SCIENTIFIC PEER REVIEW AND ASSESSMENT OF THE CALIFORNIA DEPARTMENT OF PARKS AND RECREATION OFF-HIGHWAY MOTOR VEHICLE RECREATION DIVISION HABITAT MONITORING SYSTEM

FINAL REPORT

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ABSTRACT

We evaluated, through on-site interviews with senior staff and field review of materials and methods, the Wildlife Habitat Protection Programs (WHPPs) and Habitat Monitoring Systems (HMSs) of California State Vehicular Recreation Areas (SVRAs). We found that these systems, devised by outside contractors nearly two decades ago (Kutilek, Shellhammer, and Bros, 1991a-e ; OHMVRD, 1998), provide protocols and standards that are robust and comprehensive but that have been inconsistently implemented and not adequately informed by management needs as articulated by site staff. We recommend that:

1. the existing systems of habitat protection and monitoring be modified with an emphasis on priorities defined by management needs and staff and funding constraints as identified by SVRA staff, including superintendents, environmental scientists, and maintenance personnel

2. the 2nd generation HMS adhere more closely to experimental design standards for replication and random sampling
3. the 2nd generation HMS be implemented more consistently within and among SVRAs
4. the 2nd generation HMS have a greater focus on ecosystem monitoring and indicator (or umbrella) species as barometers of SVRA environmental health
5. a greater emphasis be placed on data management, including the development of a dedicated data management system designed to accumulate, document, and digitize all existing data and reports
6. all sites be required to analyze and interpret data with explicit focus on trends in percent coverage of habitats, species distributions, and species abundances and that these analyses emphasize focal species and comparisons between riding and non-riding areas
7. SVRAs utilize the results of these analyses in management activities and planning efforts in an adaptive management context.

INTRODUCTION

The California Department of Parks and Recreation helps to preserve the state's biological diversity while providing high-quality outdoor recreational opportunities. The Off-Highway Motor Vehicle Recreation Division (OHMVRD, or "Division") of the Department of Parks and Recreation was created with the Chappie-Z'Berg Off-Highway Motor Vehicle Law of 1971 in response to increasing demands for off-highway motorized vehicle recreation opportunities (Bedrossian and Reynolds, 2007). This legislation was intended to provide increased opportunities for motorized, off-highway recreation at designated sites (State Vehicular Recreation Areas, or SVRAs) while simultaneously conserving natural resources (water, soil, plants, and animals). This and subsequent legislation, primarily SB877, Chapter 1027/87 PRC, the Off-Highway Motor Vehicle Recreation Act of 1988 (Garamendi, 1988), required the Division to: 1) inventory plants and animals and to conserve soils, 2) prepare wildlife habitat protection programs and 3) monitor soils, vegetation, and wildlife on SVRAs in an attempt to assess the impacts of motorized recreation on soils, plants, and animals. The Division's off-highway motor vehicle recreation program is widely viewed as a model for OHV

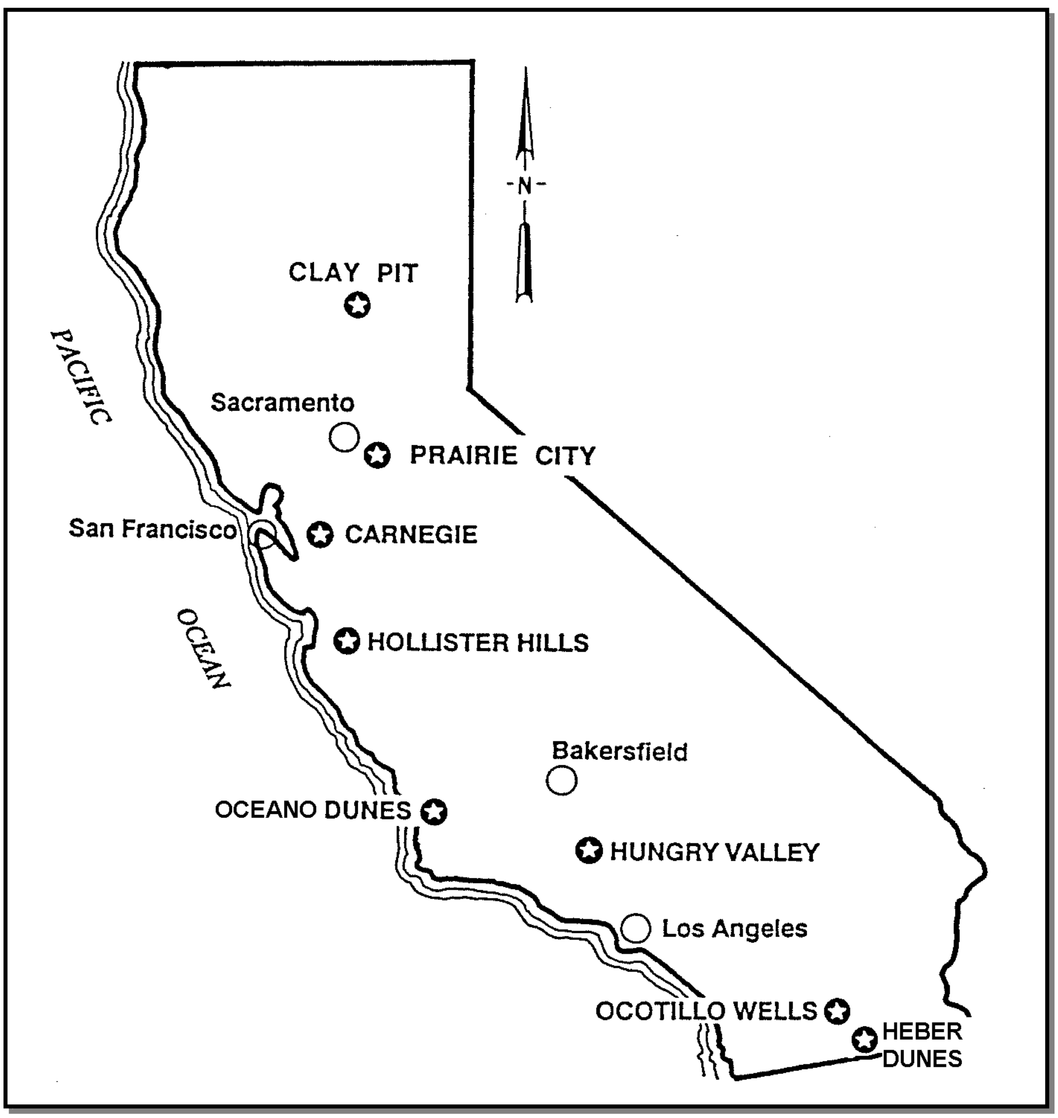

Figure 1. California State Vehicular Recreation Areas.

recreation in the rest of the United States.

Funding for the program comes from sources related to off-highway vehicle use (fuel tax revenues, fines, OHV registration stickers, day use and camping fees, special event and concessionaire fees, and interest) and supports program maintenance as well as a grants program undertaken with federal agency and local government partners.

The Division manages eight State Vehicular Recreation Areas totaling over 120,000 acres that provide off-highway riding opportunities in a variety of landscapes in nine counties (Figure 1, Table 1).

Table 1. California State Vehicular Recreation Areas.

SVRA Name	County	Size (acres)
Carnegie	Alameda and San Joaquin	4,500
Clay Pit	Yuba	220
Heber Dunes	Imperial	340
Hollister Hills	San Benito	3,350
Hungry Valley	Los Angeles	18,780
Oceano Dunes	San Luis Obispo	3,590
Ocotillo Wells	San Diego and Imperial	80,000
Prairie City	Sacramento	836

SB877, the Off-Highway Motor Vehicle Recreation Act of 1988 (Garamendi, 1988), defined “conservation” and “rehabilitation” and required soil loss standards and habitat protection plans for each SVRA. In response to SB877, the Division, from 1989 to 1991, contracted with researchers at San Jose State University to develop detailed wildlife and habitat inventory and monitoring plans for most SVRAs. The San Jose State researchers installed permanent line transects and photo plots at some of the

SVRAs, conducted baseline surveys of plants and animals, and recommended future monitoring procedures and strategies (Kutilek, Shellhammer, and Bros, 1991a-e). Additional studies were performed by U. C. Davis researchers in 1993 at Prairie City (Anderson and Hogan, 1993) and at Clay Pit (Hogan and Anderson, 1994).

To continue to develop the monitoring program, in the late 1990's the Division prepared a comprehensive HMS consisting of an overall Division HMS (OHMVRD, 1998) as well as District HMS's, one for each SVRA. The Division HMS provided guidance and set the overall goals for the entire SVRA system, while the District HMS's included standardized protocols tailored for the needs of each SVRA (e.g., Ocotillo Wells in 1997 [McClenaghan et al., 1997] and Heber Dunes in 1998 [McClenaghan et al., 1998]). At this time Division staff began to monitor vegetation and wildlife. The Resource Ecologist/Environmental Scientist for each SVRA was directed to conduct or to oversee most of the monitoring and to prepare an annual Habitat Monitoring Report based on the HMS format and protocols. Large amounts of both biotic and abiotic trend data have been collected for the SVRAs over the past several years; these additional data have been added to the baseline data collected in the late 1980's and early 1990's.

Following the development and implementation of the HMS, the Division prepared WHPPs for most of the SVRAs and the WHPPs were integrated into the HMS. The goals of the HMS are to document and to conserve plant and animal populations at levels close to the baselines that existed when the HMS was formulated and, where necessary, to rehabilitate or restore habitats where these had been demonstrated to be degraded prior to the HMS program. Importantly, the HMS is intended to be adaptive, that is, as new information is made available through monitoring, or more effective monitoring strategies are developed, the HMS program and/or management practices will change or “adapt” as warranted by the new information. An effective monitoring program needs to be able to assess progress towards explicit and meaningful population and habitat protection goals and program objectives (Elzinga et al., 2001; Atkinson et al., 2004).

The HMS is expected to keep pace with evolving science to ensure that it continues to be effective and appropriate to meet program goals. The HMS was to have been evaluated annually by a Division resource team and periodically reviewed by scientists and resource professionals outside the Division, if necessary (OHMVRD, 1998). Prior to this assessment, the HMS had not been subject to an independent, outside review to help the Division to evaluate and update, as needed, its wildlife habitat protection and monitoring programs. This assessment is particularly appropriate now in light of the more stringent performance and accountability standards being required of the OHV grant recipients, recent advances in monitoring protocols and methodologies, and the current emphasis on linking monitoring programs to explicit management goals and objectives. The purpose of this assessment is to provide an independent peer review of the existing HMS program as called for by the enabling legislation as well as previous investigators (OHMVRD, 1998).

METHODS

The peer review consisted of six individuals, two from the OHMVR Division and four from outside the Division. Division staff facilitated the peer review process by providing: 1) names and contact information for SVRA staff, 2) relevant documents, and 3) logistical support for site visits. Division representatives were Karen Feldheim, Environmental Scientist, who served as program manager, and Sarah Cumber, Environmental Scientist, who served as program assistant. Robert Meese, an ecologist at the University of California, Davis, served as coordinator of the peer review, recruited the review panel, participated in the peer review process, and integrated the reports of the peer review panelists into the final report.

The review panel consisted of three individuals: James Weigand, plant ecologist with the U.S. Department of the Interior, Bureau of Land Management, Sacramento, who examined the HMS for plants; Geoff Geupel, Director of the Terrestrial Ecology Division, PRBO Conservation Science, Petaluma, who examined the HMS with an emphasis on birds, and Kent Reeves, senior planner for Yolo County, California, who examined the HMS with an emphasis on amphibians, reptiles, and mammals.

The peer review process consisted of four elements: 1) a review of existing HMS and WHPP documents, 2) site visits to each State Vehicular Recreation Area, 3) this final report, and 4) a presentation of findings and recommendations at OHMVR Division HQ in Sacramento.

The SVRAs were visited according to the following schedule:

i. Orientation at OHMVR Division HQ, Sacramento: 2/7/2008
ii. Prairie City: 2/27/2008
iii. Ocotillo Wells: 3/24-3/25/2008
iv. Hollister Hills: 4/4/2008
v. Carnegie: 5/13/2008
vi. Hungry Valley: 6/9-6/10/2008
vii. Oceano Dunes: 9/23-9/24/2008; Geoff Geupel 11/17-11/18/2008

viii. Clay Pit: 11/18/2008

Prior to each site visit, panelists were provided with electronic copies of existing reports (HMS, WHPP, and annual reports) and data sets (typically Excel® spreadsheet files) for their review. Each site visit consisted of two elements: 1) an initial introduction of peer review panelists and an overview of the goals of the peer review followed by a question and answer period with the site superintendent and senior environmental scientist, and in some cases the senior maintenance staff person, and 2) a review of existing protocols and methods in the field with the senior environmental scientist and additional natural resource staff members.

Panelists provided individual reports of their findings, conclusions, and recommendations to Robert Meese, who synthesized the individual reports into a draft final report that was returned to the panelists for their review and then submitted to the OHMVR Division program manager following the presentation at Division headquarters in Sacramento.

RESULTS

The SVRA environmental scientists are competent, knowledgeable, and committed to performing the tasks associated with monitoring plant and animal populations on SVRAs. All had the training and experience necessary to implement the methods as recommended in the original WHPP and HMS reports (Kutilek, Shellhammer, and Bose, 1991a-e; OHMVRD, 1998), but the SVRA environmental staffs are too small to conduct the comprehensive ecosystem-based monitoring as originally devised (Kutilek, Shellhammer, and Bose, 1991a-e; OHMVRD, 1998). Staff at most sites are dedicated to or heavily focused on needs as dictated by conservation priority, and monitoring of listed species typically dominates staff time and resources at the expense of more broadly-based habitat and ecosystem monitoring or monitoring of non-listed “indicator” species. Existing and historical emphasis appears to be on *how* to do monitoring and in implementing recommended monitoring protocols, including data management and reporting. However, data are commonly not analyzed and even less frequently are the results of data analyses interpreted to investigate whether plant and animal populations are changing through time. Questions related to *why* to do monitoring and to the application of the results of monitoring in effecting management actions are poorly addressed. At present, monitoring does not appear to be tied to specific, well-defined management goals, except in the case of listed species (e.g., snowy plovers and least terns at Oceano Dunes). Although a decade of monitoring has produced much useful data, these data are derived from plots that have often been non-randomly chosen. Existing data have been inconsistently analyzed, the results of these analyses have been only infrequently interpreted, and in only a few instances have the interpreted monitoring results led to changes in resource management. Generally, natural resource monitoring appears to occur in isolation from site management and results of monitoring activities are not used in making management decisions except in cases of listed species (e.g., beach closures to protect nest sites of snowy plovers at Oceano Dunes).

The field methods originally recommended (Kutilek, Shellhammer, and Bose, 1991a-e; OHMVRD, 1998) have been uniformly adopted and appear to be generally appropriate and effective. Vegetation is monitored primarily by aerial photography and permanent transects; however, the temporal interval between successive aerial photographs appears to be highly variable, which may impede efforts to evaluate observed changes (see below), and most transects have been non-randomly sited and sampling points along transects occur at regular intervals. The non-random placement of transects and of sampling points along transects is at variance with accepted standards required for the unbiased characterization of vegetation. We address these concerns further below.

Multiple methods are used to detect and monitor amphibians, reptiles, and mammals, as some members of these groups may be more effectively detected using one method than another (e.g., Ryan et al., 2002; Garden et al., 2007) and serious biases may result from the reliance upon a single, or too-few, survey techniques (Ribeiro-Júnior et al., 2008). However, regular bat surveys appear to be absent from most sites. Birds are surveyed primarily by point counts except at Prairie City, where line transects have been used.

Data collection is often idiosyncratic, inconsistent, and strongly influenced by staff time conflicts and turnover and regulatory concerns (listed species receive disproportionate attention yet may not yield much information on more general question of how species abundances are changing through time). Several sites have experienced gaps in data collection as well as in the reporting of results, whereas both the enabling legislation (SB877) in Section 11, paragraph (c) as well as the Division HMS document (OHMVRD, 1998) call for the twice-annual monitoring of birds and the biennial monitoring of vegetation, amphibians, reptiles, and mammals. As far as we are aware, the every-two-year aerial photographic record recommended in the HMS document (OHMVRD, 1998) as a means to monitor habitat and to document changes in vegetation cover and density does not exist, and this recommendation has not been implemented. The Hungry Valley HMS 2006 annual report refers to a switch from aerial photography to digital satellite imagery in 2004 (Hungry Valley SVRA, 2007), but it is unclear whether this change was implemented system-wide. Either aerial photographs or satellite imagery taken at consistent intervals may be especially useful as means to document landscape conditions through time, but will be most useful if uniformly implemented across the system of SVRAs. While it may be insightful to include remote sensing (aerial photographs or satellite images) as part of the monitoring of vegetation and habitats, we are not aware of any GIS-based analyses of changes in vegetation cover, nor does it appear that any standard analytical methodologies or protocols have been proposed to be used by environmental staff system-wide.

Field data are well recorded and documented on paper field forms but are inconsistently documented in annual reports and not readily accessible to off-site (e.g. Division HQ) staff nor other interested persons. Data analyses of the type performed in the original monitoring plans (Kutilek, Shellhammer, and Bose, 1991a-e), which included numerous statistical analyses, appear to be lacking in most of the annual reports submitted by site environmental scientists. The annual reports of Ocotillo Wells are notably more faithful to the original methods of data analysis and interpretation. Similarly, thorough interpretation of the results of data collection and analysis efforts are in general missing from annual reports and we are unaware of examples of specific management recommendations that resulted from the interpretation of the analyses of monitoring data, with the exception of closures to protect the breeding attempts of listed species.

The calculation of diversity indices is widespread but the subsequent analyses of trends utilizing indices of diversity is lacking. Diversity indices are expressly designed to enable the comparison of measures of diversity through time or space (Magurran, 1988), as illustrated in the original Kutilek, Shellhammer, and Bose (1991a-e) and Oceano Dunes 2000 annual reports (Oceano Dunes SVRA, 2001); however, results of comparisons of multiple indices are rarely reported in the annual site reports, and thus the utility of calculating these indices is lost. Despite the explicit goals of the WHPP/HMS systems (Kutilek, Shellhammer, and Bose, 1991a-e; OHMVRD, 1998), i.e. to detect trends, we are aware of few examples of analyses of trends in either vegetation coverage or species populations; an exception is the comparisons of 1994 to 2000 vegetation coverage at several locations at Oceano Dunes (Oceano Dunes SVRA, 2001).

DISCUSSION

Our interviews and field reviews with SVRA staff demonstrated that a clear dis-connect currently exists between field work and the goals of the field work, with the exception of efforts devoted to listed species. The methods historically and currently being used are generally appropriate for monitoring plant and animal populations, but the reasons why the monitoring is occurring and the ultimate use or application of results of monitoring and how they relate to management of natural resources are unclear and not well documented.

Monitoring Protocols

The authors of the monitoring system understand how to implement diverse monitoring protocols although nowhere are the protocols spelled out in the degree of detail that assures that the environmental scientists clearly understand the methods and data to be gathered. No discussion of training to reduce variability caused by different observers is discussed. A serious concern is that experimental design is poor in most cases, an understanding of statistical testing is absent from the monitoring system, and no attention is paid to the importance of developing an efficient sample size. Current monitoring programs utilize statistical power considerations to determine effective sample sizes (Elzinga et al., 1998; Lenth, 2001; Steidl et al., 1997), as too few samples can be a waste of resources for not having the capability to produce useful results, while too many samples waste staff time and use more resources than are necessary (Lenth, 2001).

Pseudoreplication, the sampling of points that are not independent of one another, is particularly prevalent in the existing plant monitoring system as points from one or a very few transects are typically pooled together. If points are not randomly selected on a randomly selected transect or at least have a random starting point on a transect the points are not independent and thus not valid for a randomized, statistically valid sampling scheme. The randomly selected transect becomes the sample unit rather than the points themselves.

Data Collection

The existing WHPP and HMS programs divide data collection into activities to acquire quantitative AND qualitative information (OHMVRD, 1998).   Monitoring that is scientifically credible and able to withstand challenges in a court of law needs to be objective (i.e., requires random sampling), accurate, unbiased (precise, not dictated by convenience; Anderson, 2001), and statistically robust. Careful selection of variables, statistical design, efficient sampling, appropriate sampling methods, quality assurance for data collection, and quality control for data recording and storage are the elements of an effective monitoring system (Elzinga et al., 1998).

The authors of the OHMVR monitoring system regard monitoring as important for providing estimates of change from baseline conditions. General criteria for tasks in the vegetation monitoring system for use in SVRAs come from an EPA document cited on pages G-12 and G-13 of the Division HMS document (OHMVRD, 1998) and include the following (somewhat reworded for brevity and clarity):

a. test the effectiveness of vegetation management practices in OHV recreation settings to meet existing regulations, standards, and guidelines

b. compare results of management with control sites where management does not occur

c. identify significant changes, their trends, and rates of change

d. achieve within the constraints of available labor and capital

We did not examine the monitoring hypotheses for T&E species because other authorities, the U.S. Fish & Wildlife Service, National Oceanic and Atmospheric Administration, and the California Department of Fish and Game, have jurisdiction over T&E species protocols and their implementation. The hypotheses that furnish the basis of the existing monitoring system for SVRAs are not explicitly stated in the HMS document; however, the focus of plant and animal monitoring described in the document suggests that perhaps three hypotheses are intended for testing across all

SVRAs (H_o: indicates the null hypothesis while H_1 indicates the alternative or research hypothesis):

H_0: Extent of vegetation cover of SVRAs is not changing.
H_1: Extent vegetation cover of SVRAs is changing.

H_0: Species diversity of plants and animals in SVRAs is not changing.
H_1: Species diversity of plants and animals in SVRAs is changing.

H_0: Evenness of species populations in SVRAs is not changing.
H_1: Evenness of species populations in SVRAs is changing.

These global hypotheses reflect OHMVR Division-wide concern that motorized recreation may have impacts on the amount and types of plants, animals, and vegetative cover within SVRAs. An evaluation of the necessity and sufficiency of these hypotheses for managers and the public should be on-going based on evolving policy, current scientific knowledge, available technology, and statistical design. The monitoring system should provide information to management and should continue to develop in response to the needs of SVRA natural resource managers (i.e., monitoring should occur within an adaptive management framework).

Our evaluation of the existing WHPP/HMS program examines four questions in regard to the hypotheses that form the basis of a monitoring system:

(1) Do current observations continue to validate the observations that prompted the hypotheses?

(2) Are the hypotheses correctly and completely stated?

(3) Are the monitoring protocols and the statistical design chosen to determine hypothesis adequate to provide data needed by ecologists and SVRA managers with the required confidence for further decision making by SVRA managers?

(4) What additional hypotheses need to be tested, if any, to meet the needs of natural resource managers?

The existing system (OHMVRD, 1998) utilizes data collection methods that characterize plant and animal communities generally - they use a comprehensive approach to cover multiple variables that may or may not be of immediate concern to managers but are more likely to detect an unanticipated or previously unnoticed change from the baselines established in the Kutilek et al. (1991a-e) reports. This strategy is different from monitoring site-specific variables of immediate concern to SVRA environmental scientists and managers in response to an outcome or unforeseen consequence of a management action to control a variable of concern. Because the general strategy to detect change is diffuse and not focused on concerns expressed by site environmental scientists or managers, the data collected may or may not be relevant to management goals. This observation, noted at several SVRAs, may explain the apparent disconnect in interest and application of information from monitoring between environmental scientists and managers.

Reliance upon Indices

At present, both plant and animal "health" is being measured through the system-wide calculation of indices as recommended in the HMS (OHMVRD, 1998), primarily the Shannon-Weiner index of diversity (SDI). Species diversity consists of two components: species richness, which is the number of species in an area, and evenness, which refers to the relative abundances of the species in an area (Magurran, 1988). By calculating an index, investigators are provided a means to compare the diversity in one area to that in another, or to compare estimates of diversity of a single area through time. However, although the calculation of diversity indices may provide a means to compare diversity through time or space, much essential information is lost, as diversity indices provide no insights into causality, i.e. the underlying reasons for observed changes, and therefore we strongly recommend a parallel evaluation of quantitative results from field data separate from the values of SDIs or other diversity indices.

We are concerned about the reliance upon the Habitat Assessment Matrix, which gives rise to the two diversity indices (SDI and SDJ) calculated at each SVRA, as the development of this matrix appears to encourage the disengagement of natural resource from management staff through a one-size-fits-all approach to evaluating ecological conditions. The calculation, without analysis or interpretation, of the matrix obscures the underlying complexity of ecosystem processes and impedes efforts to delineate and understand the factors responsible for landscape changes. The production of a single number does little to inform managers about changes on the ground, does not identify species so may obscure changes in the distribution and/or abundance of species of interest, and has not been utilized in an adaptive management context.

The Habitat Assessment Matrix could assist the manager to determine whether resources may be at risk but does not inform the manager about the specific resources nor about the factors that may be responsible for putting resources at risk. A total scoring (or index calculation) is a mechanical exercise that assumes all resources are equally valued, but such equality is seldom the case: decisions about the importance of management resources are policy decisions that are seldom if ever based on an ordinal score. The Matrix spreadsheet calculation may be one assessment tool if properly interpreted, and likely arose as a recommended assessment tool due to an explosion of interest in such indices in the 1970's and 1980's (Magurran, 1988), but the ultimate responsibility for evaluating monitoring data for multiple variables lies with the decision maker and cannot be adequately represented in a single value derived from a spreadsheet formula.

A more effective monitoring system will enable ecologically informed managers to make decisions on the basis of quantitative field data rather than generalized indices. Management recommendations can then be based upon the explicit weighting of variables used in evaluations of the ecological data and justify decisions intended to conserve natural resources.

Grid Sampling

The Division may want to consider sampling not from transects but instead from points randomly selected from a grid of evenly-spaced points covering the entire quadrat or vegetation type. From all of the points, randomly select a subset of points to sample.   The time required to acquire a sample may be longer as the sample covers the entire quadrat, but an accurate estimate of the variance in the factor of interest is more likely (see Elzinga et al., 1998 for examples).

Reporting of Results

The reporting of results of monitoring efforts in annual reports is inconsistent and idiosyncratic and detracts from the Division's mission to comprehensively monitor the natural resources on its system of SVRAs in an integrated and systematic program. The dependence upon a series of annual reports that are produced in different ways at different sites with different levels of analysis and interpretation impedes efforts to get a picture of whether and/or how conditions are changing on SVRAs, let alone understand the reasons why these changes may be occurring.

Interpretation of Results

It is apparent that the designers of the monitoring system have experience in assessment and data collection methods for plant community and animal population inventories and provide a series of well-justified methods to analyze monitoring data (Kutilek et al., 1991a-e); however, less attention is paid to the interpretation and application of results to serve a role in guiding management for SVRAs in a process of iterative evaluation to improve and refine management of natural resources and motorized recreation (adaptive management) nor have the protocols and analyses been uniformly implemented among sites. We recommend that environmental scientists in collaboration with superintendents and maintenance managers discuss protocols used to gather as well as to analyze and interpret the data collected to make the results of monitoring efforts most appropriate, available, and comprehensible to both biologists and resource and administrative managers. Recommendations for management actions must be based upon and backed up by reliable methods of data collection, analysis, and interpretation, but be presented to decision-makers in ways that are most readily understood by them in an iterative process that engages both managers and field staff. These discussions may lead to decisions to modify existing methods given the constraints of staff and financial resources but must continue to implement broad-based, ecosystem-level habitat monitoring that meet SVRA management needs.

RECOMMENDATIONS

We recommend that the OHMVR Division design a second generation WHPP/HMS system that is expressly designed to meet the needs of the State Vehicular Recreation Areas in fulfilling the goals set forth in SB877 and subsequent legislation as well as legal obligations as described in state and federal statutes. We recommend that the Division engage senior environmental and management staff, perhaps with outside assistance, in designing the second generation WHPP/HMS system that is focused on answering questions of greatest management interest and need. Questions of interest to SVRA staff may include:

- Is vegetation coverage declining through time as a result of OHV usage?
- Is plant species richness declining through time as a result of OHV usage? If so, in which vegetation types?
- How will we define success in efforts to restore degraded landscapes?
- What percentage, and which species, of birds that are expected to breed at each SVRA have been confirmed to do so?
- Does relative rate of trail use affect rates of habitat occupancy by vertebrate animals? Which species are most affected? Does the SVRA provide habitat for these species in non-riding areas?
- Have the bat species that may be expected to occur at SVRAs been confirmed to occur? Does OHV use affect bat use of appropriate habitats?

We stress that the questions of greatest management interest must be formulated by SVRA management and environmental staff and that the HMS must then be designed to best answer these questions.

In similar settings, state and federal biologists have designed large-scale monitoring programs according to a multi-step process that applies a step-wise approach (e.g., Elzinga et al., 1998; Atkinson et al., 2004; Elliot et al., 2004). Such a step-wise approach appears to be lacking in the design and implementation of the existing HMS yet is essential to the Division if it desires to collect, analyze, interpret and apply data to answer questions that enable it to fulfill its mission of monitoring and conserving the natural resources on the State Vehicular Recreation Areas. The following schema, adapted from Atkinson et al. (2004), is suggested as a guide to Division attempts to re-design, re-think, and re-focus energies, talents, and resources.

Step 1. Identify the goals and objectives of the habitat monitoring system; this is an essential first step, and one that the panelists found lacking in the existing HMS schema. The papers by Anderson (2001), Oakley et al. (2003), and Atkinson et al. (2004) and the excellent book by Elzinga et al. (2001) stress the importance of planning in the development and implementation of successful long-term monitoring efforts.

Step 2. Identify the scope of monitoring program – what species, habitats, and other variables will be measured, over what temporal and spatial scales?

Step 3. Compile information relevant to monitoring program design – this report may serve as a guide to relevant independent literature

Step 4. Strategically divide the system and prioritize for monitoring program development; what species and habitats will be chosen for annual, biennial, or other (every 5 years?) monitoring? Modify existing design to use focal and/or surrogate species that are linked to specific management objectives.

Step 5. Develop simple management-oriented conceptual models; see the excellent paper by Davis (1993) for examples

Step 6. Identify monitoring recommendations and critical uncertainties

Step 7. Determine strategy for implementing monitoring. To some extent this was the goal of the original work by the San Jose State and U.C. Davis researchers, but strategic input for the design and implementation of the WHPPs and HMSs must come from within the Division, perhaps with the assistance of outside consultants from academia or other agencies, as only the Division can identify and articulate the questions that the WHPPs and HMSs are intended to answer as well as define the constraints (funding, staff, time, effort) that affect design and implementation decisions. SVRA management considerations must guide the development of the HPPs and HMSs and be guided by the results of these programs.

Step 8. Develop data quality assurance, data management, analysis, and reporting strategies. Although not lacking in the existing HMS, there is a great need for improved data management that scales from the field site to the SVRA to the Division level – the Division environmental scientists ought to be able to access and query site data from the Sacramento HQ and to quickly and easily identify particular data sets that important for documenting trends. The original HMS documents (Kutilek, Shellhammer, and Bose, 1991a-e) called for such a custom database application that contained automated statistical routines to test for differences in percent-cover of plants and changes in abundances of animals. We specifically recommend that <u>all</u> existing data and reports be accumulated into a central repository and that <u>all</u> data and reports be made electronic. Existing paper-copy reports should be scanned and converted into portable document format (pdf) files and stored and archived appropriately. This is easily done with a flat-bed scanner, automatic document feeder and appropriate software.

Step 9. Complete the adaptive management loop (Figure 2) by ensuring effective feedback to decision-making. The results of analyses of field data (e.g., the detection of a declining amphibian population or a reduction in percent cover or other abundance measure of a plant species or plant community type) ought to lead to appropriate management actions (e.g., erecting of exclusion fences and/or appropriate signage) intended to conserve the population or habitat of interest.

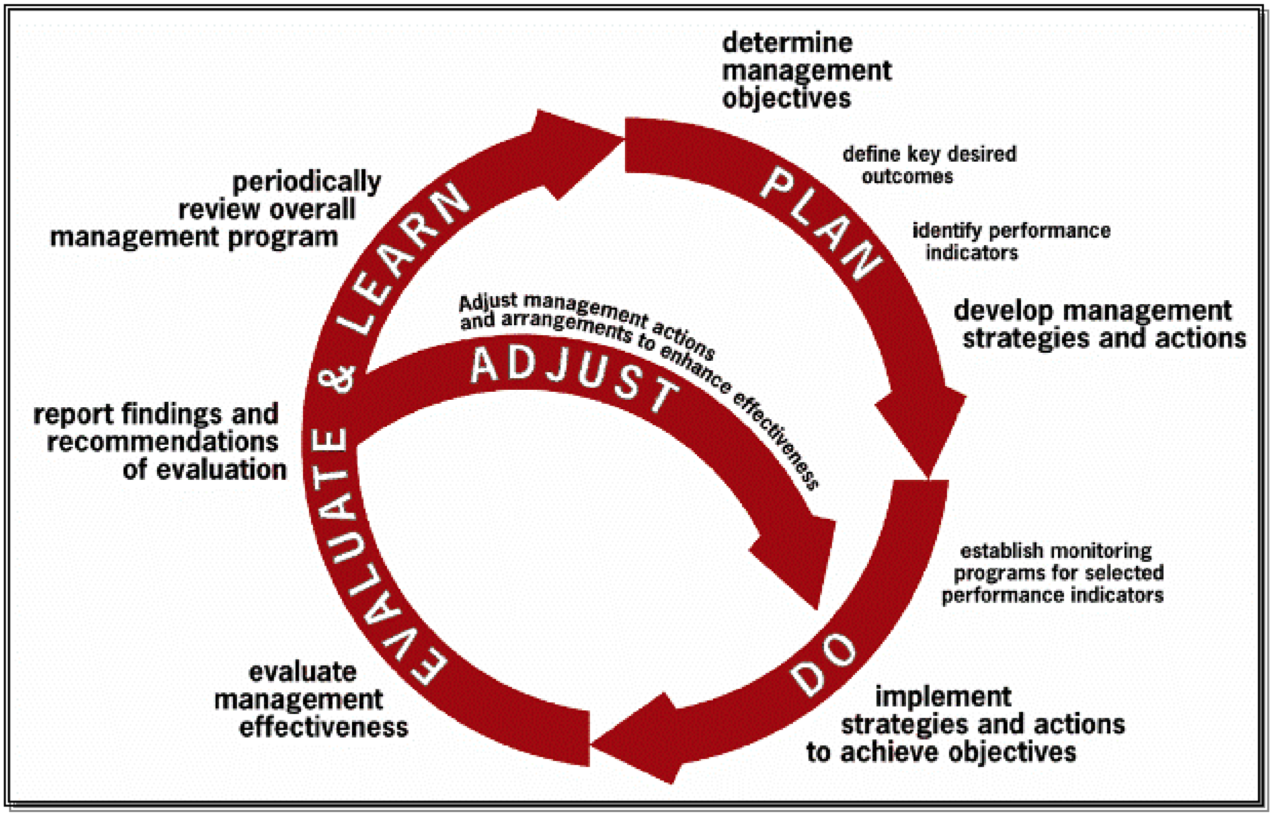

Figure 2: Adaptive Management Feedback Loop

We feel that the Division, perhaps in consultation with outside experts, ought to produce a new strategic guide to the Wildlife Habitat Protection Programs/HMS focusing equally on the needs and goals for the HMS and as well as on the strategies and tactics necessary to meet them.

Specifically, we recommend that the Division:

1. Adopt an Ecosystem Management approach, as recommended in the original site reports (Kutilek, Shellhammer, and Bros, 1991a-e), as a guiding framework for the next-generation HMS: management

questions must guide the development and implementation of the HMS and the HMS must inform management in a positive feedback loop.

2. Replace the existing transect-based vegetation monitoring scheme with a scheme based on randomly-selected points on a grid of a quadrat or vegetation type.
3. Pair all samples, with one sample taken from a riding area and the other from an adjacent and geographically similar (i.e., similar slope and aspect) non-riding area.
4. Include bats in mammal survey efforts.
5. Measure vegetation and create an index of OHV use at all bird count and pit trap array locations to enhance the results and utility of the data collected. Collection of these additional data will allow future analyses of animal-habitat relationships, habitat suitability indices and spatial predictive models of species occurrence which will greatly increase the relevance of monitoring data to management. At a minimum, a vegetation 'relevé', as described in Ralph et al. (1993), page 38, should be conducted for each point count/pit trap location to characterize and document the vegetation matrix (= habitat) that surrounds these points.
6. The assessment of OHV trails, perhaps as described by McCreedy et al. (2007), should include the distance from the center of point count/pit trap locations and estimate trail density within a fixed radius.
7. Superintendents and environmental scientists, in consultation with maintenance staff, should collaborate on creating management plans that identify specific management needs and goals. The purpose(s) of species and habitat monitoring should be made explicit and related to stated management objectives
8. Conduct an "inventory of inventories": require all SVRAs to document all existing data and reports and then accumulate these into a central repository, regardless of original sources (paper, word processor files, spreadsheets, annual, consultant, or other reports, user reports, etc.).

All paper information, including data and reports of SVRA staff, the original HMS and WHPP documents, peer-reviewed publications, theses, and reports submitted by outside consultants should be digitized and deposited into a centralized electronic data repository. This repository is needed to archive (safeguard) existing information and to serve as a resource available to SVRA and Division personnel as well as qualified persons outside the Division who seek to answer a multitude of questions of management interest and to identify within and among-site trends.

9. Develop a dedicated data management system consisting of a shared database with on-line data entry capability that includes: 1) the ability to generate geographic coordinates (as with an API to Google Maps®), 2) accumulate and store geo-referenced image files (digital photographs taken at known times and locations), 3) query data via pre-defined as well as user-defined queries, 4) analyze and visualize data via pre-defined tools (statistical tests, plots of abundance over time, etc.) and 5) output data via preformatted reports of species inventories as well as graphs of species abundance and percent coverage through time. Data reporting should look at among-year results and illustrate trends by fitting a line to the abundance data through time and automatically determine whether the slope of the fitted line <> 0 (that is, automate the process of performing a linear regression to tell you whether abundance is increasing or decreasing through time) or document complex relationships.
10. Encourage outside research by nearby academic institutions to answer questions of management interest. Faculty and their graduate students are typically well-trained and have knowledge and experience that may complement that of site staff. In addition, in most cases graduate student stipends are of considerably lower cost than are costs associated with environmental consultants, thus, the sites may obtain the information they need while conserving financial resources.

Examples of such studies include the work of Beauchamp et al. (1998) on flat-tailed horned lizards (*Phrynosoma mcallii*) in Ocotillo Wells SVRA and Fridell's (1990) work on Hungry Valley SVRA.

11. Extend outreach efforts to encourage user groups (riders, campers, birders, and others) to report observations. Methods may include providing handouts to users as they enter SVRAs and encouraging reports of observations during educational activities or while giving public presentations.
12. Provide a mechanism to rapidly and reliably record observations provided by public. The most efficient means to record these observations would be to create a module within the recommended HMS data management system that accumulated observation records (who, what, when, where; although the primary purpose of the recommended HMS data management system would be to manage and report results of formal monitoring activities).
13. Do more outreach: the public needs to be educated about the benefits to wildlife and its habitats of concentrating riders on well-managed SVRAs and why riding on SVRAs is preferable to riding on public lands with minimal protection and enforcement. Encourage the kinds of multiple-use activities that are common at Hungry Valley SVRA but less so elsewhere in the system.

FUTURE CONSIDERATIONS

As the global human population increases, attendant impacts on natural systems will continue to increase. Among the many considerations for land managers is the emerging emphasis on appropriate responses to global climate change. For the WHPP/HMS systems, applicable considerations include:

- Stratifying sampling points by elevation in those SVRAs with substantial topographic relief in an attempt to detect changes in species abundances as a function of elevation
- Include trail width as a variable to be assessed, as changes in vehicle type, as from motorcycles to "quads", may lead to increases in trail widths, which may impact some bird species (Holmes and Geupel, 2005).

LITERATURE CITED

Anderson, D.R. 2001. The need to get the basics right in wildlife field studies. Wildl. Soc. Bull. 24: 1294 – 1297.

Anderson, D.W. and B. Hogan. 1993. Prairie City SVRA wildlife and habitat inventory and monitoring plan. Dept. of Wildlife and Fisheries Biology. University of California Davis, Davis, California. Report for the Dept. of Parks and Rec., OHMVR Division. 45pp.

Atkinson, A.J., P.C. Trenham, R.N. Fisher, S.A. Hathaway, B.S. Johnson, S.G. Torrres, and Y.C. Moore. 2004. Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans. U.S.G.S. Western Ecological Research Center, Sacramento, California, in partnership with the California Department of Fish & Game, Habitat Conservation Division, and the U.S. Fish & Wildlife Service, Carlsbad, California. Available from the Western Ecological Research Center website at: http://www.werc.usgs.gov/sandiego/pdfs/NCCP%20Monitoring%20Framework-10-12-04.pdf.

Beauchamp, B., B. Wone, S. Bros, and M. Kutilek. 1998. Habitat use of the flat-tailed horned lizard (Phrynosoma mcallii) in a disturbed environment. J. Herp. 32: 210-216.

Bedrossian, T.L. and S.D. Reynolds. 2007. Development of a soil conservation standard and guidelines for OHV recreation management in California. Env. & Eng. Geoscience 13: 241-253.

Chase, M K. and G. R. Geupel**.** 2005. The use of avian focal species for conservation planning in California. p 130-142 *In* Proceedings of the Third International Partners in Flight conference, C.J. Ralph and T.D. Rich eds. USDA Forest Service Gen. Tech. Report PSW-GTR-191. Available from: http://www.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/130-142.pdf.

Dale, V.H. and S.C. Beyeler. 2001. Challenges in the development and use of ecological indicators. Ecological Indicators 1: 3 – 10.

Davis, Gary E. 1993. Design elements of monitoring programs: the necessary ingredients for success. Environ. Monitoring and Assessment 26: 99-105.

Elliot, G., M. Chase, G. Geupel, and E. Cohen. 2004. Developing and Implementing an Adaptive Conservation Strategy: A Guide for Improving Adaptive Management and Sharing the Learning Among Conservation Practitioners. Petaluma, California: PRBO Conservation Science. Available for download from: http://www.prbo.org/cms/279

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. U.S.D.I. Bureau of Land Management Technical Reference 1730-1.

Available from: http://www.blm.gov/nstc/library/techref.htm.

Elzinga, C.L., D.W. Salzer, J.W. Willoughby, and J.P. Gibbs. 2001. Monitoring plant and animal populations. Malden, MA: Blackwell Science (with associated internet resources available at: http://www.esf.edu/efb/gibbs/monitor/popmonroot.html).

Fridell, D.A. 1990. Analysis of the impacts of off-road vehicle use in Hungry Valley California State Vehicular Recreation Area. Masters Thesis. Dept. of Geography, San Diego State University. San Diego, California. 103 pp.

Garamendi 1988. Senate Bill No. 877: Off-highway vehicles. Chapter 1027. 15 pp.

Garden, J.G., C.A. McAlpine, H.P. Possingham, and D.N. Jones. 2007. Using multiple survey methods to detect terrestrial reptiles and mammals: what are the most successful and cost-efficient combinations? Wildl. Research 34: 218-227.

Hogan, B. and D.W. Anderson. 1994. Clay Pit State Vehicular Recreation Area Wildlife and Habitat Monitoring Plan. Prepared for California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division. Sacramento, CA.

Holmes, A.L. and G.R. Geupel. 2005. Effects of trail width on the densities of four species of breeding birds in chaparral. p 610-613 *In* Proceedings of the Third International Partners in Flight conference, C.J. Ralph and T.D. Rich eds. USDA Forest Service Gen. Tech. Report PSW-GTR-191.

Hungry Valley State Vehicular Recreation Area. 2007. 2006 Hungry Valley State Vehicular Recreation Area Habitat Monitoring Annual Report. Prepared by California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division, Hungry Valley District Staff Environmental Scientist Kim Matthews.

Kakiba, K.M. and R.J. Vogl. 1986. The impact of off-road vehicles on the perennial desert vegetation at Ocotillo Wells SVRA, San Diego County, California. Dept. of Biology, California State University, Los Angeles. Report for the Dept. of Parks and Rec., OHMVR Division. 103 pp.

Kutilek, Michael, H. Shellhammer, and W. Bros. 1991a. Inventory, wildlife habitat protection program and monitoring program for Hollister Hills SVRA, California. Dept. of Biological Sciences, San Jose State University, San Jose, Calif. Report for the Dept. of Parks and Rec., OHMVR Division. 81 pp.

Kutilek, Michael, H. Shellhammer, and W. Bros. 1991b. Inventory, wildlife habitat protection program and monitoring program for Carnegie SVRA, California. Dept. of Biological Sciences, San Jose State University, San Jose, Calif. Report for the Dept. of Parks and Rec., OHMVR Division. 60 pp.

Kutilek, Michael, H. Shellhammer, and W. Bros. 1991c. Inventory, wildlife habitat protection program and monitoring program for Ocotillo Wells SVRA, California. Dept. of Biological Sciences, San Jose State University, San Jose, Calif. Report for the Dept. of Parks and Rec., OHMVR Division. 64 pp.

Kutilek, Michael, H. Shellhammer, and W. Bros. 1991d. Inventory, wildlife habitat protection program and monitoring program for Pismo Dunes SVRA, California. Dept. of Biological Sciences, San Jose State University, San Jose, Calif. Report for the Dept. of Parks and Rec., OHMVR Division. 55 pp.

Kutilek, Michael, H. Shellhammer, and W. Bros. 1991e. Inventory, wildlife habitat protection program and monitoring program for Hungry Valley SVRA, California.

Dept. of Biological Sciences, San Jose State University, San Jose, Calif. Report for the Dept. of Parks and Rec., OHMVR Division. 74 pp.

Lenth, R.V. 2001. Some practical guidelines for effective sample size determination. Amer. Statistician 55: 187-193. See also his Java applets for power and sample size at: http://www.stat.uiowa.edu/~rlenth/Power/.

Magurran, A.E. 1988. Ecological Diversity and Its Measurement. Princeton, New Jersey: Princeton Univ. Press.

McClenaghan, Lee, T. Zink, J. Tizler and D. Wood, 1997. Ocotillo Wells State Vehicular Recreation Area Vegetation and Wildlife Survey. San Diego State University, San Diego, Calif. Report prepared for the California Department of Parks and Recreation, OHMVR Division.

McClenaghan, Lee, T. Zink, F. Edwards, L. Heffernan and D. Wood, 1998. Heber Dunes Vegetation and Wildlife Survey. San Diego State University, San Diego, Calif. Report prepared for the California Department of Parks and Recreation, OHMVR Division.

Oakley, K.L., L.P. Thomas, and S.G. Fancy. 2003. Guidelines for long-term monitoring protocols.

Oceano Dunes SVRA. 2001. 2000 Annual Report, Habitat Monitoring. California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division, Oceano Dunes District.

Off Highway Motor Vehicle Recreation Division, California Department of Parks and Recreation (no author). 1998. Habitat Monitoring System.

Pudoff, T.J. 1992. The spatial and temporal effects of off-highway vehicles on vegetation and landforms in an arid environment: a case study of Ocotillo Wells SVRA, California. Unpubl. Masters Thesis, San Diego State University.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante 1993. Handbook of field methods for monitoring landbirds. USDA Forest Service Publication, PSW-GTR 144, Albany, CA. 41p. Available on-line at: http://www.fs.fed.us/psw/publications/documents/psw_gtr144/psw_gtr144.pdf. HTML version available on-line at: http://www.fs.fed.us/psw/publications/documents/gtr-144/.

Ribeiro-Júnior, M.A., T.A. Gardner, and T.C.S. Ávila-Pires. 2008. Evaluating the effectiveness of herpetofaunal sampling techniques across a gradient of habitat change in a tropical forest landscape. J. Herpetology 42: 733-749.

Ryan, T.J., T. Philippi, Y.A. Leiden, M.E. Dorcas, T.B. Wigley, and J. W. Gibbons. 2002. Monitoring herpetofauna in a managed forest landscape: effects of habitat types and census techniques. Forest Ecology and Management 167: 83-90.

Steidl, R.J., J.P. Hayes, and E. Schauber. 1997. Statistical power analysis in wildlife research. J. Wildl. Manage. 61: 270-279.

APPENDIX I. SITE-SPECIFIC RECOMMENDATIONS.

Prairie City

1. Control plots paired with riding plots are missing for most plant sampling sites.
2. Need stratified-random bird point count surveys in riding and non-riding (buffer) areas. Higher concentrations of point count locations in sensitive habitats (coastal scrub) may also be warranted.
3. Evaluate effects of invasive species, especially bullfrogs, as these are known to deleteriously affect many amphibian species.
4. Evaluate effects of non-riding areas (buffer zones) on decreasing noise and dust and providing habitat for vertebrates. Documenting their use by vertebrates must be a goal of monitoring program.
5. Updated management plan, currently being written by a consultant, needs to integrate with current and future results of a monitoring program. A spatially explicit occupancy model using monitoring data should be built (and updated annually) to guide design of riding trails and non-riding areas that maximize species protection and minimize urban noise/dust issues.

Ocotillo Wells and Heber Dunes

1. Use of two vegetation monitoring methods (one for the land original acquisition and one for the new lands in the east) is inefficient and unjustified. The Kutilek version is not as good as the SDSU version for monitoring design.
2. There is no reason to sample less common plant communities any differently from the more common plant communities. The only thing that might change for sampling is the density of sampling transects.
3. Sampling to obtain 400 points per plot is excessive; conduct power analysis to determine most efficient sample size.
4. Pseudoreplication is a problem – all points are based on regular, not random, sampling along transects without a random start.
5. Using transects that radiate in the cardinal directions from a common start point in the center of the plot oversamples (biases) the sample by concentrating sampling at the center of the plot.
6. Better documentation of populations of annual plant species would be essential to calculate diversity and evenness indices. Annual plant species were noted, but apparently not tallied. Monitoring of annual plants should take place annually and correlated with weather and climate. Understanding relationships between weather, especially frequency, intensity, and distribution of rainfall, and annual

plant diversity and abundance would be critical to efforts to restore native desert annual plants.

7. Annual vegetation monitoring is best done with permanent randomized plots with procedures in place to avoid trampling plants and compacting sensitive soils.
8. The timing of surveys for annual herbaceous plants may need to vary from year to year depending upon the timing of precipitation, but mid-to-late March is likely the annual optimum. An attempt should be made to survey during the “peak bloom” interval each year, as this will help to standardize results.
9. Need stratified-random bird point count surveys in riding and non-riding areas. Higher concentrations of point count locations in sensitive habitats may also be warranted. Areas with minimal to no vegetation could probably be excluded from vertebrate surveys.
10. Point counts of birds should begin in February, as breeding by some desert resident species, for example thrashers, may start as early as February.
11. Surveys during winter to coincide with heavy-use interval would provide much useful information on impacts on resident species.
12. Enhance communication with Anza-Borrego State Park to make maximum use of staff time and avoid duplication of effort. A coordinated monitoring program across both sites and additional properties being considered for inclusion (and other public lands) would help to define habitat relationships, prioritize species of management interest, and aid in the coordination of management responsibilities among sites.
13. Include impacts of campgrounds on vertebrates and habitats in monitoring program.
14. Document wildlife responses to vegetation protection in Heber Dunes as the importance of this small island of habitat in the surrounding sea of agriculture is worth documenting. Less intensive and more limited use over time should be a long-range objective of this unique area.

Hollister Hills

1. The sample size of long-term sampling plots is likely too small for statistically meaningful results if a subset of the original plots is the sampling unit. It would be better to dispense with the large Kutilek plots because they are not the sample unit. The sample units should be small sample plots centered on randomly selected points within the entire area of the four habitats of interest.
2. Pseudoreplication is a problem with the existing plant sampling design – sampling is done regularly at 1 meter intervals with a non-random starting point. The start point should be random and the subsequent sampling points should be randomly assigned from the start point.

3. The practice of excluding two quadrats (i.e. 50% of the plot) randomly is not useful in randomization to obtain an accurate sample of the entire plot. The entire area covered by the vegetation type should be available for sampling.
4. Excluding vegetation plots because they are "inaccessible" after the random sample selection process indicates poor stratification before randomization took place and is a bias in the sampling design. All plots were not treated equally. All inaccessible areas should be eliminated before the selection of random points begins.
5. Need stratified-random bird point count surveys in riding and non-riding areas. Higher concentrations of point count locations in sensitive habitats may also be warranted.
6. Site appears mostly driven by 'compliance' monitoring thanks to a 1992-2001 lawsuit over dust, noise and traffic. A multi-species 'effective' monitoring program as described in this report would help to guide management and give the site a more proactive response to threats and opportunities (listed below) and lawsuits.
7. We recommend enhanced outreach and use of the site's natural areas in the non-riding season to the riding and non-riding public.
8. If an HCP is being developed for the county, the site and its monitoring data should be included and the site recognized for contributing to the conservation of plants and animals, especially T&E species.
9. Fire may be used as an effective management tool to reduce risk of catastrophic wildfires while promoting habitats for T&E species.
10. Invasive species, especially yellow star thistle and pigs, require active control/eradication programs.
11. Excellent opportunity to develop resource management/field biologist intern program with West Valley College and San Jose State University programs. Such an internship program would help to build public support and provide the site with future dedicated, well-trained staff.
12. New low-use trails are being established; obtaining pre-riding baseline data could yield interesting results and help to guide trail design and related management decisions in future.

Carnegie

1. The existing two-step randomization (with biased cardinal directions for transects) method for sampling vegetation is poor and it is recommended that it be replaced by a completely randomized sample of points. The concern is that with the existing method, results derived from sampling only half the total area are extrapolated to characterize the entire area.

2. Original control quadrats that were later opened to OHV recreation suggest poor coordination or communication between environmental science staff and management. Sacrificing control plots is unfortunate and precludes attempts to establish a consistent time series. A second inefficiency was to exclude the original Kutilek control plots converted to OHV recreation sites from further study, as these plots could have been utilized by environmental scientists to gather important information with management applications relative to types of impacts from motorized recreation. Examples include effects of off-highway vehicles on habitat fragmentation, loss of vegetation cover, and rate of natural recovery of vegetation under recreation use. The specific start date for the opening of the control plots provided a known time from which to observe and measure change.
3. Repeated trampling and foot traffic by the monitoring team may create lasting impacts on soils and vegetation at monitoring sites, thus great care is needed when sampling from one year to another at the same site to avoid altering the character of sample sites. Using a different set of sampling points every year would avoid cumulative trampling effects on plants and soil but would greatly increase the sample size needed to detect small changes in vegetation.
4. No vegetation monitoring seems to have occurred since at least 2003. No data on vegetation monitoring were made available.
5. Need stratified-random bird point count surveys in riding and non-riding areas coupled with an assessment of surrounding vegetation. Higher concentrations of point count locations in sensitive habitats may also be warranted.
6. Must address potential observer-dependent bias, as multiple observers were used in 2005 and only one observer was used in 2006, potentially affecting results and interpretation.
7. Bird surveys should be concentrated in the winter (= riding) and spring (= breeding) seasons.
8. Need to guide riders away from sensitive areas when amphibians are out; therefore, frequent randomized geospatially referenced sampling with associated vegetation component is warranted. This schema will allow environmental scientists to identify/predict peak activity periods and delimit sensitive areas. May want to overlap with bird count locations to investigate the use of easier to monitor surrogate species.
9. In the newly acquired area, need to:
    a. Identify sensitive sites or hot spots for protection
    b. Establish a baseline for subsequent comparison (pre- vs. post-use)
    c. Design trail system to minimize impacts on soils, vegetation, and wildlife
    d. Heritage oaks likely have unique bird species that warrant/require protection
10. Integrate monitoring plan with new general plan being developed by consultant (EDAW)
11. Continue restoration in riparian area and monitor to evaluate results of efforts
12. Continuity of staff an issue; may want to develop an intern program.

13. Volunteer trails proliferating, must seek to limit riding to established, approved trails and areas. Perhaps limit number of riders in SVRA – establish a site "carrying capacity"
14. Monitoring for small mammals, including bats in mines, especially those that may be near the limits of their geographical ranges, to detect distribution and abundance changes associated with riding and/or climate change. Specific management actions for some of these species?

Hungry Valley

1. The number of plot samples per stratified vegetation layer is too small to be useful under the sampling design. The small number of plots does not solve the concern about pseudoreplication and efficient sample size.
2. The great diversity of vegetation types makes sampling here complex and likely time-consuming. Using just a few plots from which to draw plots for a specific vegetation type, however, is likely to provide an inaccurate sample. Likely, significant areas of the same vegetation type are excluded from sampling altogether.
3. The design of two annual grassland plots in riding areas compared to two perennial grasslands in non-riding plots is not a good pairing for comparison of vegetation effects.
4. The purpose of the single riparian plot without a control is unclear.
5. It would be good to specify in a protocol how the vegetation ecologist should select the timing of the vegetation survey each year depending on rainfall.
6. Points established for transects sampled randomly across the entire area of the vegetation type is preferable. The concern is the lack of sampling coverage over an entire plot or the entire vegetation type when just two transects cover points non-randomly (regularly) selected along each transect. The large number of points sampled along a transect does not compensate for the limited number of plots, quadrats, or transects considered.
7. Need stratified-random bird point count surveys in riding and non-riding areas coupled with an assessment of surrounding vegetation. Higher concentrations of point count locations in sensitive habitats (riparian area and oak woodlands) and additional points at random in other habitat types (e.g., grassland) may be warranted.
8. Inventory then monitor bat populations.
9. Overall, an exceptionally well-managed SVRA with a team oriented approach to management with a close relationship and good communication between resource and management staff. Some unique and innovative ideas that could serve as examples for other SVRAs include:
    a. Trail crew working under resource staff
    b. Riparian areas closed to riding
    c. Open riding being reduced on highly erodible soils

    d. Low staff turnover as resource personnel are part of core staff
    e. Active public relations/outreach program that includes an interpretive assistant and wildflower walks for visitors on non-riding days. Interestingly, and significantly, this SVRA is used by 300,000-500,000 people year-round and visitors include Sierra Club members.
10. Coordinate monitoring and management with USFS neighbor.

Oceano Dunes

1. The timing for monitoring vegetation in summer and early fall is appropriate for shrubs and subshrubs, but perhaps not for annual or herbaceous perennials - sampling of annuals should happen in the spring.
2. Aerial overflights would likely be better flown every year rather than every two years given the dynamic nature of dune ecosystems; it is appropriate to chronicle change more frequently.
3. The vegetation islands within the riding area are especially at risk; conserving them is critical to the OHMVR Division mission for conservation of resources and species. More aerial monitoring can promote prompt management response to protect vegetation islands.
4. The excellent vegetation restoration work at the SVRA deserves specific monitoring to test effectiveness of individual restoration practices so that these may be evaluated and adopted or abandoned as appropriate.
5. We recommend a power analysis to determine the most efficient sample sizes to detect statistically significant change.
6. It would be interesting to know how managers treat sampling on dunes that lose their vegetation over time. The movement of sand and eventual disappearance of vegetation from a site at vegetation plots may make the plot or randomized sampling scheme no longer serviceable. How are new plots to be substituted for denuded plots?
7. Randomly placed plots at a fixed angle should be tallied separately from the perpendicular plots – not pooled. This is a problem of pseudoreplication. The individual pairs of plots are not independent from one another.
8. The classification of vegetation by life form and height limits is specific and clear. One might argue that the rules for classification are not useful and can lead to confusing samples of vegetation for the same species at sample points along a transect. The statement: “Estimates of the maximum height…and the minimum height of the tree layer” does not make sense. It is not clear what the minimum height of the tree layer is or how it is to be determined. The value of a maximum height of the herbaceous layer is dubious when the herb layer has an upper limit of 40 cm AND when many herbs exceed 40 cm in height. (OHMVRD, 1998, page OD – 24).
9. Placing a second transect perpendicular to the first transect does not eliminate slope and aspect effects on the sample as stated on page OD – 24.
10. For rare plant searches, pollinator counts on the plants are an excellent idea. I am wondering whether it might be possible to spend more than ten minutes per

site on pollinator counts. Also, taking samples of pollinators themselves for identification by an entomologist would be important.

11. A look at the vegetation analysis for plant life forms used by the US Forest Service for its Forest Inventory and Analysis program (http://fia.fs.fed.us/) might be helpful to improve the protocol for monitoring (assessing) vegetation layers.
12. The “use of decision rules” is a good feature of the monitoring system for Oceano Dunes SVRA.
13. The protocols established by the U.S. Fish and Wildlife Service and the California Department of Fish and Game take up most the monitoring effort at Oceano Dunes. The monitoring system proposed for Oceano Dunes SVRA is eclipsed by T&E species monitoring.
14. An exceptionally well organized, well funded, and concentrated monitoring and management program focused on endangered species. As part of an HCP, monitoring results are used daily to guide management, protect sensitive areas, and limit use, as needed. May serve as a model for other SVRAs.
15. Seek to expand existing multi-species shorebird count along the beach.
16. Evaluate biological responses to habitat island restorations.
17. Interact with staff at the California Avian Data Center (CADC) to enhance database management for snowy plover nest, color band, and shorebird census data.
18. Open garbage bins attracting predators; document increases in gull numbers and attendant impacts around garbage bins to justify recommendation to cover garbage bins.
19. Excellent interpretive program including a boardwalk for non-riders.

Clay Pit

1. Need more-frequent monitoring, as brief visit on 11/18/2008 added one new bird species (Ferruginous hawk) to species inventory.
2. Encourage local birders to report observations? Close enough to urban area (Oroville) that many birders likely in local community and would be delighted to be asked to help.
3. Establish stratified-random bird point count surveys and pit traps in riding and to-be-established non-riding areas. Protect (fence off) and document vertebrate use of sensitive habitats (riparian area, cottonwood groves). Take advantage of opportunity to document pre-development conditions.
4. Encourage non-riding use of cottonwood groves (picnic and rest areas) while permitting the groves to expand and to provide more shade for riders and additional habitat for birds and other vertebrates.