affect pool integrity, water quality or fairy shrimp reproduction (e.g., wading in pools, dog feces, etc.).

Control of human activities in the vicinity of the Radio Tower Road pools should be less problematic because the area would continue to be part of the private Ranch operation, but Ranch personnel should be made aware of the sensitive nature of the pools and procedures to avoid impacts.

1.5.2 Plant Identified Species

This section addresses adaptive management of the plant Identified Species presented in Table 1-14. Regional and subregional background information for these species is provided in the Species Accounts in the Draft NCCP Guidelines. It is important to note that the data base for the plant Identified Species on RMV property is comprehensive and reflects several survey efforts over the past decade. It is unlikely that additional *major* or *important populations* in *key locations* will be discovered on the RMV property, although small populations may still be discovered.

a. Adaptive Management Issues

The environmental stressor approach is applied to plant Identified Species in the same manner as to the major vegetation communities and associated focal species. Potential stressors for each of the plant species are identified in *Table 8-14.*

The main stressor of the plant species in the RMV Open Space is exotic plant species, which affect thread-leaved brodiaea, many-stemmed dudleya, southern tarplant, and Coulter's saltbush. The exotic plants that are most troublesome are artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, mustards, and wild radish. These exotic species directly displace the native species, disrupt native habitats, and compete for water and nutrients.

As noted in the stressor models for upland vegetation communities (Figures 3-7), the impact of exotic species can be exacerbated by drought, too frequent fire and over-grazing. Thus, the control of exotic species needs to consider the effects of these stressors as well.

TABLE 1-14
IDENTIFIED PLANT SPECIES

Species	Known or Potential Stressor(s)
Chaparral beargrass	• Too frequent fire (?)
Coulter's saltbush	• Non-native plants (wild radish and mustards) • Over-grazing
Many-stemmed dudleya	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, mustards) • Over-grazing • Human activities (hiking, mountain bikes, equestrian)
Salt spring checkerbloom	• Altered hydrology
Southern tarplant	• Non-native plants (wild radish and mustards) • Over-grazing
Thread-leaved brodiaea	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, mustards) • Over-grazing • Human activities (hiking, mountain bikes, equestrian)

Relatively little is known about stressors on chaparral beargrass and salt spring checkerbloom. As a chaparral species, it can be hypothesized that fire management would be important for chaparral beargrass, but no information is available on the relationship between fire intervals and this species. Likewise, little is known about potential stressors of salt spring checkerbloom. However, it only occurs in slope wetlands in the RMV Open Space and thus it is assumed that this species would be sensitive to changes in subsurface hydrology.

b. Adaptive Management Goals and Objectives

The overall goal for plant Identified Species is to maintain *major* and *important populations* of Identified Species in the RMV Open Space.

This overall goal would be addressed through the following management objectives:

- Conduct periodic monitoring of *major* and *important populations* of Identified Species in a manner that allows RMV to track the long-term status of the species in the RMV Open Space.

- Control invasions of herbaceous exotic species in areas supporting *major* and *important populations* of Identified Species.

- Manage grazing to avoid adverse impacts to, and to the extent feasible benefit, *major* and *important populations* of Identified Species.

- Manage fire to avoid adverse impacts to, and to the extent feasible benefit, of *major* and *important populations* of Identified Species.

- Maintain habitat to support plant dispersal and pollinators between *major* and *important populations* to the extent possible.

c. Monitoring, Management and Restoration of Plant Identified Species

The plant Identified Species management and monitoring program would focus on *major* and *important populations* because these areas by definition are considered to be important for the conservation of the species in the subregion (Southern NCCP/HCP Guidelines).

Permanent monitoring areas would be established for most species. Selection of sample areas for species with variable spatiotemporal distributions (e.g., southern tarplant), selection of monitoring sites would need to be flexible from survey to survey in order to track the status of the species. In areas where subpopulations of the total population are widely distributed (e.g., many-stemmed dudleya locations in Cristianitos Canyon), sample plots would be established in representative locations within the population. Where populations are relatively discrete and boundaries are definable (e.g., thread-leaved brodiaea on Chiquadora Ridge), the entire local population would be monitored.

The frequency and timing of plant surveys would need to be flexible in order to respond to varying environmental conditions. In general, monitoring should be conducted on a periodic basis and frequently enough to detect population trends; generally, species exhibiting high year-to-year variability need to be monitored more frequently than species with low variability to detect trends. Fairly intensive baseline monitoring of plant populations would be needed to establish the appropriate monitoring schedule. Site visits within a given survey season should be timed to coincide with peak production for the season, possibly requiring more than one site visit per season. Furthermore, because many plant species, and geophytes in particular, are highly opportunistic and responsive to weather conditions, flexibility in timing surveys over different years needs to be retained in the overall monitoring schemes to ensure that surveys capture the variability exhibited by the species, including both years with high and low productivity. Finally, timing of surveys for species known or possibly influenced by major disturbance events (e.g., southern tarplant by flood and chaparral beargrass by fire) should take advantage of these disturbance events to measure species responses.

Each of the plant Identified Species have different management and monitoring needs, and thus, are addressed separately below.

1. Thread-leaved Brodiaea

Thread-leaved brodiaea occurs in five discrete locations (Figure 16). Two of the five locations comprise *major populations* in *key locations*; the location supporting approximately 2,000 individuals on Chiquadora Ridge and the location supporting more than 6,100 individuals in the southern portion of Cristianitos Canyon. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, and mustards. Over-grazing also is a potential stressor for the Cristianitos Canyon population. Conserved areas also would need to be protected from human disturbance such as trampling (by hikers, mountains bikers and equestrians) and collection of flowers.

a) Monitoring

The monitoring of thread-leaved brodiaea would be focused on the two *major populations* since they account for approximately XX% of the counted individuals in the Habitat Reserve. Monitoring would use direct counts or estimates of flower stalks as the index of the population size. Typically there are many corms in the ground for every flower stalk, with an estimated potential range of 5-100 corms for every flowering stalk (pers. comms. Bomkamp and Elvin 2002). Because the two *major population* of brodiaea occur in two fairly discrete locations, complete counts or estimates to the nearest 100 flowering stalks in each location would be conducted.

The two locations would be monitored annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Annual monitoring over the first five years is important to establish baseline information on the variability of the populations in terms of number of flowering stalks produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by RMV in coordination with the Wildlife Agencies. If specific management actions (e.g., a prescribed burn) are implemented during the five-year period, it is anticipated that frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent threats to the population have been identified, less frequent monitoring may be warranted.

Monitoring would be conducted during the blooming period of this species, which typically is March to June. Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This would require at least three site visits during the blooming period – one each in the early, middle, and late portions of the season (e.g., March, April and May). As flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark counted/estimated individuals to avoid double counting.

In addition to direct counts or estimates of thread-leaved brodiaea flowering stalks, the presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, an example of which is provided here.

One-meter sample quadrats would be randomly established in each brodiaea population each year. The number of locations would be adequate to provide a representative sample of the area. The sampling methodology would consist of randomly tossing a 1-meter quadrant frame in front or to the side of the field monitor. Native and non-native vegetation cover would be estimated within the quadrat. A count of individual species would be made for each quarter quadrat in a clockwise pattern beginning in the lower left quarter. Individuals would be categorized by size class within one of the quadrat quarters, alternating in a clockwise pattern for each successive quadrat sample. In addition to the random quadrats, permanent photostations would be established through the area to document existing conditions during each survey period.

Additional data that would be recorded during each site visit include observations of pollinators such as sweat bees (Halictidae) and tumbling flower beetles (Mordellidae), soil conditions (e.g., surface disturbances, cracking, etc.), and other evidence of disturbance (e.g., deep hoof prints, human activities).

b) Management

The main stressor of thread-leaved brodiaea in the RMV Open Space is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by too frequent fire and over-grazing. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. A variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment. Timed-grazing and prescribed burns are the most efficient forms of exotics control, especially where non-native annual grasses such as bromes, wild oats and wild ryes are widespread and for which site-specific, selective manual treatments are not very effective. Herbicide treatment of artichoke thistle has been a successful control method on RMV. A potential limitation of timed-grazing as a management tool is that peak production of annual grasses on RMV coincides with the early growing season of thread-leaved brodiaea and the fleshy stalks are likely to be grazed before they have a chance to flower and set seed. Likewise, a prescribed burn in the spring would also burn stalks before they mature. Given that the locations being managed are by far the two largest populations in the Habitat Reserve, untested management actions that may depress productivity in these locations even temporarily may not be desirable.

The management recommendations for the two *major populations* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge population, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with the focus of grazing on the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. Grazing in this time period would allow the thread-leaved brodiaea on Chiquadora Ridge to bloom and set seed before cattle are introduced. Furthermore, because this location is within a few hundred feet of the eastern edge of planned development in lower Chiquita Canyon, it is unlikely that prescribed burns would be an acceptable management tool for exotic species (although occasional wildfires in the area may benefit the brodiaea over the long-term).

2. For the lower Cristianitos Canyon population, grazing may be a problem because cattle are in the area from October through May during the period of peak annual grass production and the period brodiaea are growing and flowering. Given that the existing population appears to be healthy under the existing grazing regimen, the benefits of grazing may outweigh the negative impacts. Removal of grazing from the area may allow exotics to proliferate, with a consequent net loss of the brodiaea population. It is recommended grazing continue in this area and that the population be monitored for the first five years of program to determine if grazing is in fact detrimental to the brodiaea population. If it is found that grazing has a net negative impact on the brodiaea, this area may be suitable for prescribed burns in the future because it is more remote from planned development. However, before any active management actions are undertaken, it is recommended that an experimental grazing/burn study, as described below, be carried out on smaller populations of brodiaea before being applied to this *major population*.

An experimental adaptive management study of grazing and prescribed burning should be conducted on the smaller populations of thread-leaved brodiaea in Cristianitos Canyon. Several questions could be addressed:

1. What is the effect of grazing on brodiaea during the growing season?

2. What is the effect of prescribed burns on brodiaea during the growing season?

3. What is the effect of combined burning and grazing (e.g., fall burn followed by winter/spring grazing)?

This experiment could be set up as a 2 x 2 factorial design with four combinations as set out in *Table 1-15*. For the grazed/burned site, a combination of fall burning to remove dead thatch and winter/spring grazing to control new annual growth/seed setting may be an effective double treatment to control invasives.

TABLE 1-15
SAMPLE EXPERIMENTAL TREATMENTS FOR
THREAD-LEAVED BRODIAEA ADAPTIVE MANAGEMENT

Treatments	**Burned**	**Unburned**
Grazed	Grazed/Burned	Grazed/Unburned
Ungrazed	Burned/Ungrazed	Control (Ungrazed/Unburned)

c) Restoration

Thread-leaved brodiaea, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, Sulphur Canyon, upper Cristianitos Canyon, Ladera Open Space adjacent to the Arroyo Trabuco Golf Course, and upper Gabino Canyon. Receiver sites should support clay soils suitable for brodiaea and should be placed in locations that maximize connectivity and genetic exchange; i.e., habitat areas accessible to pollinators from other locations. Details of the translocation approach are described in detail in the Plant Species Translocation, Propagation and Management Plan.

2. Chaparral Beargrass

Chaparral beargrass occurs in one location in the RMV Open Space comprised of five individuals in the eastern portion of the Talega sub-basin (Figure 16). Single individuals also have been recorded in non-reserve open space adjacent to the planned TRW development areas and in the Foothill-Trabuco Specific Plan area between Live Oak Canyon Road and Trabuco Oaks Road, but outside the Habitat Reserve. Because of the rarity of this species in the subregion, the population in the Talega sub-basin is considered an *important population* in a *key location*.

Very little information is available for chaparral beargrass from which to base a management program. The USFS identified protection of the species from frequent fire as a management issue, for example, but no scientific information is available on the relationship between the species and fire frequency to support this management approach.

The management and monitoring program for chaparral beargrass focuses on monitoring the population in the Talega sub-basin at three-year intervals following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. The initial monitoring survey would document the current status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Photostations would be established at the site. It is recommended that the site be visited at least every three (3) years during the blooming season (April-June) to assess reproductive activity of the plants. This species is an evergreen shrub and unlikely to exhibit significant year-to-year variation. If a fire occurs at the site, follow-up surveys should be conducted for at least five (5) consecutive years to determine the species' response to fire. New fires within the area should be suppressed to the extent feasible within this five-year period. If, based on a lack of new vegetative growth or flowering, the individuals do not appear to have recovered from the original fire within this five-year period, additional monitoring and possibly protection of this population from fire may be required beyond this period.

Management actions cannot be determined until more information about the species is collected. With only one population in the Habitat Reserve, experimental management actions are not recommended at this time.

3. Coulter's Saltbush

Coulter's saltbush occurs in three general locations in the RMV Open Space (Figure 16). A *major* and two *important populations* occur in Chiquita Canyon, an *important population* occurs in the upper Cristianitos Canyon, and an *important population* occurs in upper Gabino Canyon. This species occurs in alkaline soils, and in Chiquita Canyon is associated with southern tarplant, also an Identified Species.

Little information is available for this species to guide management. It is hypothesized that exotic species and trampling by cattle are likely to be the primary stressors of this species in the RMV Open Space and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish and mustards and/or by cattle grazing in the meadows adjacent to Chiquita Creek during the summer.

Because little is known about the variability of this species, the management and monitoring program for Coulter's saltbush focuses on monitoring the population in all three locations annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals whichever is later. These initial monitoring surveys would document the annual status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions (e.g., from cattle). Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Photostations would be established at each of the sites. The site should be visited during the blooming season (March-October) to assess reproductive activity of the plants. The frequency of surveys beyond the first five years with a given year would be determined by RMV in coordination with the Wildlife Agencies and would be based on the variability of the species and identified stressors.

If Coulter's saltbush is directly impacted, individuals, and associated soils to the extent feasible, should be experimentally translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange. Details of the translocation approach are described in detail in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

4. Many-stemmed Dudleya

Many-stemmed dudleya occurs in four general *key locations* in the RMV Open Space (Figure 17). Three of the four locations comprise *major populations* in *key locations*: the Chiquadora Ridge complex, the Cristianitos Canyon complex, and the middle/upper Gabino Canyon complex. Chiquita Ridge supports an *important population* in a *key location*. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, and mustards. Over-grazing also is a potential stressor on the Cristianitos Canyon and Gabino Canyon populations because grazing in the southern pastures coincides with the dudleya growing season. Conserved areas also would need to be protected from human disturbance by hikers, mountains bikers and equestrians.

Appendix J

a) Monitoring

The monitoring of many-stemmed dudleya would be conducted in the three *major populations* and one *important population* because XX% of the estimated individuals in the RMV Open Space occur in these four areas. Monitoring would use direct counts of observed individuals or estimates to the nearest 100 individuals as the index of the population size. Similar to thread-leaved brodiaea, it is likely that only a fraction of plants in a population bloom during any given year.

Each of the four general monitoring areas encompasses a relatively broad area and it would not be possible to conduct exhaustive counts of the populations. Representative sample plots would be selected at each of the four monitoring areas that reflect the general size, distribution and habitats within the population complex. An emphasis would be placed on selecting sample plots where potential stressors such as exotic species, over-grazing, and human activities could pose risks to the population.

The four locations would be monitored annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Annual monitoring over the first five years would establish baseline information on the variability of the populations in terms of number of flowering individuals produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by the reserve owner/managers in coordination with the RMA. If specific management actions (e.g., a prescribed burn) are implemented during the five-year period, it is anticipated that frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent threats to the population have been identified, less frequent monitoring may be warranted.

Monitoring would be conducted during the blooming period of this species, which typically is March to June. Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This likely would require at least three site visits during the blooming period – one each in the early, middle, and late portions of the portions of the season (e.g., March, April and May). As areas of flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark the areas of counted/estimated individuals to avoid double counting.

The presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, such as described above for thread-leaved brodiaea, as would general soil conditions (e.g., evidence of ground surface disturbances) and other evidence of disturbance.

b) Management

The main stressor of many-stemmed dudleya in the RMV Open Space is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by too frequent fire and over-grazing. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. As discussed above for thread-leaved brodiaea, a variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment.

Similar to thread-leaved brodiaea, the management recommendations for the three *major populations* and one *important population* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge and Chiquita Ridge populations, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with most grazing in the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. This grazing period would allow the many-stemmed dudleya in these two areas to bloom and set seed before cattle are introduced in the late spring. Furthermore, because these locations are relatively close to residential development in Ladera Ranch and lower Chiquita Canyon, it is unlikely that prescribed burns would be acceptable as a management tool (although occasional wildfires may benefit the many-stemmed dudleya over the long-term).

2. For the Cristianitos Canyon and middle/upper Gabino Canyon populations, grazing may be a problem because cattle are grazed in the area from October through May during the period of peak annual grass production and the dudleya growth period. Given that the existing populations appear to be healthy under the existing grazing regimen, the long-term benefits of grazing may outweigh the negative impacts. Removal of grazing from the areas may allow exotics to proliferate, with a consequent net loss of the dudleya population. It is recommended that these populations be monitored for the first five years of program to determine if grazing is in fact detrimental. If grazing is found to have a net negative impact on many-stemmed dudleya, these areas also may be suitable for prescribed burns because they are more remote from planned development.

d) Restoration

Translocation of many-stemmed dudleya has been demonstrated to be successful (e.g., the San Joaquin Hills Tollroad [SR-73]). Many-stemmed dudleya, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, upper Cristianitos Canyon, upper Gabino Canyon, and the Radio Tower Road area (although there are no documented locations along Radio Tower Road, the area supports clay soils that might be suitable for the dudleya). Receiver sites should support clay, cobbly loam and sandy clay loam soils suitable for many-stemmed dudleya, and should be areas that maximize connectivity and genetic exchange; i.e., habitat areas accessible to pollinators from other locations. Details of the translocation approach are presented in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

5. Salt Spring Checkerbloom

Salt spring checkerbloom occurs in two slope wetlands in the RMV Open Space in lower Chiquita Canyon (Figure 17). Both sites are *important populations* in *key locations*. The slope wetlands that support this species are perennially moist wetlands that are maintained by subsurface water movement (Slope Wetland Functional Assessment, PCR 2000).

Little information is available for this species to guide management. The most important factor for managing this species likely is maintaining slope wetland hydrology.

The management and monitoring program for salt spring checkerbloom focuses on monitoring populations at the two locations at a minimum three-year intervals following execution of the IA. The initial monitoring survey would document the current status of the populations and note general habitat conditions such as hydrological conditions, species composition, native/non-native ratio, any observable disturbance conditions, etc. Photostations would be established at each of the sites. It is recommended that the sites be visited at least every three (3) years during the blooming season (March-June) to assess reproductive activity of the plants.

6. Southern Tarplant

Southern tarplant occurs in two sub-basins in the RMV Open Space (Figure 17). Three population complexes occur in the Chiquita sub-basin, including two *major populations* and one *important* population. A *major population* also occurs in Gobernadora in the northern portion of GERA. This species occurs in alkaline wet meadow, and in Chiquita Canyon is associated with

Coulter's saltbush, also an Identified Species. Southern tarplant is well adapted to disturbance associated with flood events and even appears to benefit from occasional discing or other soil disturbing activities. Consistent with this association with disturbance events, southern tarplant populations appear to exhibit high spatiotemporal variation.

It is hypothesized that exotic species are likely to be the primary stressor of this species in the RMV Open Space and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish and mustards.

The management and monitoring program for southern tarplant focuses on monitoring the populations in both the Chiquita and Gobernadora sub-basins at a minimum three-year intervals following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Monitoring in years following major disturbance events such as floods also should conducted. The initial monitoring survey would document the current status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Because this species can occur in local populations of tens of thousands and direct counts are not feasible, population estimates to the nearest one thousand individuals would be based on area density estimates. Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Photographs would be taken during surveys, but the locations likely would be different each time because of the variable distribution of this species from year to year. It is recommended that the site be visited at least every three (3) years during the blooming season (May-November) to assess reproductive activity of the plants.

If southern tarplant is directly impacted by development, individuals, and associated soils to the extent feasible, should be translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange. Details of the translocation approach are presented in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

1.6 Adaptive Management Of Habitat Linkages And Wildlife Corridors

This section describes the approach to management and monitoring of key habitat linkages and wildlife corridors. Both avian and ground-dwelling species would be managed and monitored to ensure that the habitat linkages and wildlife corridors are functioning as designed.

Appendix J

a. Adaptive Management Issues

Maintaining functional habitat linkages and wildlife corridors both within the RMV Open Space and to habitat areas outside the Open Space (i.e., CNF, Camp Pendleton) will be essential for conserving landscape ecosystem processes, habitats and species in the subregion. In principle, human-related threats to habitat linkages and wildlife corridors are greater than to "interior" habitat blocks within the RMV Open Space because linkages corridors have a greater perimeter edge-to-area ratio than large habitat blocks (i.e., they tend to be longer and more narrow or have more edge variations), though this generally is not the case for stressors such as fire and altered geomorphology. Mostly as a result of proportionally greater edge area, potential stressors on functioning habitat linkages and wildlife corridors include:

- Disturbance and degradation of habitat quality such that the habitat linkage may no longer provide suitable "live-in" habitat for resident species (e.g., small native fauna) or that mobile species such as the larger mammals (mountain lion, bobcat, mule deer) no longer use corridors for movement or dispersal. Disturbance or degradation of habitat may include loss of protective cover that provides refugia for wildlife or invasion by exotic wildlife and plant species that displace native vegetation communities and native wildlife species.

- Higher levels of human disturbance such as illegal trails, off-road vehicles, trampling of vegetation, trash and garbage dumping, and accidental and deliberation ignitions of fires.

- Increased chance of vehicle collisions with wildlife where roads cross habitat linkages and movement corridors.

- Increased lighting and noise.

- Increased urban run-off.

b. Adaptive Management Goals and Objectives

The adaptive management goals for habitat linkages and wildlife corridors include the following:

- Maintain the function of key habitat linkages and wildlife corridors within the RMV Open Space

- Maintain the function of key habitat linkages and wildlife corridors that connect to important resources areas outside the study area, including the Casper's Regional Park, CNF and Camp Pendleton.

These broad goals would be achieved by meeting the following management and monitoring objectives:

- Monitor occupation and/or uses of identified key habitat linkages and wildlife corridors by the species identified as using or depending on these linkages and corridors.

- Maintain suitable habitat in the key habitat linkages and wildlife corridors for the species associated with the specific linkage/corridor.

- Identify and rectify constraints to use or movement (e.g., physical obstacles or bottlenecks) or sources of habitat disturbance or degradation in key habitat linkages and wildlife corridors.

- Implement the comprehensive Water Quality Management Plan addressing "Pollutants of Concern" and "Hydrologic Conditions of Concern."

c. Management of Habitat Linkages and Wildlife Corridors

Identified habitat linkages and wildlife corridors in the planning area are depicted in Figure 13. Identification of these linkage and corridor functions is based on field studies of wildlife movement in the planning area (e.g., Beier and Barrett 1993, DUDEK 1995; MBA 1996; Padley 1992), input from the Science Advisors and the wildlife agencies, and the consultant team's review and analysis of the species, vegetation, and physiographic information for the subregion.

The specific linkages and corridors and associated species recommended for monitoring are shown in *Table 1-16.* Theses linkages and corridors were selected because they are located in likely strategic areas for maintaining connectivity in the RMV Open Space and/or are likely to be the greatest risk of disturbance or degradation from nearby development and human activities. Some important habitat linkages shown in Figure 13 were not selected for monitoring because they are remotely located away from development and activity (e.g., Middle Gabino Canyon, La Paz Canyon, etc.). Other linkages/corridors may be added for monitoring in the future if conditions warrant. Likewise, linkages/corridors proposed for monitoring may be deleted in the future if the monitoring program demonstrates that they are functioning properly and that the risk of disturbance or degradation is low.

]

Appendix J

TABLE 1-16 PROPOSED HABITAT LINKAGE AND WILDLIFE CORRIDOR MONITORING LOCATIONS			
Habitat Linkage/Wildlife Corridor[1]	**Description and Function**	**Key Species[2]**	**Existing or Future Constraints/Threats**
			•
C	Habitat linkage along Chiquita Ridge and Chiquita Creek that connects San Juan Creek to "horseshoe" of habitat at northern end of Coto de Caza	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Oso Parkway
D	"Narrows" area separating middle and lower Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Road connection between Oso Parkway and Gobernadora development area
E	East-west wildlife corridor located north of wastewater treatment facility in Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	**TBD – will be issue if development occurs in north of treatment plant**
G	North-south habitat linkage along Chiquadora Ridge and Gobernadora Creek	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Road connection between Oso Parkway and Gobernadora development area
H	East-west habitat linkage between Chiquita Canyon and Wagon Wheel Canyon and Gobernadora to provide connection to Caspers Wilderness Park and north-south connection to San Juan Creek.	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat. North-south connection primarily for avian species such as California gnatcatcher and cactus wren	• Coto de Caza residential development north of linkage
I	East-west habitat linkage through Gobernadora south of Coto de Caza residential development connecting Chiquita Canyon and Caspers Wilderness Park	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat.	• Coto de Caza residential development north of linkage • Gobernadora residential development south of linkage
J	Habitat linkage along San Juan Creek that is central nexus for connecting to Bell, Verdugo, Gobernadora, Chiquita and Trampas canyons in the central portion of planning area.	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Ortega Highway; corrugated steel pipe near Radio Tower Road and concrete box culvert west of Cristianitos Road provide only undercrossings of Ortega Highway.
M	Habitat linkage between upper Gabino Canyon and Verdugo Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat, as well as cactus wren.	**TBD – will be issue if development occurs in upper Gabino**
N	Habitat linkage along Cristianitos	California gnatcatchers and large	**TBD – will be issue if**

TABLE 1-16 PROPOSED HABITAT LINKAGE AND WILDLIFE CORRIDOR MONITORING LOCATIONS			
Habitat Linkage/Wildlife Corridor[1]	**Description and Function**	**Key Species[2]**	**Existing or Future Constraints/Threats**
	Creek connecting San Juan Creek with drainages in San Mateo Watershed, including off-site lower Cristianitos and San Mateo creeks.	mammals such as mountain lion, mule deer, coyote and bobcat.	**development occurs in Cristianitos Canyon**
O	Habitat linkage along lower Gabino Creek connecting RMV Open Space to CNF.	Large mammals such as mountain lion, mule deer, coyote and bobcat, as well as cactus wren.	**TBD – will be issue if development occurs in Cristianitos Canyon and/or Blind Canyon/TRW**

[1] Based on habitat linkages and wildlife corridors depicted in Figure 13.
[2] The key species issues are those identified in Section 3.5 of Chapter 3.

The selection of specific monitoring sites within these general linkage and corridor areas would require additional field work in the early stages of implementing the Adaptive Management Program. Each potential site would be field-checked to identify potential movement routes of large species such as mountain lion, mule deer, coyote and bobcat, as well as potential "live-in" habitat for smaller species such as California gnatcatcher and cactus wren. Site security for long-term monitoring also is an important practical consideration because of the potential of vandalism and theft of monitoring equipment, or simply dense public activity that can interfere with reliable data collection (e.g., trampling of tracking areas). Short-term pilot studies may be required to document wildlife use and the long-term security of an area.

Generally following the methods used by Crooks and Jones (1998) for the Nature Reserve of Orange County, survey transects would be established at primary and critical habitat linkages and wildlife corridors expected to be used by these species. Mammals such coyote, bobcat, mountain lion, and mule deer would be monitored through standard tracking techniques and calculation of indices of occurrence most appropriate for the survey transect. Indices to be used may include scat counts, track counts, and remotely-triggered cameras. These indices allow for estimations of distribution, relative abundance, movement patterns and corridor use (Crooks and Jones 1998). Scat and track surveys are economic and reliable measures that can be used in a variety of settings. Remotely-triggered cameras are useful for long-term monitoring of wildlife movement with minimal manual labor and supervision, but should be established only where they can be effectively concealed and risk of theft is minimal. These indices cannot be used to estimate absolute abundance of individuals because many observations of a single individual cannot reliably be distinguished from observations of many individuals (unless an individual has a unique identifying feature such as a missing toe).

Other focal species also would be monitored sites using survey methods appropriate for the management question being asked at the site (see discussion above in *Section 1.4.2* for focal species monitoring). For example, simple presence/absence by a species at a site can be demonstrated through areas search or points counts. A more specific question regarding the long-term function of a habitat linkage may require more detailed information on breeding status and dispersal patterns through mist nesting or nest monitoring. For example, if the question is whether the habitat linkage is functioning to convey dispersing individuals, banding of fledglings may be necessary or intensive monitoring of habitat use within the linkage during dispersal may be required; if juveniles are observed using the habitat linkage it may be possible to infer that the linkage is an effective dispersal corridor. As another example, if there is a concern that a particular linkage or corridor is vulnerable to mesopredators or cowbird nest parasitism, monitoring of nest sites to assess reproductive success may be necessary.

Along focal species data, other variables that would be recorded at monitoring sites include presence of native and non-native mesopredators (e.g., raccoon, striped skunk, opossum, and domestic and feral dogs and cats), proximity to residential and commercial development, evidence of human activity (footprints, trash and garbage, off-road vehicles, mountain bikes, equestrian), amount of natural vegetation cover, substrate, and presence of noise and artificial lighting. At underpasses, bridges and culverts, the dimension of the structure would be determined and correlated with species use.

Based on the results of the monitoring program, if certain desired species are absent or uncommon at important habitat linkages or wildlife corridors in the RMV Open Space, appropriate management actions may be taken, including, but not limited to:

- Enhancement or restoration of the corridor with natural vegetation to provide additional cover.
- Placement of fencing to funnel wildlife to safe crossings and away from exposed roadways.
- Redirection or placement of lighting.
- Placement of sound walls or other methods of attenuating noise.
- Fencing or gating to control unauthorized human access and activities.

- Control of native and domestic mesopredators.

1.7 Fire Management Plan

The Fire Management Plan for the RMV Open Space provides details for meeting the following management objectives.

- Identify appropriate spatial scales and patterns for the long-term management of fire.

- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species.

- Quantify effects of varying fire regimes on selected wildlife species.

- Utilize prescribed fire to reduce unplanned fire events from known ignition corridors.

- Define fire prescriptions that aid in the restoration of degraded shrublands.

- Investigate active restoration techniques following fire treatments.

- Develop a social environment supportive of active fire management.

The Fire Management Program describes both tactical and strategic fire protection plans.

The Tactical Fire Suppression Plan is a stand alone plan that would be used by OCFA Field Officers as their wildland fire protection by specific fire management units (FMU). The tactical plan includes policies for bulldozer use, creation of new roads, backfiring, ground unit tactics, off-road use, road grading and erosion, water saturation, and fire prevention techniques. The tactical plan includes delineations of fire management compartments (FMC's) in the planning area, generally watersheds, and FMU's, which are sub-divisions of the FMC's. Within these FMC's and FMU's different tactical operational modes are identified, including "aggressive" (direct attack), "standard" (combination of direct and indirect attack) and "modified" (indirect attack – light on land concept).

The Strategic Fire Protection Plan is a subcomponent of the overall Adaptive Management Program. It addresses the relationship between fire protection and the appropriate role of fire in the RMV Open Space. The Strategic Fire Protection Plan identifies the structure on ignition sources (i.e., radiation, convection, firebrands [embers]) and determines the appropriate fire protection policies for each FMC and FMU in the context of the biological resources being managed and the fuel model classifications and expected fire behavior in the Habitat Reserve. Expected fire behavior depends on several variables, including fuel model (e.g., tall dense mature chaparral vs. short grass), slope percents, and weather conditions (e.g., wind speed and direction and humidity).

Based on these analyses, the Strategic Fire Protection Plan specifies fuel treatment options to protect both life and property and biological resources within each FMU. These include: determination of appropriate Fuel Modification Zones (e.g., irrigated zones and thinning zones); determination of appropriate setbacks from slope based on type of building materials, height of structure, fuel model and expected fire weather conditions; and establishment of short- and long-term fire protection planning criteria for new developments.

The Fire Management Program component of the Strategic Fire Protection Plan provides the detailed fire program for habitats such as coastal sage scrub, chaparral and native grassland, including programs for restoration sites for these habitats. This program considers the current understanding of fire ecology in the southern California ecosystem.

Finally, the Strategic Fire Protection Plan includes a validation and monitoring component, which is vitally important to the overall Adaptive Management Program. This component includes a monitoring approach (i.e., general tests and sampling methods) to evaluate and validate fire management actions or non-actions. The response of vegetation communities and wildlife species to wildfires, prescribed burns, and fuel treatments (e.g., mechanical crush and burn, hand labor fuel treatment and burn) are addressed.

1.8 Grazing Management Plan

1.8.1 Overview of Grazing Management Plan

A Grazing Management Plan was prepared for the RMV. General Policy 6 of the Southern NCCP/HCP Guidelines addressed grazing management as follows:

> *Cattle grazing shall be permitted within the Rancho Mission Viejo portion of the Habitat Reserve provided that grazing activities are consistent with a "grazing management plan" approved as part of the certified NCCP/HCP.*

Rancho Mission Viejo has grazed cattle on the property since 1882. Since that time, RMV has practiced a rotational grazing pattern that takes into consideration available water and forage and the goal of maintaining an average of 25 percent residual dry matter (RDM) for natural grass pastures (i.e., pastures not planted in a forage crop such as barley). In turn, available water, forage and RDM dictate the stocking levels of the RDM pastures.

The Grazing Management Plan reviews the literature on grazing as it affects native valley and foothill grasslands. In brief, it has been suggested that grazing by large herbivores has been an important factor in the evolution of native grasses in California (e.g., Heady 1968, 1977). While cattle are not a native herbivore, and over-grazing clearly can damage the grassland ecosystem, timed grazing can be a useful part of a native grassland restoration and management program (Menke1996). Some of the beneficial effects of timed grazing include:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available fpr native grasses.

1.8.2 Goals and Objectives

The broad goals of the Grazing Management Plan are as follows:

- Identify suitable grazing areas and allowable grazing practices that are consistent with NCCP/HCP policies and the aquatic resource management plan.

- Incorporate grazing management techniques (e.g., timed grazing) to address the needs of species and habitat identified for protection, promote native grasses, and allow for continued cattle grazing sufficient to support cattle operations, and where appropriate, reduce fuel loads for fire.

- Within the upper subunit of the Gabino sub-basin, protect the headwaters through restoration of existing gullies using a combination of slope stabilization, grazing management, and native grassland and/or coastal sage scrub restoration. Grazing management would be modified in this headwater area to support restoration and vegetation management.

To achieve these goals, eight objectives of the Grazing Management Plan are to:

1. Establish a minimum residual dry matter (RDM) per acre for active existing pastures and adjust as necessary to accommodate changes in pasture configuration and stocking levels.

2. Identify interim and long-term changes to existing pasture configurations and stocking levels to maximize use of available forage and facilitate restoration and management of native vegetation communities.

3. Identify a timed rotational grazing scheme to maximize use of available forage and facilitate restoration and management of native vegetation communities.

4. Identify sensitive resource areas where cattle grazing shall be excluded seasonally or permanently.

5. Identify additional facilities required to promote better distribution of cattle within pastures (e.g., water sources, shade, supplemental feed/nutritional blocks).

6. Outline methods (e.g., exclosures) for monitoring forage levels in order to assess range conditions and provide guidance for the introduction and removal of cattle.

7. Identify pastures that may be appropriate for prescribed fire. Identify appropriate pasture rest periods following prescribed and wildfire burns to promote vegetation recovery.

8. Outline procedures for re-evaluating grazing management practices every 3 to 5 years to ensure that existing practices are achieving desired results.

1.8.3 General Description

The Grazing Management Plan includes a description of the pastures on RMV in terms of existing environmental conditions (vegetation communities and species) and current grazing status, including stocking levels, timing and rotational practices, estimates of RDM for different pastures and goal RDM values (e.g., 25% as a minimum standard for pastures with natural forage).

The Grazing Management Plan describes future grazing strategies designed to meet the goals and objectives stated above. These future strategies include:

- Recommended RDM parameters for each active pasture, taking into consideration rainfall patterns, soils and slopes.

- Recommended stocking rates to achieve the recommended RDM based on projected annual forage per pasture and using Animal Unit (AU) as the standard measurement of livestock forage requirements (UC Extension Leaflet 21456).

- Recommended timed grazing patterns for specific areas of the Ranch, depending on the resource issues (e.g., native grassland restoration in upper Cristianitos).

- Sensitive habitat exclusions to protect important resources, including both permanent and seasonal exclusions.

1.9 Habitat Restoration Plan

1.9.1 Overview of Habitat Restoration Plan

The Habitat Restoration Plan is a key component of the overall Adaptive Management Program for the RMV Open Space. It describes the spectrum of possible upland and riparian/wetland restoration activities within the RMV Open Space and in areas subject to the aquatic resource management plan. The term "restoration" is used very broadly in this plan and covers a range of activities from enhancement of existing degraded habitats to creation of new habitats. The restoration activities described in this plan would be undertaken in accordance with Wildlife Agency approved restoration plans .

The Habitat Restoration Plan identifies several restoration areas on the basis of their important location and function in the RMV Open Space. The overall goal of restoration in these areas is contribute to and help maintain *net habitat value* in the RMV Open Space on a *long-term* basis for Identified Species that receive regulatory coverage under Section 10.

1.9.2 Upland Habitat Restoration Areas

Several areas were identified for coastal sage scrub (CSS) and valley needlegrass grassland (VGL):

- CSS restoration in Sulphur Canyon elsewhere along Chiquadora Ridge in the Gobernadora sub-basin;
- CSS and VGL restoration along Chiquita Ridge in the Chiquita sub-basin;
- VGL restoration in the upper Cristianitos sub-basin and portions of Blind Canyon Mesa in the Gabino and Blind Canyons sub-basin; and
- CSS/VGL restoration in upper Gabino Canyon sub-basin; and
- CSS/VGL restoration in the Chiquita Canyon sub-basin.

1.9.3 Riparian/wetland Restoration Areas

Areas identified for riparian/wetland restoration includeconsist of the following:

- Gobernadora Creek to address historic meander condition and excessive sediment resulting from upstream land uses;
- Creation of breeding habitats in Gobernadora Creek for tricolored blackbird, least Bell's vireo, southwestern willow flycatcher and other riparian species;
- Upper Gabino Creek to address erosion and excessive sediment generation (this restoration program would occur in combination with upland CSS/VGL restoraion); and
- Chiquita Creek and upper Cristianitos to address locally-induced headcuts.

Although not specifically part of the riparian/wetland restoration plan discussed here, additional riparian/wetland areas have been identified for enhancement through control of invasive species such as giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), pampas grass (*Cortaderia selloana*), castor bean (*Ricinus communis*), and tree tobacco (*Nicotiana glauca*). Major targeted areas include San Juan Creek, Arroyo Trabuco Creek and lower Cristianitos Creek. Details of this program are provided in *Section 8.10* below and in the Invasive Species Control Plan.

1.9.4 Approaches to Restoration

As indicated above, the term "restoration" is used in the broad sense to refer to the spectrum of restoration activities to be conducted in the RMV Open Space. Restoration activities may be passive or active, depending on the needs and/or response of a site to restoration.

Passive Restoration generally refers to removing or controlling disturbance events such as discing that perpetuate non-native or disturbed habitats. Passive restoration may involve some site preparation and maintenance such as weed control, and trash and debris removal, but generally the site would be allowed to revegetate naturally without extensive intervention. Some initial seeding may be used if the natural seed bank onsite is inadequate. Passive restoration sites would be monitored, and if the site is not meeting performance standards by a designated period, active restoration may be applied.

Active Restoration broadly refers to the specific application of restoration techniques. On a large scale (e.g., 10s to 100s of acres), active restoration techniques may include timed grazing or prescribed burning. On a smaller scale (e.g., a few acres or less), active restoration may include site-intensive techniques such as soil preparation, planting and/or seeding, irrigation, weed control, erosion control, etc. Active restoration implies a higher level of effort than passive restoration and typically is used on sites that would not regenerate naturally, or would only regenerate over an unacceptably long period of time without direct intervention. For example, a mitigation requirement that a site meet certain performance standards such as percent native plant cover or species occupation within five years probably would require active restoration to ensure that the performance standards were met.

Along with passive and active restoration, it is important to distinguish between enhancement and revegetation activities

Enhancement generally refers to restoration of sites that support degraded forms of the target native vegetation community. The level of effort needed to enhance a site typically is less than revegetating a site because the target native community is already present. A primary enhancement approach in the RMV Open Space where low quality native habitat is already present would include timed grazing and prescribed burning to control non-native invasive grasses and weeds. Seeding may be used to supplement the existing native vegetation, but planting of container plants and irrigation generally are not used on enhancement sites. Enhancement tends to be more passive, letting nature take its course.

Revegetation involves active restoration of a site whereby container plants and/or seeds are used to create or restore habitat. Typically the target native vegetation community is absent from the site; e.g., a site supporting non-native annual grasslands revegetated with VGL. Site preparation and maintenance may include annual grass and weed control, and trash and debris removal. Depending on site conditions, soil remediation and/or irrigation may be necessary to support a viable revegetation site. Generally, revegetation sites would have higher performance standards than passively restored sites and the monitoring and maintenance program is more specific as far as the responsibilities of the Restoration Ecologist and the Installation/Maintenance Contactor.

In practice, there often is not a clear distinction between active and passive restoration, revegetation and enhancement because each site has its own distinct requirements for successful restoration. The Restoration Ecologist and reserve owner/manager would have the flexibility to implement the appropriate restoration techniques in an adaptive fashion to produce the desired results in the most efficient manner. However, specific performance standards would be set for each restoration site so that success can be objectively measured.
.

1.9.5 Components of Specific Restoration Plans

A detailed restoration plan would be prepared for each restoration site. The appropriate restoration approach would be taken, and may include, but not be limited to:

- Removal or control of the disturbing event
- Specific site preparation such as weeding or trash and debris removal
- Prescribed burning
- Timed grazing
- Active revegetation, including site preparation, seeding and/or container plant installation, and monitoring

For each site, a set of success criteria would be established to measure whether the restoration project has achieved the desired result. Depending on the type or size restoration project the success criteria may be qualitative or quantitative. For example, for a large passive CSS restoration area, success criteria may be as simple as measuring a consistent increasing trend of percent cover of CSS shrub species and concomitant decline in non-native invasive species such as black mustard or artichoke thistle. For a smaller active revegetation area, specific quantitative performance criteria can be set, such as X percent cover of weedy species after 1, 2, 3, 4 and 5 years. Active revegetation projects also typically specify plant palettes, planting techniques, seed application, irrigation systems and schedules (if necessary), weed control, erosion control, pest control, other maintenance activities, and monitoring and data collection methods.

8.10 **Invasive Species Control Plan**

1.10.1 Overview of Invasive Species Control Plan

An Invasive Species Control Plan was prepared to address the existing and foreseeable impacts of invasive plant and animal species on the RMV Open Space. This Plan provides the long-term management guidelines for the control of invasive species on RMV. The objectives of the Invasive Species Control Plan are to:

- Census and map invasive plants and introduced vertebrate predators on RMV.
- Review the ecology and habitat requirements of invasive species targeted control.
- Provide an overview of species-specific and density-dependent control methods.
- Analyze the impacts and benefits of the Plan on focal species and habitats.

The Invasive Species Control Plan is comprised of three main components: (1) invasive plants; (2) invasive invertebrates; and (3) invasive vertebrates.

1.10.2 Invasive Plant Species

The invasive plant species targeted for control include several riparian species and one upland species. The riparian invasive plants along with their priority rankings are:

Riparian Species

- Giant reed (*Arundo donax*) – Priority 1

- Pampas grass (*Cortaderia selloana*) – Priority 2
- Castor bean (*Ricinus communis*) – Priority 2
- Tamarisk (*Tamarix ramosissima*) – Priority 3
- Tree tobacco (*Nicotiana glauca*) – Priority 3
- Spanish sunflower (*Pulicaria paludosa*) – Priority 3

The upland plant species targeted for control is artichoke thistle (*Cynara cardunculus*).

For the riparian invasive species, several control methods can be used:
- Manual
- Foliar spray
- Cut stem/stump spray
- Cut, resprout and spray
- Mechanical

Each of these methods has advantages and disadvantages, and application, timing and equipment considerations. The selection of treatment method would depend on site-specific characteristics. For example, in large monotypic areas with minimal other sensitive resource present, mechanical removal with heavy equipment may be the most effective and efficient control technique. On the other hand, in areas with sensitive resources (e.g., arroyo toad breeding habitat), a more "surgical" method such as manual removal (i.e., hand pulling, digging with a shovel, or using a pick-ax, loppers or machete) may be more appropriate.

The control of artichoke thistle has been an ongoing program on RMV property and the problem is much less severe on the Ranch compared to other untreated areas of southern Orange County. While mechanical removal of this species in possible, the most effective treatment is the use of herbicides.

1.10.3 Invasive Invertebrate Species

Two invasive invertebrate species are targeted for control: Argentine ant (*Linepithema humile*) and red imported fire ant (*Solenopsis invicta*). Both species pose direct and indirect threats to native species, including direct predation of native vertebrates and competition/displacement of important invertebrate prey of native species.

The Invasive Species Control Plan acknowledges that eradication of either Argentine or red imported fire ants is not feasible or practical because of their ubiquity in southern California and their ability to colonize new areas. The goal of the program would be to control their populations and prevent their spread into new areas of the RMV Open Space. Control methods would include:

- Managing the urban-RMV Open Space interface to minimize opportunities for colonization (e.g., by controlling moisture).
- Direct nest/mound treatments with insecticides.
- Broadcast applications of insecticides.

The direct nest/mound and broadcast insecticide treatments would be used with great caution in areas of the RMV Open Space in consideration of the inadvertent impacts on sensitive species and habitats as well as other non-target, native invertebrate species.

1.10.4 Invasive Vertebrate Species

The vertebrate control component of the Invasive Species Control Plan addresses four invasive species:

- Bullfrog (*Rana catesbeiana*)
- Crayfish ((*Procambrus* spp.)
- Brown-headed cowbird (*Molothrus ater*)
- European starling (*Sturnus vulgaris*)

a. Bullfrog

Bullfrogs may be the most pernicious invasive animal in the RMV Open Space. They have a voracious appetite that includes almost any living thing, including other amphibians, arthropods, fish, snakes, birds, and small mammals (including bats). Bullfrogs have few natural predators and have explosive reproductive potential, producing up to 20,000 eggs per female per year. Bullfrog impacts appear to be a significant factor in the decline of native amphibian populations in much of western North America, including the endangered arroyo toad. Most of the ponds, lakes and creeks on RMV support populations of the bullfrog, although some may be too ephemeral to support successful reproduction.

The bullfrog control program would take a watershed approach, as opposed to a pond-by-pond approach, because there may be extensive movement among ponds. Unless source populations in the larger waterbodies are controlled, bullfrogs would continue to be a significant problem in the Habitat Reserve. Control methods would be site-specific and field experiments would be conducted to determine the most effective and cost-efficient control method for a particular site. Potential control methods, ranging from broad approaches to more labor-intensive specific methods, include:

- Pond draining and then killing all bullfrogs left behind, including those burrowing in banks.
- Fencing to prevent movement from the pond areas as it dries and recolonization of the pond.
- Gill netting, seining, and/or sifting water for eggs.
- Shooting and gigging (spearing or hooking)

Public awareness and education also would be an important part of the bullfrog control program. Signs and posting warning of the risks of invasive plants and animals would be placed in key areas at risk for reintroductions of the bullfrog.

b. Crayfish

Crayfish (*Cambarus* spp.) are recognized predators of amphibian eggs and their larvae and thus can contribute to population declines. The arroyo toad and crayfish evolved independently of each other, suggesting that arroyo toad larvae may be considerably more vulnerable to crayfish than bullfrog tadpoles, which share the same historic distribution with crayfish and thus have a linked evolutionary history (i.e., a co-evolved predator-prey relationship). Arroyo toad tadpoles, being relatively small detrital feeders, are more vulnerable to crayfish predation than the huge algal feeding bullfrog larvae.

Rancho Mission Viejo has two species of crayfish: the widely distributed *C. clarkii* and another relatively recent arrival whose species identity currently is unknown. *C. clarkia* is common in San Juan Creek and portions of Gobernadora Creek Both species are abundant in San Juan Creek, and on some reaches are actually super abundant with 3-4 crayfish/sq. m being standard for certain 100-m reaches of creek. *C. clarkii* seems to be the more abundant of the two species overall on RMV. The source of the Gobernadora Creek population may be from upstream areas of Coto de Caza, which has perennial ponds within golf course areas from which crayfish may be washed downstream. Control of this source would be important as it provides a source to invade areas of San Juan Creek subject to ongoing crayfish control.

Arroyo toad breeding distribution in the San Juan Creek Watershed probably is affected by the presence of crayfish in San Juan Creek, and possibly in Gobernadora Creek. Any future detailed survey of arroyo toad populations in San Juan Creek should also survey for the presence of crayfish. Potential control methods for crayfish would be similar to those described above for the bullfrog.

c. Brown-headed Cowbird and European Starling

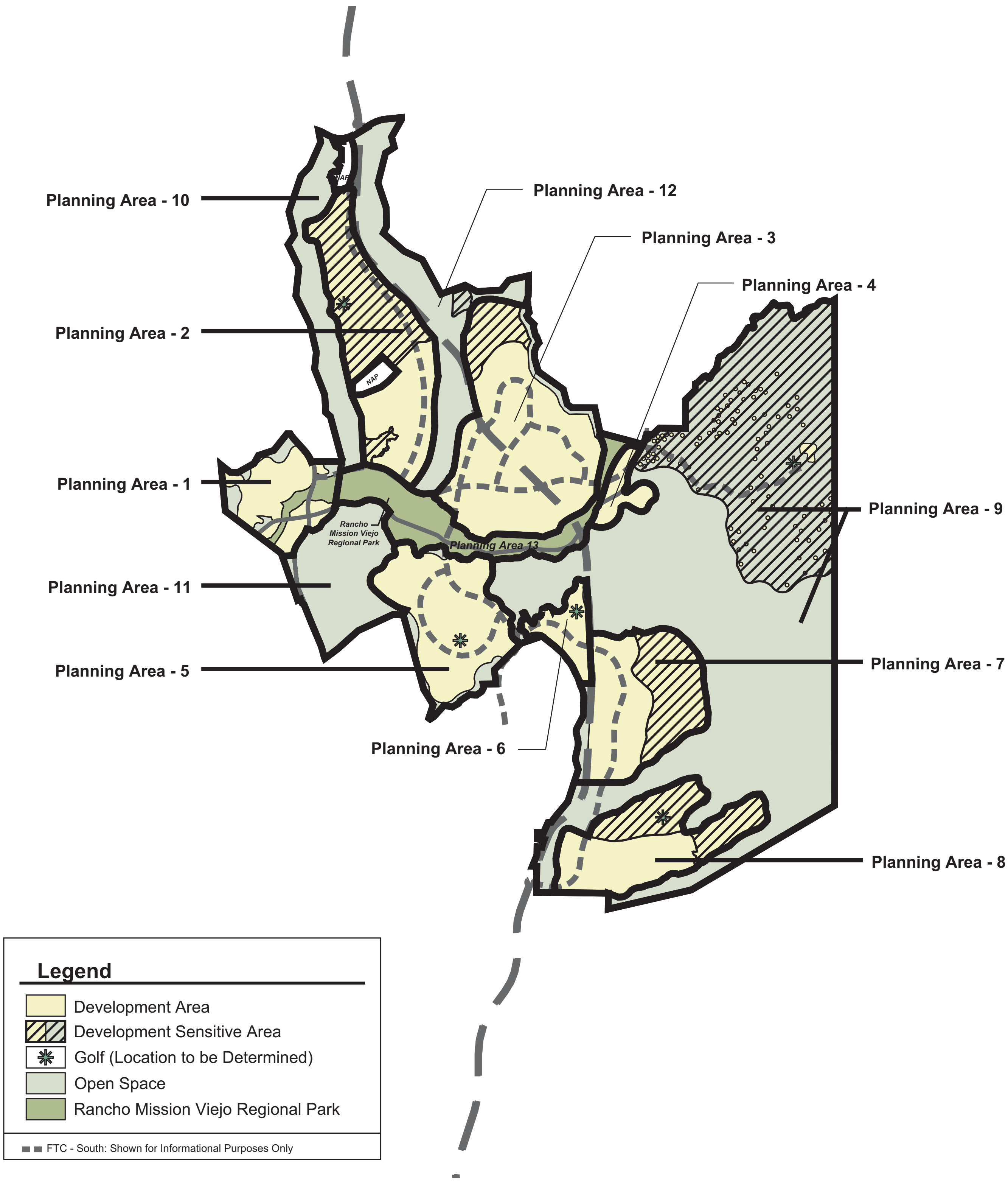
Brown-headed cowbirds are native to the central plains of North America where they co-evolved with bison. The cowbird's range has expanded to the west with the increase in cattle grazing and irrigated agriculture. As a nest parasite, they now pose a serious threat to native passerine species, and were implicated in the decline of the least Bell's vireo.

The European starling is a non-native species that only arrived in California in the early 1940's. The starling is a secondary cavity nester that usurps nests built by woodpeckers and used by other secondary nesters such as the ash-throated flycatcher. They are an aggressive species that has successfully outcompeted native species. Starlings occur throughout the RMV property, but are particularly common around Cow Camp along San Juan Creek, where they are concentrated in western sycamores and man-made structures.

Brown-head cowbirds and starlings would be controlled by strategically placing Australian cowbird traps in areas where these species are a problem for native host species (e.g., vireos and gnatcatchers for the cowbird and acorn woodpeckers for the starling). The effectiveness of the trapping program would be evaluated annually and trap locations the trapping effort would be adjusted. In addition for starlings, management may include the placement of species-specific nest boxes that are not accessible to starlings (e.g., small holes) or the use of mist-netting where starling populations are particularly dense (e.g., Cow Camp).

1.11 Interim Protection of Habitat Values on Lands Within the Proposed RMV Open Space

It will require several years to assemble the entire RMV Open Space area following execution of the Development Agreement and obtaining necessary Wildlife Agency approvals. Therefore, to the extent feasible, RMV will take the steps necessary to assure that lands designated for inclusion in the Open Space system are not degraded in a way that results in a net loss of habitat value prior to their inclusion in the RMV Open Space. Accordingly, during the interim period prior to inclusion of lands in the Open Space, RMV shall not develop or otherwise permit uses within the Open Space area that would significantly degrade biological values with the proposed RMV Open Space.



Planned Community Development Map

Figure 1

RMV Adaptive Management Plan

N W E S

Source: EDAW, Inc. 2003

S:/GIS_Exhibits/RMVJ008/Ex1_RMV_AMP_050604.pdf

ADAPTIVE MANAGEMENT FLOWCHART

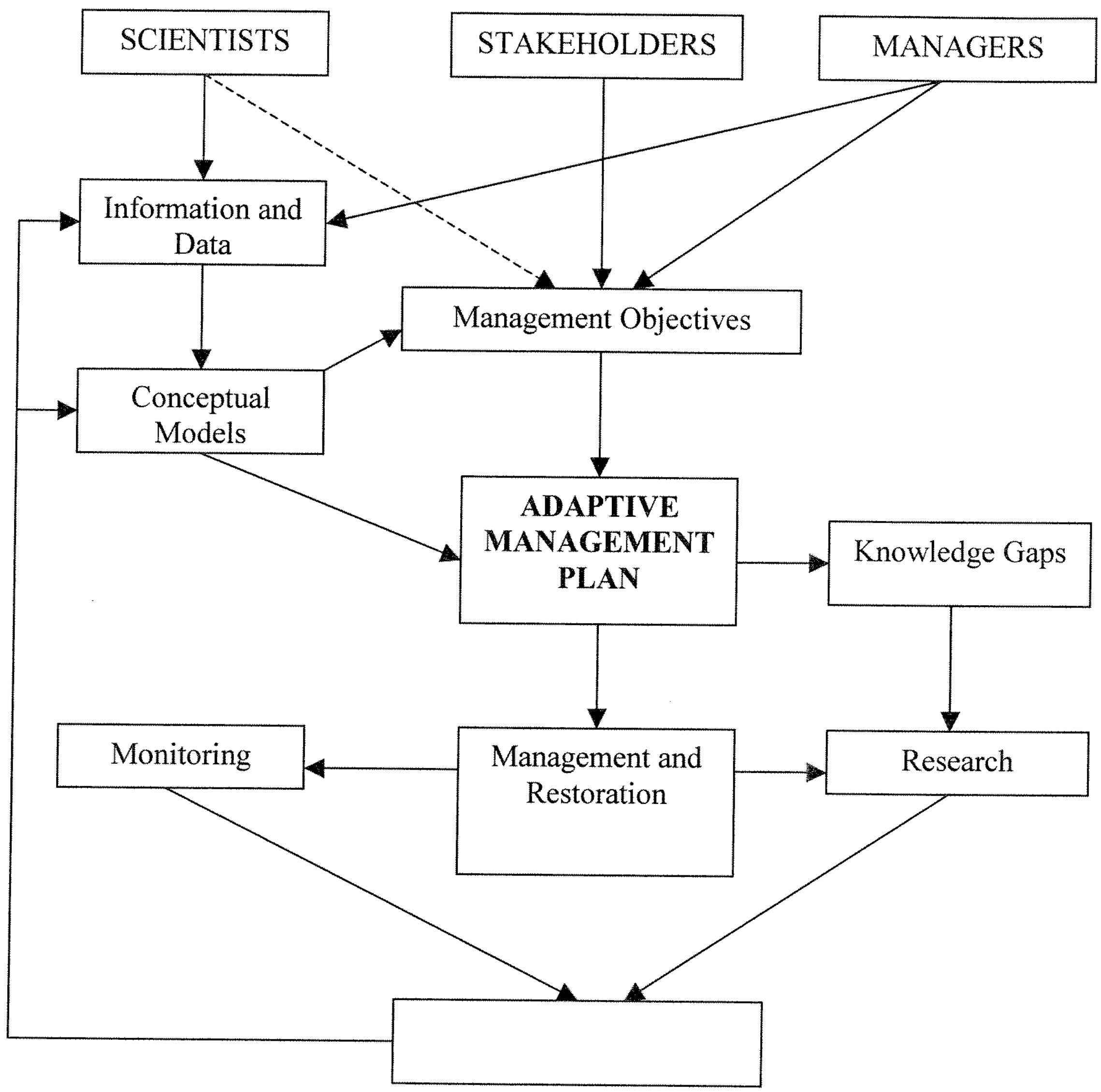


Figure 2

Source: Southern Orange County NCCP Science Advisors. 1997. Principles of Adaptive Management for the Southern Orange County NCCP.

COASTAL SAGE SCRUB GENERAL STRESSOR MODEL

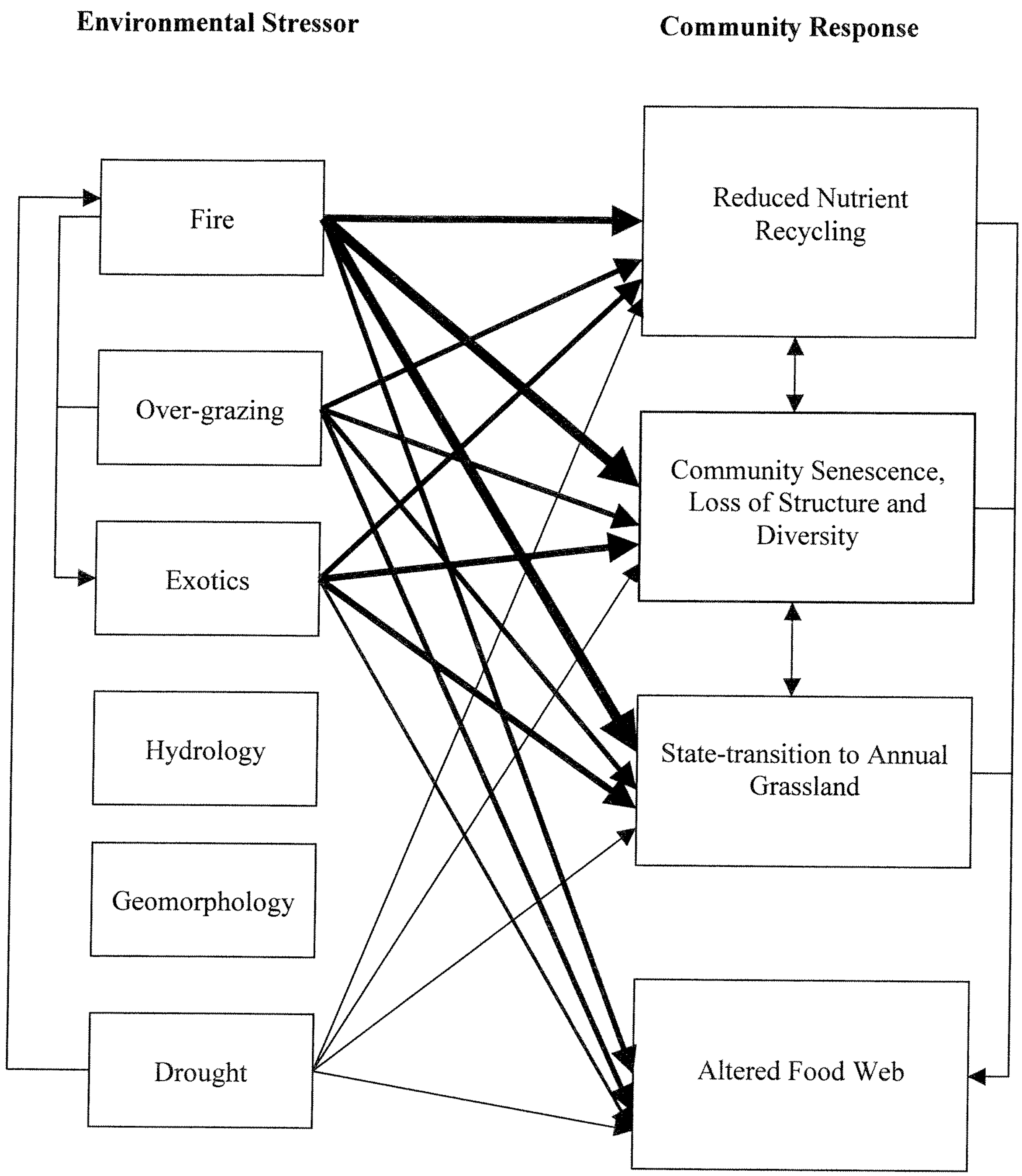


Figure 3

CHAPARRAL GENERAL STRESSOR MODEL

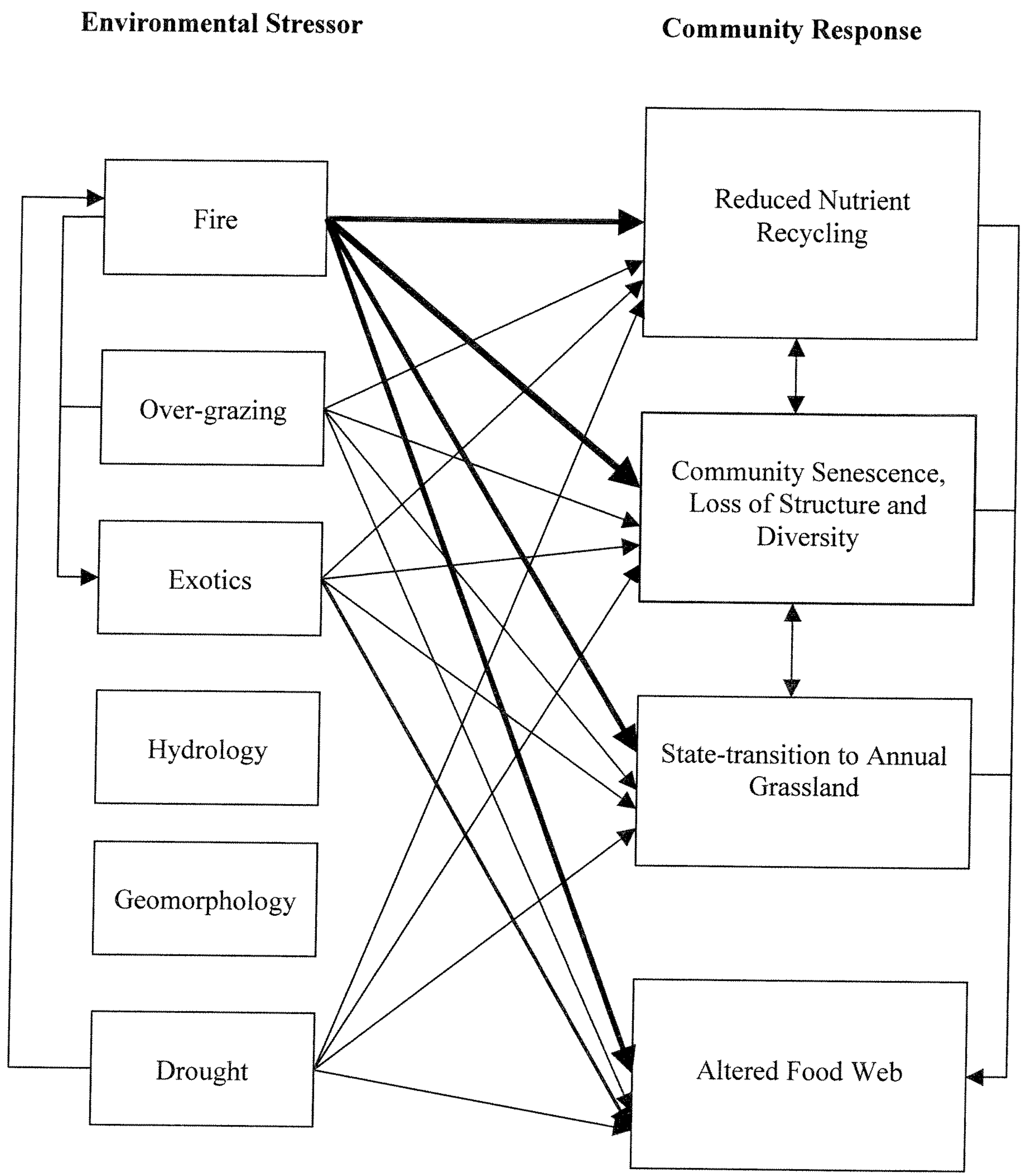


Figure 4

NATIVE GRASSLAND GENERAL STRESSOR MODEL

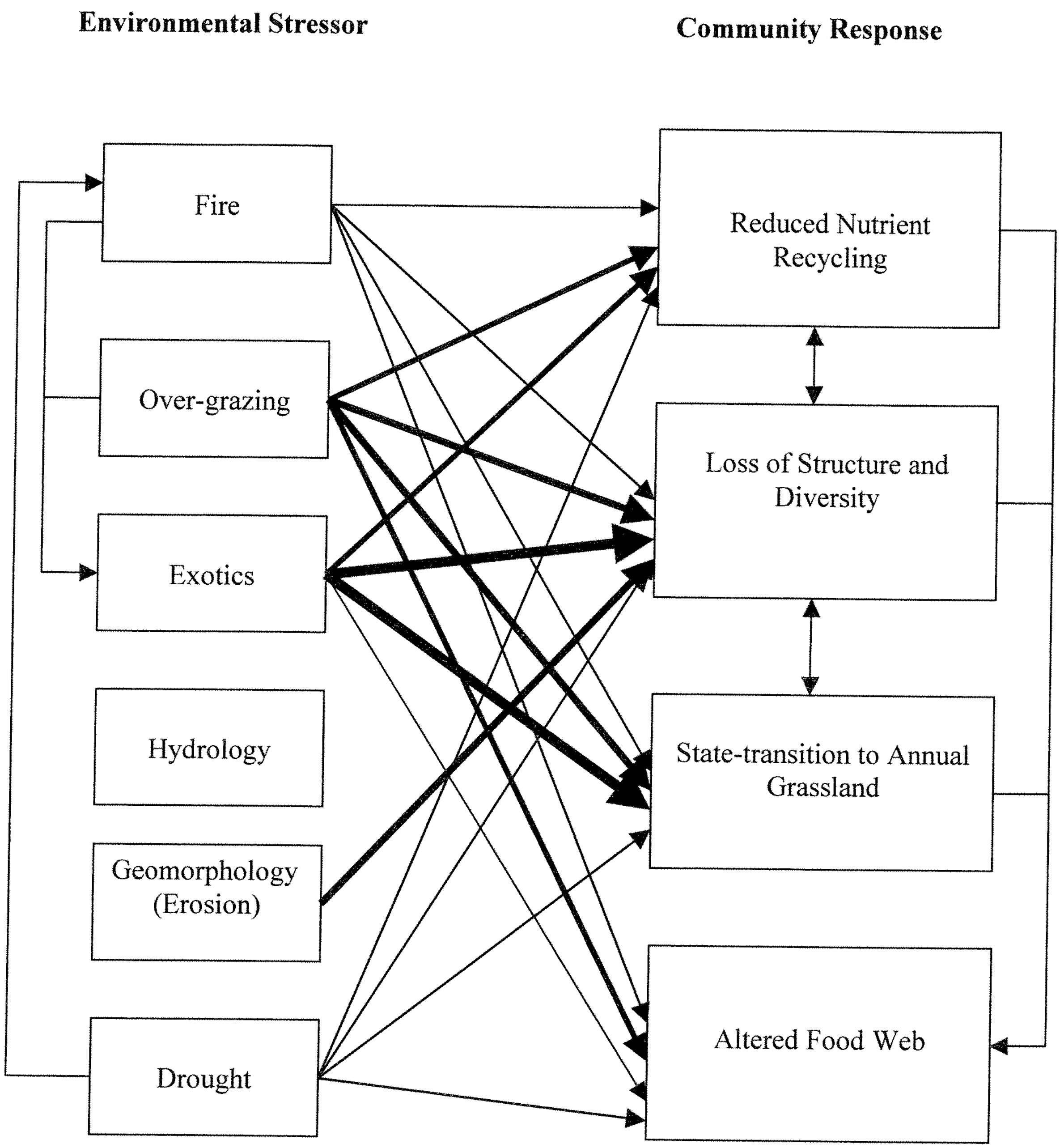


Figure 5

OAK WOODLAND GENERAL STRESSOR MODEL

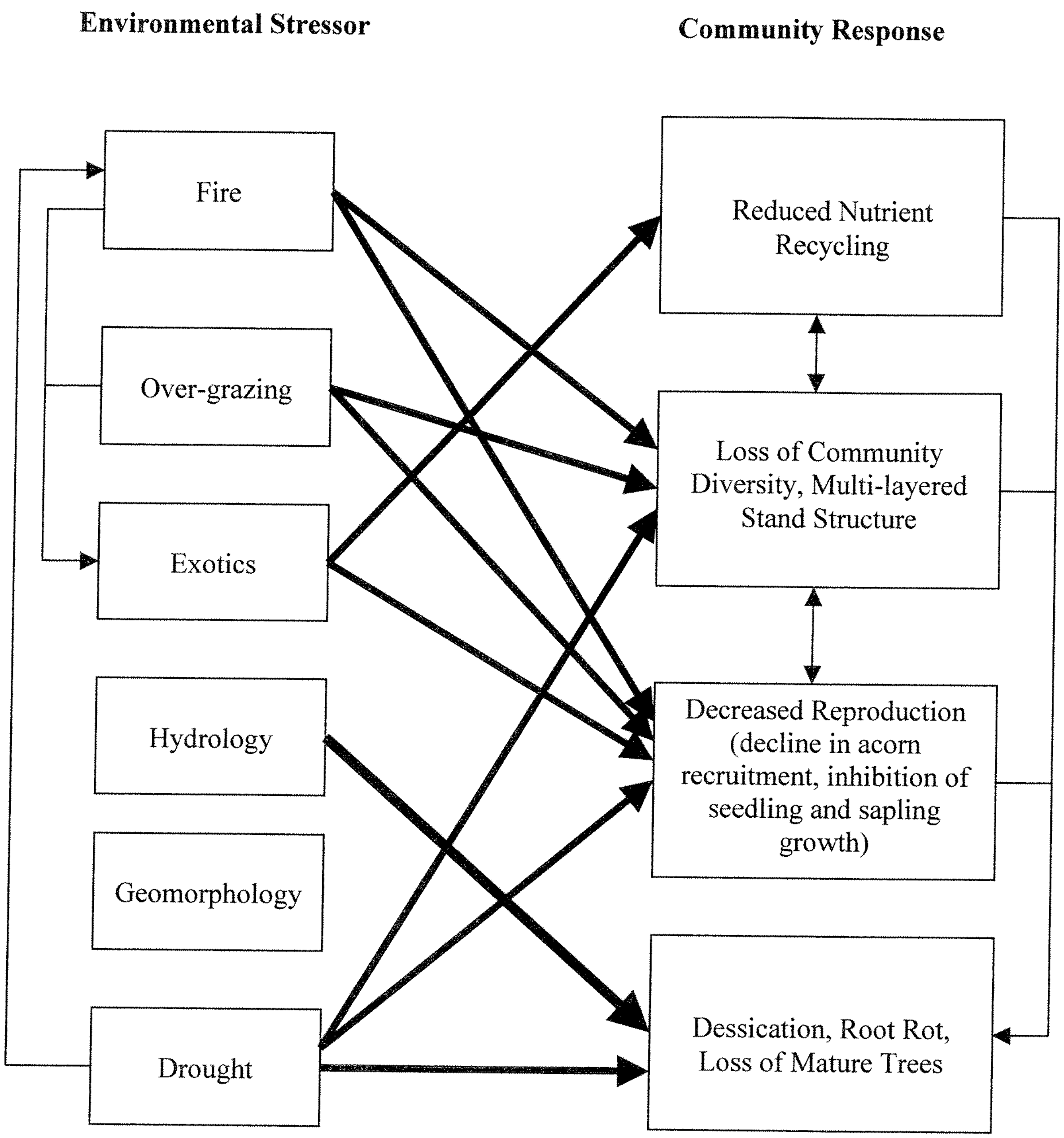


Figure 6

RIPARIAN/WETLAND GENERAL STRESSOR MODEL

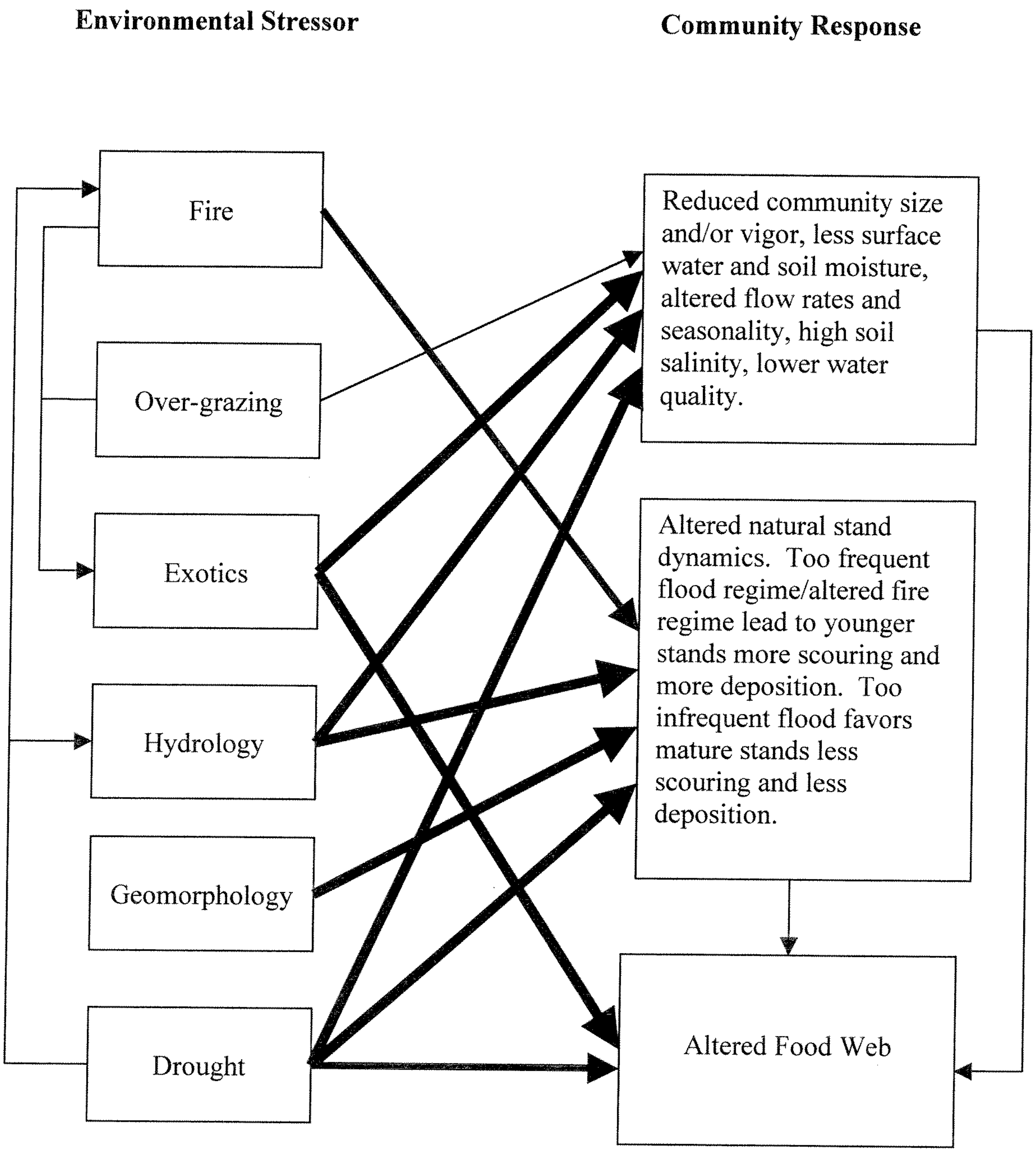


Figure 7

Figure 8. COASTAL SAGE SCRUB FOCAL SPECIES STRESSOR MODEL

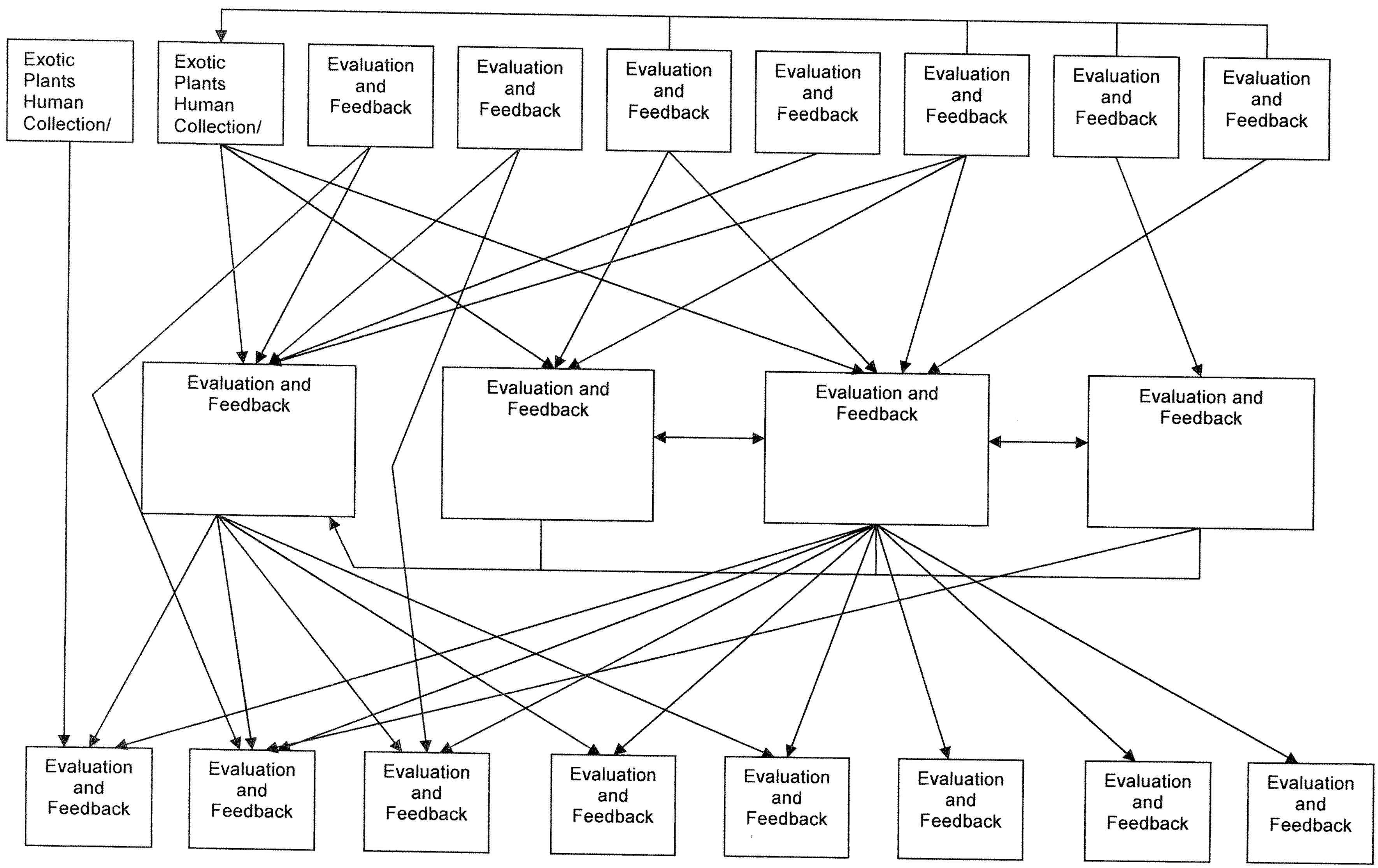


Figure 9. CHAPARRAL FOCAL SPECIES STRESSOR MODEL

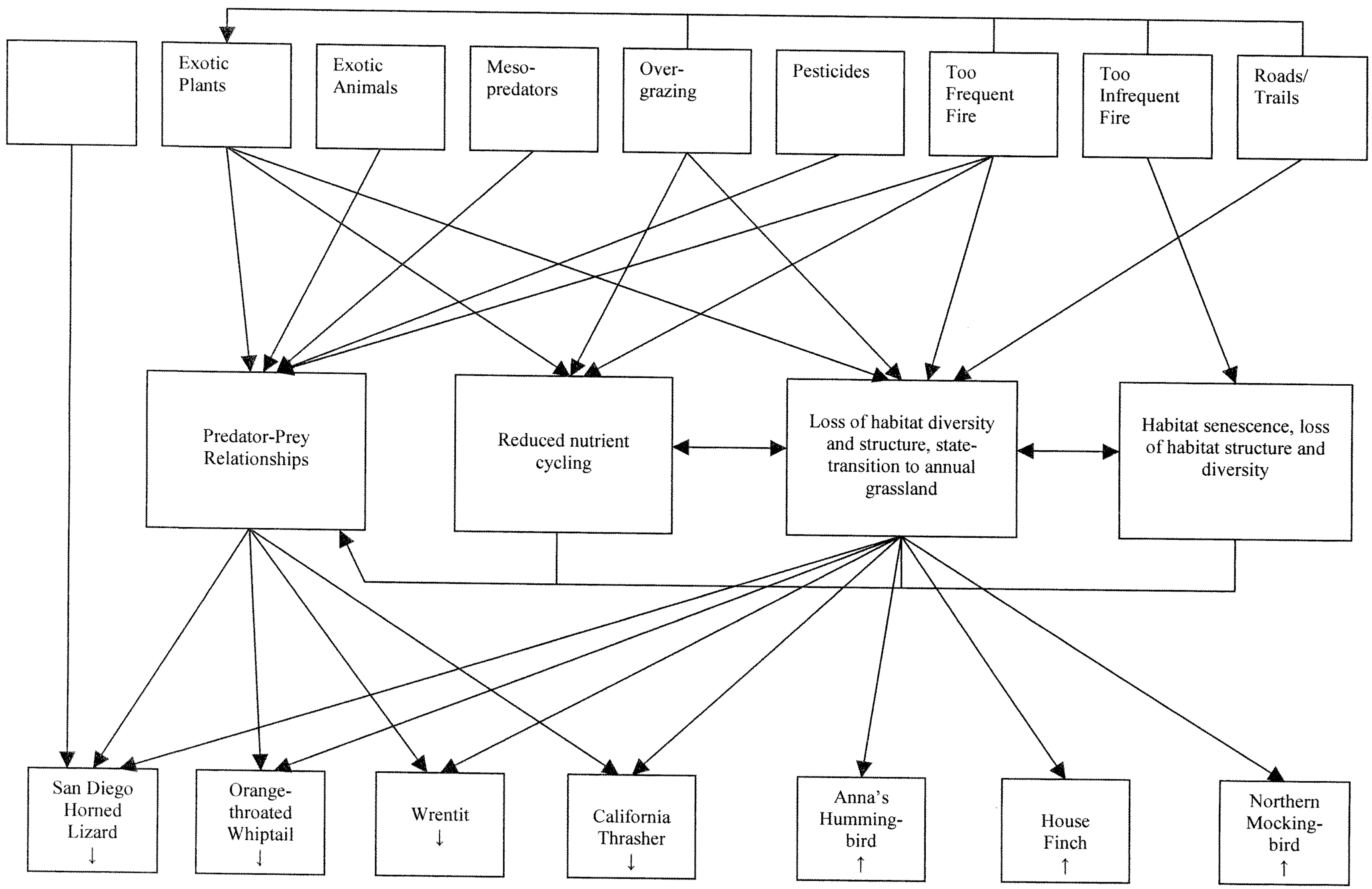


Figure 10. NATIVE GRASSLAND FOCAL SPECIES STRESSOR MODEL

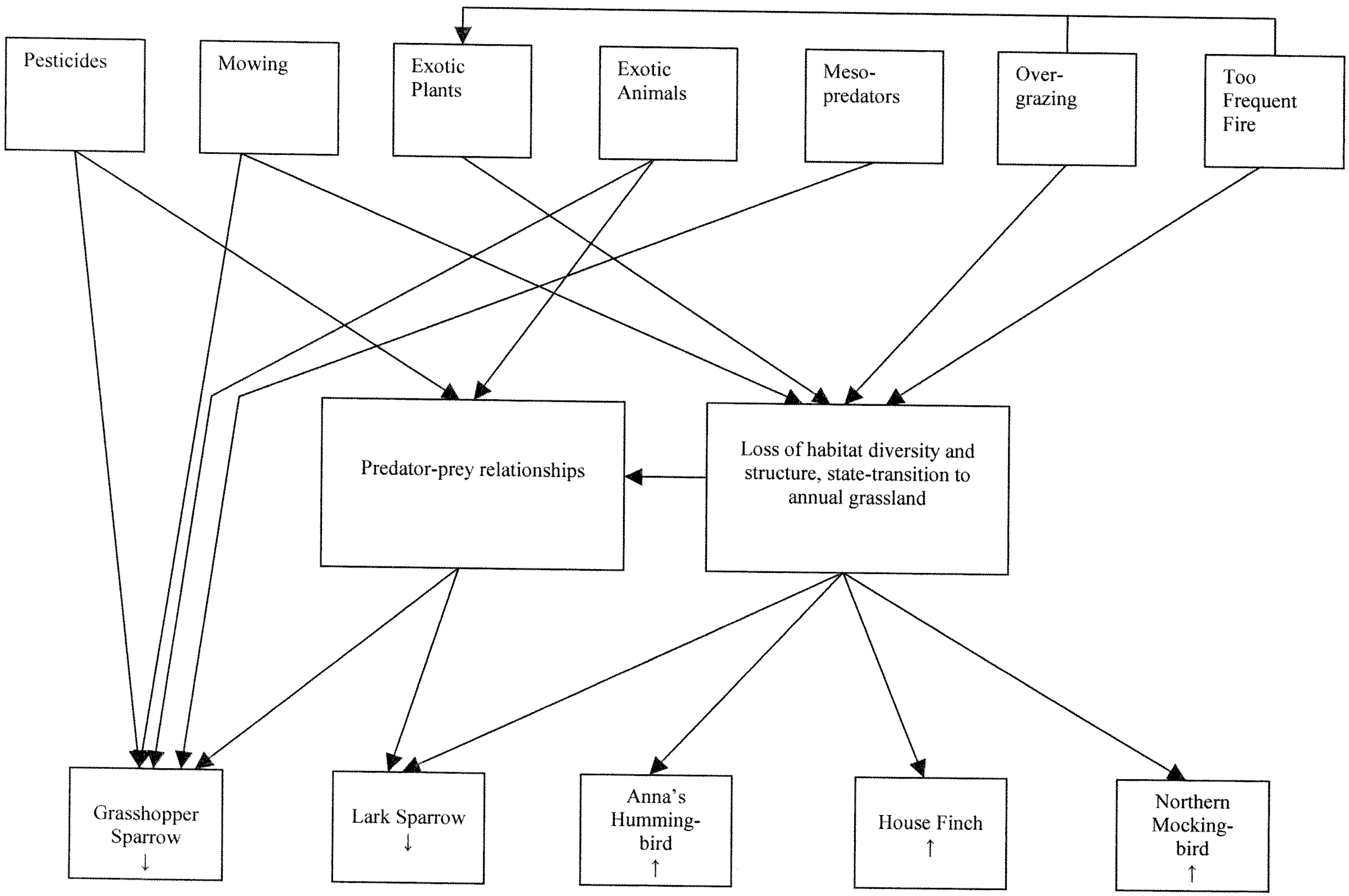


Figure 11. OAK WOODLAND FOCAL SPECIES STRESSOR MODEL

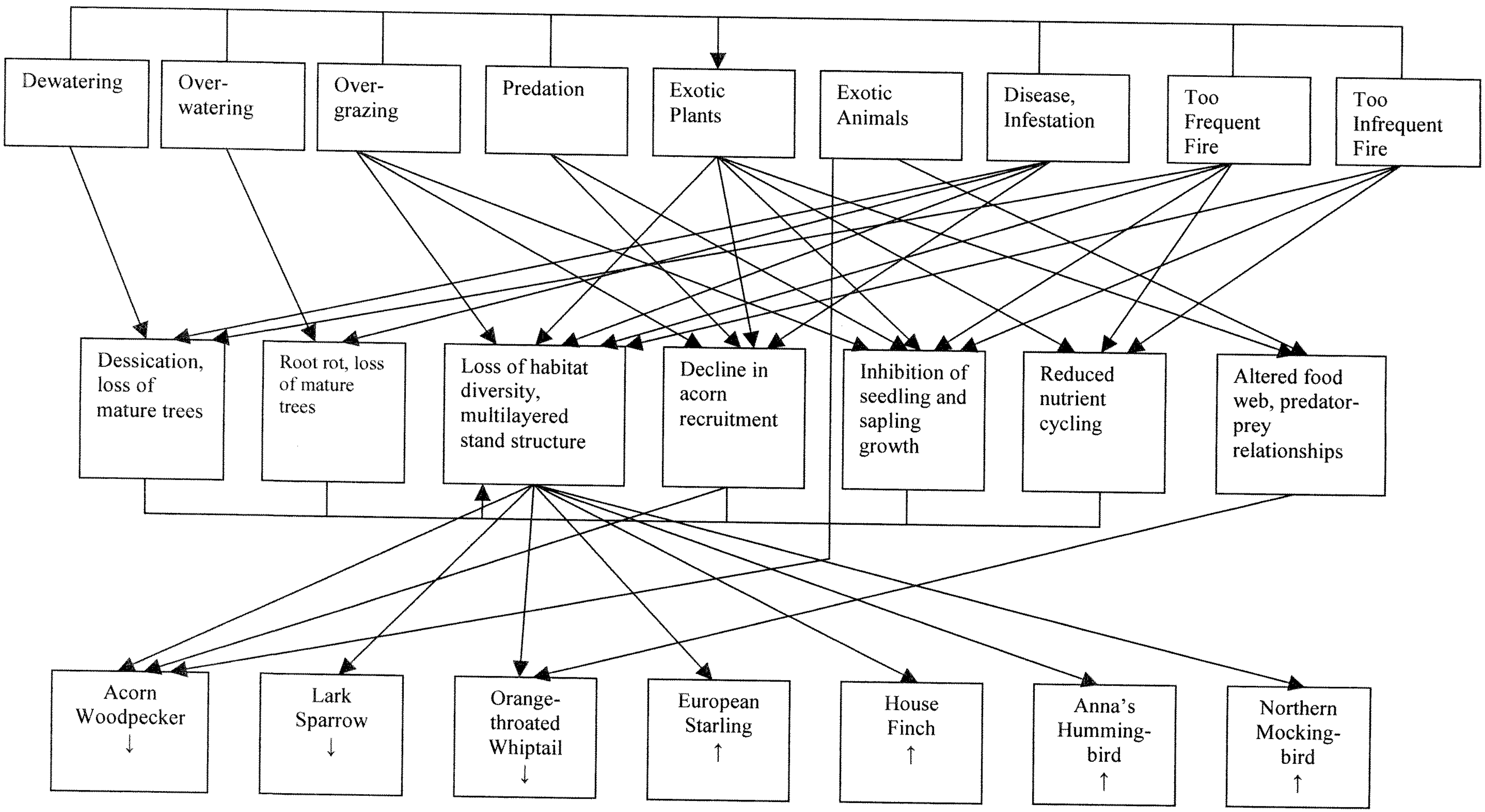
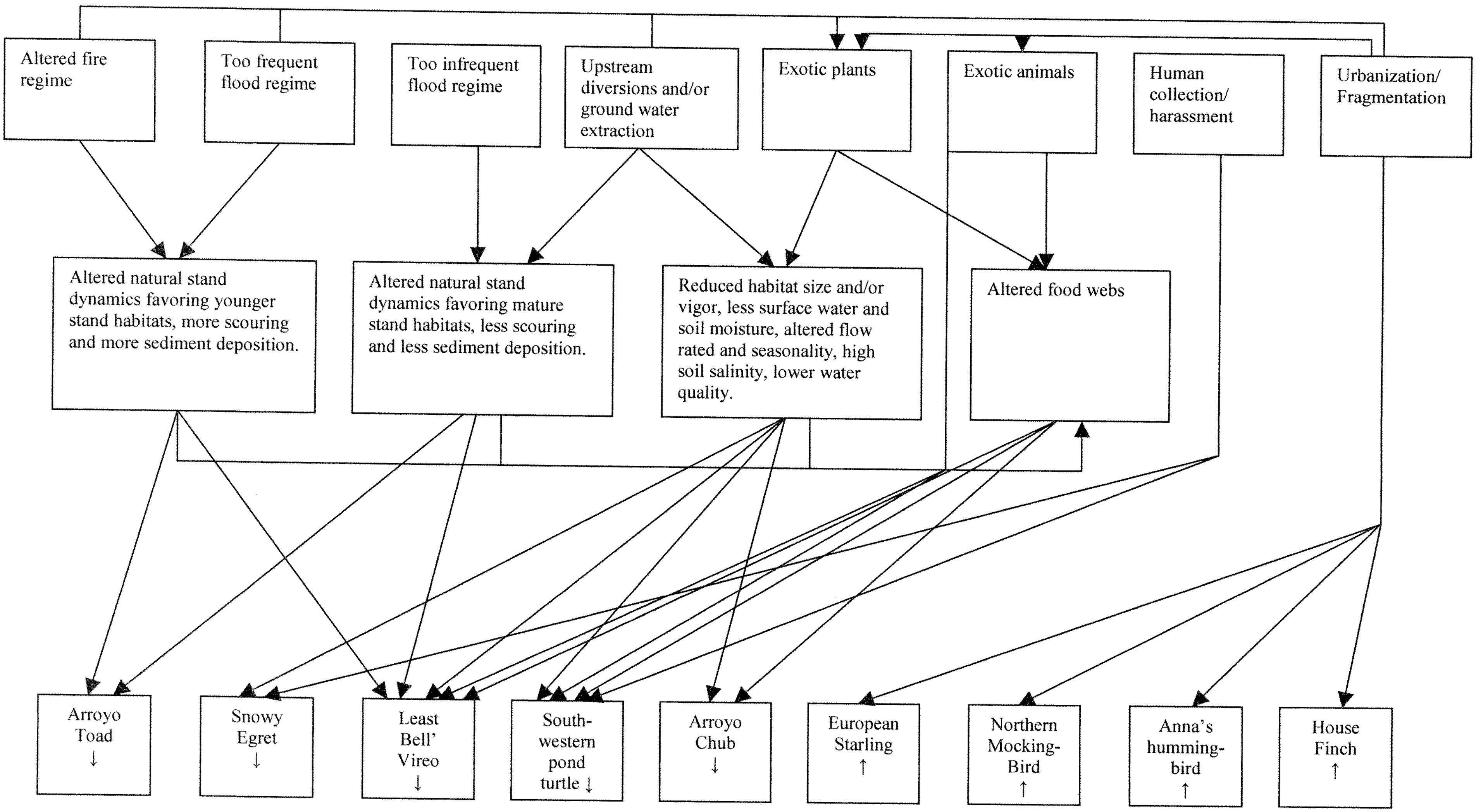
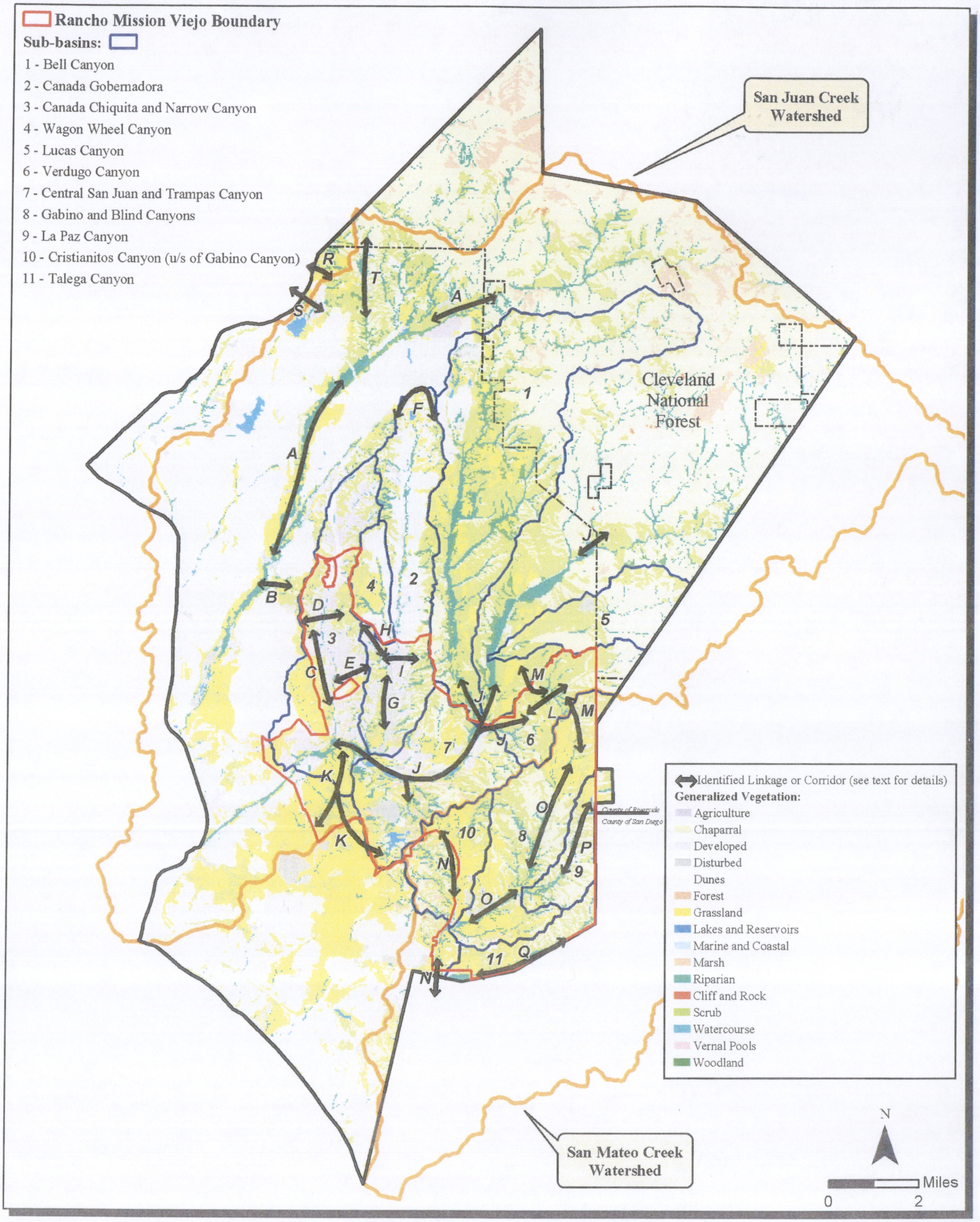


Figure 12. RIPARIAN/WETLAND FOCAL SPECIES STRESSOR MODEL

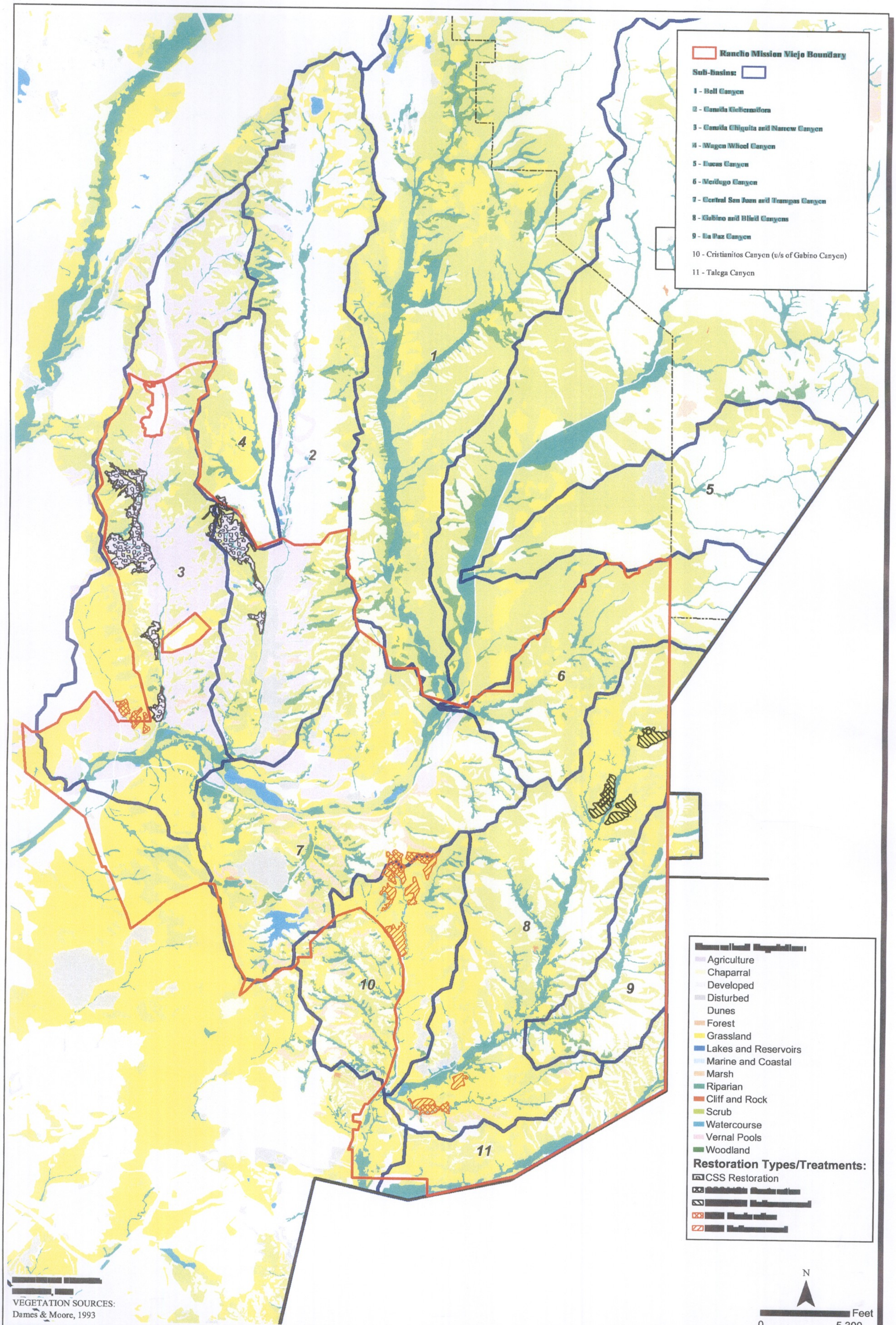




RMV Adaptive Management Program

FIGURE 13

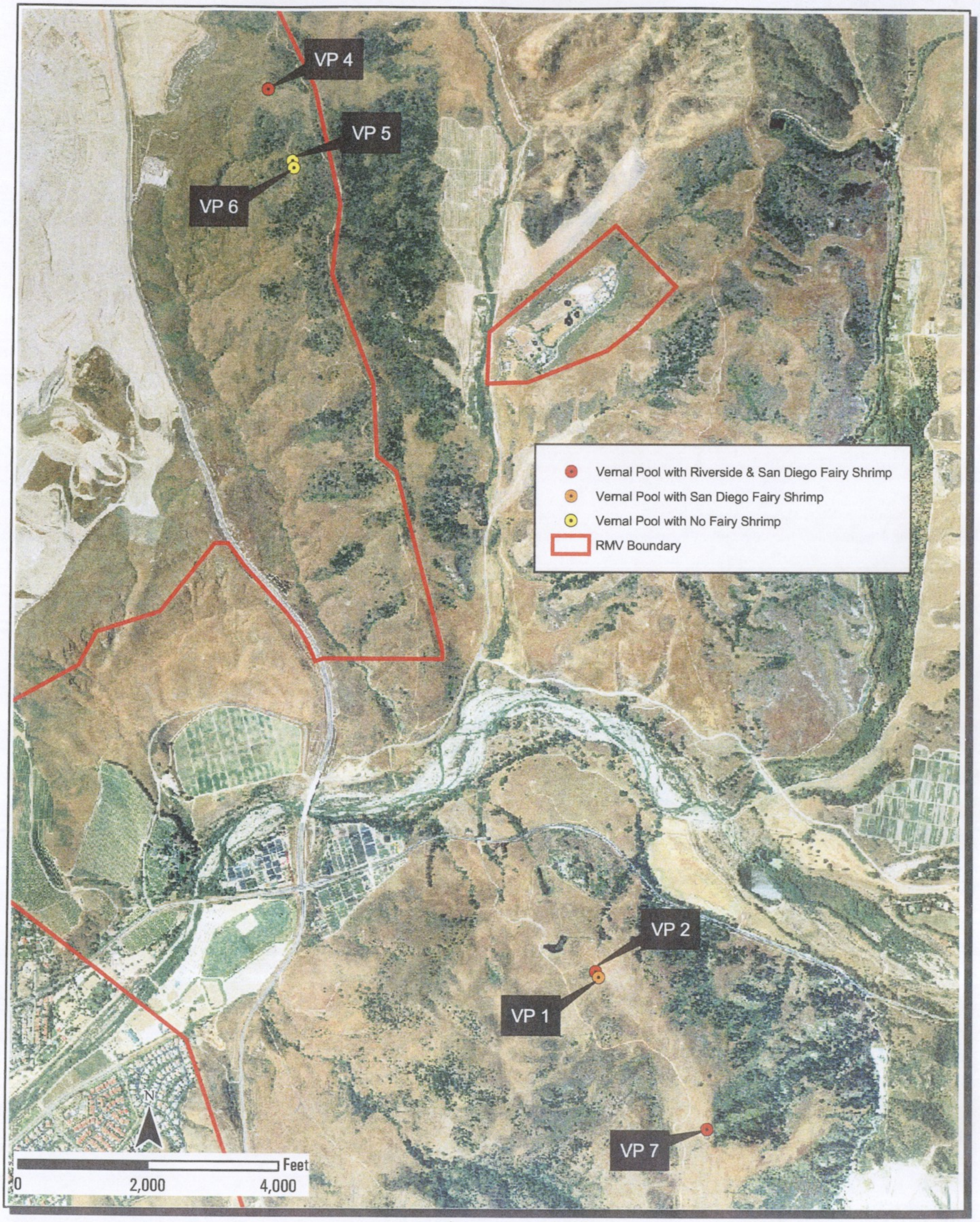
Habitat Linkages and Wildlife Corridors Map



RMV Adaptive Management Program

Preliminary Restoration Areas

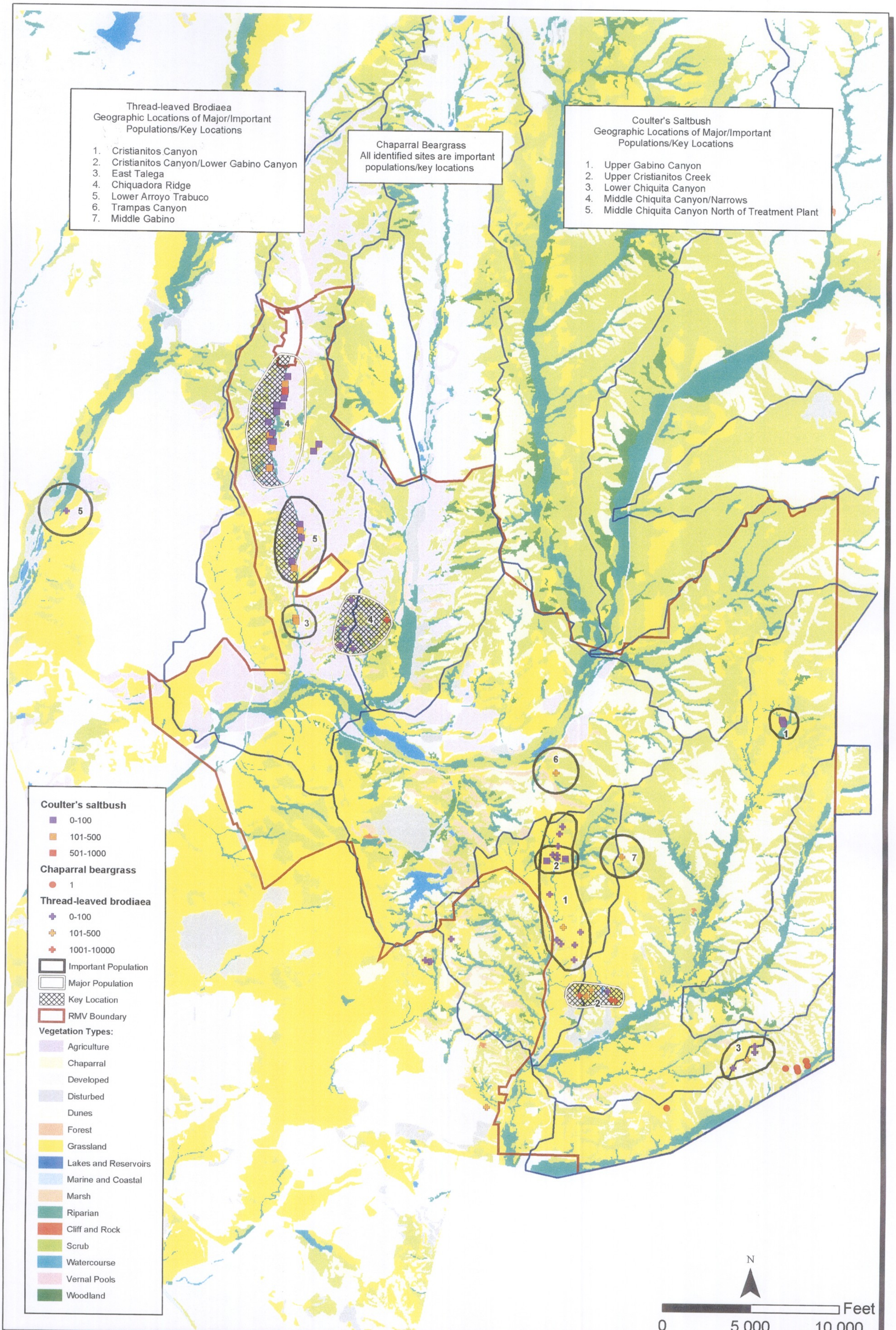
FIGURE 14



RMV Adaptive Management Program

Vernal Pools

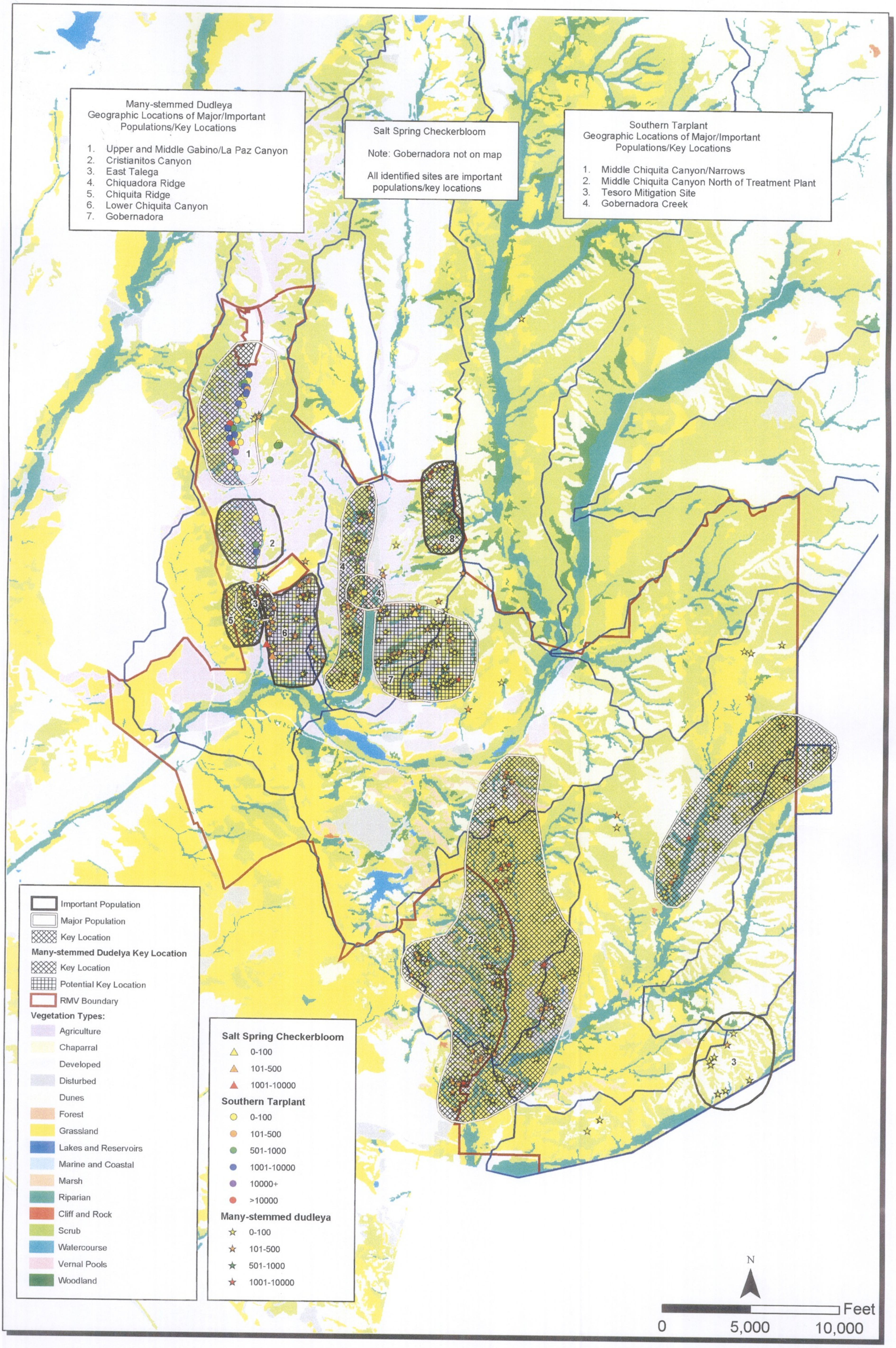
FIGURE 15



RMV Adaptive Management Program

Thread-leaved Brodiaea, Chaparral Beargrass, and Coulter's Saltbush

FIGURE 16



RMV Adaptive Management Program

Many-stemmed Dudleya, Salt Spring Checkerbloom, and Southern Tarplant

FIGURE 17

Appendix J

Rancho Mission Viejo Open Space
Adaptive Management Program

J-1 Plant Species Translocation, Propagation and Management Plan

J-2 Habitat Restoration Plan

J-3 Invasive Species Control Plan

J-4 RMV Grazing Management Plan

J-5 Wildland Fire Management Plan