# Adaptive Management Report for the Clark County, Nevada Multiple Species Habitat Conservation Plan

May 1, 2006

Clark County, Nevada
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Desert Conservation Program
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Cover image by Ann Magliere: Blackbrush Ecosystem in Red Rock Canyon National Conservation Area

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# SUMMARY

This document, the 2006 Adaptive Management Report for the Clark County, Nevada Multiple Species Habitat Conservation Plan (MSHCP), is a status report on the effectiveness of conservation actions implemented by the Desert Conservation Program (DCP), land use trends, habitat loss, species population trends, and ecosystem health. Four Adaptive Management Program (AMP) tasks are defined in the MSHCP (section 2) and the Biological Opinion for the section 10 take permit (p 2.11). The tasks are:

a) provide an analysis of all land-use trends in Clark County to ensure that take and habitat disturbance is balanced with solid conservation,
b) monitor population trends and ecosystems health,
c) evaluate effectiveness of management actions at meeting MSHCP goals of conservation and recovery, and
d) track habitat loss by ecosystem.

In addition, this report makes recommendations for future implementation of MSHCP permit requirements and conservation actions, as well as recommendations for further development of the AMP.

Land use trends as described in chapter 2 appear to be consistent with the anticipated land uses analyzed in the Biological Opinion for the section 10 take permit for the MSHCP, but the rate of human population growth and the pace of anticipated land uses are greater than anticipated. Clark County, Nevada continues to be among the fastest growing areas in the Nation, and is likely to remain so. In fact, the forecasts used by most local municipalities and agencies to anticipate growth have been exceeded year after year. As the human population of Clark County continues to grow, we can expect land disturbance under the section 10 take permit to continue. Status and trends in habitat loss by ecosystem are discussed in chapter 4. The increasing human population also exerts an increasing demand on public lands, including those lands used to mitigate for land disturbance under the section 10 take permit. The direct and indirect impact these actions may have on covered species and their habitats are discussed in chapter 4.

Described in chapter 3, the AMP is tasked in the Biological Opinion for the section 10 take permit with tracking habitat loss by ecosystem in order to ensure balance between take and conservation. Thus, it can be inferred that habitat loss is equivalent to take, or land disturbance under the section 10 take permit. The most recent land disturbance report delivered to the U.S. Fish and Wildlife Service (USFWS) showed that approximately 15,000 acres exempted from fees for municipal use and 44,148 acres of private land had been disturbed under the section 10 take permit. The overlap with the eleven ecosystems described in the MSHCP as habitat surrogates is

unclear at this time. Approaches to address tracking habitat loss by ecosystem are described in chapter 7.

Species Status and Ecosystem Health are described in chapter 4. During the 2003-2005 biennum, the DCP worked with the Adaptive Management Science Team (AMST), the Implementation and Monitoring (I & M) Committee and the I & M Committee's Rare Plant Working Group to review the outline for species' status reports recommended by University of Nevada, Reno - Biological Resources Research Center (UNR-BRRC) as Science Advisor contractor in the 2004 Adaptive Management Report. The final outline was submitted to the USFWS on 6 January 2006, with a proposal to produce or update species' status reports on a rotating basis, with one third of the covered species receiving reports or updated report each biennium. As of 5 January 2006, 41 of 160 datasets requested of past contractors had been received. A primary focus of the AMP in 2005-2007 will be to assess the quality of these datasets to compile a database to inform AMP analyses including species' status and ecosystem health reports.

Ecosystem health was not addressed during the 2003-2005 biennium. However, during 2003-2005 the Ecosystem Indicators contract with UNR-BRRC shifted its focus from a search for surrogate species indicator to remote sensing data analysis techniques that might inform surrogates of ecosystem health (Clark County 2005b). The final report for this contract had not been provided in time to inform this Adaptive Management Report, but the potential utility of this contract's final report is discussed in chapters 6 and 7.

The status of MSHCP implementation and AMP development are described in chapter 5. The DCP has expended approximately 2 million dollars each year for implementation of the MSHCP. In addition, the DCP administers section 7 funds for desert tortoise mitigation actions as requested by the USFWS. The DCP also has sought opportunities to secure additional funding from the Southern Nevada Public Lands Management Act (SNPLMA) fund. The increased expenditures of the DCP for each biennium's Implementing Plan and Budget are described. The Implementation Agreement agencies have also expended a variety of funds, including internal agency operating funds and SNPLMA funds, to address many of the conservation actions listed in the MSHCP. Charts of the projects addressing each MSHCP permit requirement and conservation action are presented. In summary, all permit requirements are being addressed, and since 1999, 459 of 604 conservation actions have been described as being addressed by contractors or Implementing Agreement signatory agencies. The conservation action data are self-reported, and the quantitative and spatial data currently being received by the DCP may be used to partially validate the extent of implementation to date. Also, many conservation actions are ongoing activities that will need to be addressed over the term of the section 10 take permit.

The status of development of the AMP is also described in chapter 5, with progress shown in the areas of development of Geographic Information System capacity

among many Implementing Agreement signatory agencies, compilation of data produced by MSHCP-funded projects, evaluation and management of roads and off-highway vehicle activity by the Bureau of Land Management, finalization of a species' status reporting strategy, AMST review of 2005-2007 proposals for funding that contained technical or scientific components, development of a prototype law enforcement data collection and reporting system, development of the Adaptive Management Science Plan, hiring of two DCP staff dedicated to the AMP, development of a draft charter for the AMST and development of a task tracking list for the Science Advisor contractor. In addition, a system dynamics model of implementation of the MSHCP was developed and is presented in chapter 1 of this report.

Many efforts have been taken both with MSHCP-administered funding and with other funding sources to implement the MSHCP Permit Conditions and Conservation Actions, and to further the development of the AMP. However, as described in chapter 6, few quantitative data on the efficacy and effectiveness of these efforts were available for the 2006 Adaptive Management Report. More data have since been received by the DCP, and availability of additional data sources has been indicated by several Implementing Agreement signatory agencies. The availability of these data poses both an opportunity and a challenge for the DCP and AMP: to most efficiently utilize those data within their limitations. In other words, the data in most cases should not be used to draw conclusions beyond the purposes for which these data were collected. In most cases these data were collected solely to document the location, time, and methods implemented. These data can be used by the DCP to evaluate the status of implementation of past projects. These data might also appropriately be used to detect patterns and make observations that guide the design of more rigorous effectiveness monitoring designs within an active adaptive management framework.

Chapter 7 addresses the recommendations of the AMP for the 2007-2009 biennium. The DCP has made progress in implementation of conservation actions and development of the AMP. However, there is much improvement to be made in the development of explicit monitoring to inform active adaptive management. No data were available to the AMST to make specific, prioritized recommendations for implementation of the MSHCP in the 2007-2009 biennium. The AMST recommended that similar efforts be made in each project category funded in the 2003-2005 biennium. In addition, a renewed focus on monitoring and active adaptive management research that addresses key land and resource management uncertainties in a statistically defensible framework is recommended for AMP.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| AMP | Adaptive Management Program |
| AMST | Adaptive Management Science Team |
| BLM | Bureau of Land Management |
| CMS | Conservation Management Strategy |
| DAQEM | Department of Air Quality and Environmental Management |
| DCP | Desert Conservation Program |
| EIS | Environmental Impact Statement |
| GAP | Gap Analysis Program |
| GIS | Geographic Information System |
| GMP | General Management Plan |
| I & M | Implementation and Monitoring (Committee) |
| IMA | Intensively Managed Areas |
| IPB | Implementation Plan and Budget |
| LE | Law Enforcement |
| LIMA | Less Intensively Managed Areas |
| LR | Lands Records |
| MSHCP | Multiple Species Habitat Conservation Plan |
| MUMA | Multiple Use Managed Areas |
| NCA | National Conservation Area |
| NDF | Nevada Division of Forestry |
| NDOT | Nevada Department of Transportation |
| NDOW | Nevada Department of Wildlife |
| NPS | National Park Service |
| NRA | National Recreation Area |
| NSP | Nevada State Parks |
| OHV | Off-Highway Vehicle |
| PA | Per Annum |
| PIE | Public Information and Education |
| PL | Public Law |
| RMP | Resource Management Plan |
| SNPLMA | Southern Nevada Public Lands Management Act |
| TM | Trademark |
| UMA | Un-Managed Areas |
| UNLV-CBER | University of Nevada, Las Vegas - Center for Business and Economic Research |
| UNR-BRRC | University of Nevada, Reno - Biological Resources Research Center |
| USAF | U.S. Air Force |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |

# ACKNOWLEDGEMENTS

A report of this scope demands the involvement of many individuals with a variety of expertise. It is not possible to list all of the individuals who provided insights and suggestions to improve this report, however the following deserve special recognition for their contributions. Bill Harris of Facilitated Systems and Rob Mrowka, Clark County Department of Air Quality and Environmental Management (DAQEM), are thanked for co-authoring chapters 1 and 2, respectively, with this author. Members of the UNR-BRRC Science Advisor consultant team are thanked for coauthoring chapters 4,5 and 6, and providing recommendations for inclusion chapter 7. The members of this team were Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear and Dick Tracy.

The Adaptive Management Science Team (AMST) member organizations and representatives and invited experts from the member organizations provided presentation materials and worked tirelessly during marathon meeting sessions in 2005 and early 2006 to critique, review and provide thoughtful suggestions that vastly improved the content and structure of this report. They are: Drs. Alison Hill, Durant McArthur and Jeanne Chambers, U.S. Forest Service Rocky Mountain Research Station; Jody Brown and Cynthia Martinez, U.S. Fish and Wildlife Service; Sue Wainscott and Marci Henson, Clark County; Dr. Ken Kingsley, SWCA, Inc.; Dr. Phil Medica, U.S. Geological Survey (USGS); Dr. Kenneth Nussear, USGS as subcontractor to University of Nevada Reno-Biological Resources Research Center (UNR-BRRC) as Science Advisor contractor; and Drs. Karin Hoff, Ron Marlow, Jill Heaton (UNR-Geography), Dick Tracy and Dennis Murphy, UNR-BRRC as Science Advisor contractor.

The AMST also worked with Bill Harris of Facilitated Systems to develop a system dynamics model of the Multiple Species Habitat Conservation Plan (MSHCP). This effort challenged many assumptions regarding the purpose and limitations of the MSHCP and provided insights into the assumptions made in the MSHCP regarding ecosystem health and species conservation. Bill's facilitation skills allowed the group to better describe the role of landscape process function in the assessment of ecosystem health, and the complex implications this hypothesized surrogate for ecosystem health may have among species with varying habitat needs.

The Federal and State Land and Resource Management Agencies and Nevada Department of Transportation provided countless hours of staff time to inform the development of the MSHCP conceptual model and tracking of implemented conservation actions. Of special note are the efforts by Ross Haley, Kristen Murphy, Susan Barrow and Margie Klein who actively participated as experts in the MSHCP model development. The above and Amy Sprunger-Allworth, Brad Hardenbrook and Julie Ervin Holoubeck with assistance of other agency staff, including Carolyn Ronning, Nicole Sikula and Cris Tomlinson, completed conservation action

spreadsheets that vastly improved tracking of the implementation of the MSHCP conservation actions.

UNR – BRRC in their capacity as Science Advisor contractor to the DCP provided staff and technicians in addition to the UNR faculty named above to assist in the development of much of the analysis upon which this report is based. Of special note are the efforts of Dr. Hoff for her efforts to coordinate with County staff on a regular basis and respond to requests for science advise in a timely fashion. Lisa Smith is thanked for data quality control assessment for many incoming data sets, comparison of original MSHCP ecosystem data to the Southwest Regional Gap Analysis Program data and 2005 Nevada Natural Heritage Program data, as well as analyses for the preliminary risk assessment. Ankur Goyal provided several implementation database outputs as well as constant maintenance and technical support for the implementation database. Dr. Nussear also provided specific analyses utilizing data extracted from the implementation database, and was the lead in developing the prototype law enforcement data collection devise. Sonja Kokos, Tracy Kipke, and Walker Johnson worked under the direction of Dr. Hoff to prepare the spreadsheets describing data generated by projects that was used as the basis for data requests that will vastly improve the data available for the Adaptive Management Program (AMP) in the future. Dr. Murphy provided the AMP with insights and challenging questions regarding the fundamental assumptions of the MSHCP regarding coarse and fine filter approaches to conservation.

Participants in the Implementation & Monitoring Committee's Adaptive Management Working Group reviewed the progress made by the AMST and Adaptive Management Coordinator to produce this report, and provided suggestions and reality checks that vastly improved the structure of this document as well as identifying many sources of information on land use trends that improved the content of chapter 2.

Members of the public and other observers participated in the Adaptive Management Working Group and observed the work of the AMST. These observers provided many salient comments and posed thought provoking questions. I thank them for their interest in the process and the information they offered.

Several Clark County staff provided valuable data and support for the production of this report. Jon Wardlaw, Department of Comprehensive Planning, provided data on demographics and land use in unincorporated Clark County. Many DAQEM staff are to be thanked: Ron Gregory provided data on federal disposal areas, Rob Mrowka, provided updates to the Growth Task Force Report regarding the MSHCP disturbance permit acreage cap and estimated rate of applications for those permits, the 2003-2005 Biennial Progress Report compiled by Jodi Bechtel was a critical reference document for this report, Betty Blattel provided timely research on contract dates for implementation tracking and land disturbance permit tracking, Ann Magliere provided the image for the cover of this report and developed a tracking system for incoming project datasets, Christina Gibson provided desert tortoise exclusionary

fencing data, Lee Bice provided several maps to illustrate this report, and Denise McConnell edited portions of chapter 7. Rob Mrowka, Jodi Bechtel and Marci Henson are also thanked for comments on an early draft of this report.

Six reviewers provided comments on all or portions of a draft of this report: Dr. Ken Kingsley, Dr. Bruce Marcot, Phil Medica, Dr. Clinton Moore, Dr. Barry Mulder and Dr. Rob Sutter. All of the reviewers are thanked for their insightful, objective and constructive comments. Due to capacity and time constraints, not all comments could be addressed in this report, but several have been incorporated into the recommendations in chapter 7, or forwarded to the Adaptive Management Program's work plan for 2006.

Finally, the credit for this report is shared among many, but the responsibility for errors resides with this author and editor.

*--Susan Wainscott, Adaptive Management Coordinator, Desert Conservation Program, DAQEM*

# CHAPTER 1 INTRODUCTION

*Co-authors Bill Harris and Sue Wainscott*

- **The Desert Conservation Program implements the Multiple Species Habitat Conservation Plan (MSHCP) to maintain a section 10 take permit for desert tortoise and for assurances of the same for 77 other species.**
- **The MSHCP is in its sixth year of implementation.**
- **Over the term of the permit, a total of 145,000 acres may be disturbed.**
- **Fees will be collected for each acre disturbed, excluding up to 15,000 municipal acres, and expended on implementation of the MSHCP.**
- **A model is presented that shows the interactions among the MSHCP, species, habitats, humans and development.**

The Clark County Desert Conservation Program (DCP) has entered the sixth year of implementation of conservation actions identified in the Clark County, Nevada Multiple Species Habitat Conservation Plan (MSHCP). The DCP is defined broadly in this document and is comprised of the signatories of the Implementing Agreement for the MSHCP as well as advisory groups and contractors. The MSHCP was developed and is implemented in support of an Endangered Species Act section 10 take permit issued by the U.S. Fish and Wildlife Service (USFWS) for the threatened desert tortoise (Mojave population) *Gopherus agassizii* and 77 other species (appendix A). The general objectives of the MSHCP are listed in section 1.2.2 of the document (RECON 2000) and are listed below:

- Avoidance of the necessity to list additional species in Clark County and the conservation and recovery of currently listed species.
- Assistance to Federal and state land and wildlife managers.
- Comprehensive and coordinated mitigation for species and habitat impacts as a substitute for project-by-project evaluation and mitigation.
- Provision for long-term protection of habitats and species on a regional basis with a focus on source population, reduction of threats and/or impacts on key conservation areas, and enhancement of connectivity between conservation areas.
- Protection of long-term habitat carrying capacity for species by, to the maximum extent practicable, avoiding, minimizing, and mitigating impacts and by assuring that any take allowed will not appreciably reduce the likelihood of the survival and recovery of species covered by the MSHCP.
- Identification and evaluation of the effectiveness of alternative and adaptive habitat management techniques over time and utilizing the Adaptive Management Process (AMP) set forth herein.

- Identification and evaluation of habitats with significant potential for enhancement and restoration.
- Provisions for appropriate development and economic growth within the county compatible with the MSHCP and the needs of the residents of the county.
- Identification of equitable and effective funding and implementing mechanisms adequate to implement recommended actions and achieve the objectives set forth in the MSHCP.
- Early involvement of interested agencies, landowners, managers, and other stakeholders in advance of proposals for specific conservation strategies in an effort to minimize conflicts and delays and facilitate appropriate public and private development.

The DCP is tasked with achieving these objectives over the term of the section 10 take permit. While the section 10 take permit (USFWS 2001b) was signed on 9 January 2001, and the Implementing Agreement signed by all parties in January 2001, actions to implement the MSHCP (RECON 2000) were initiated by the DCP as early as July 1999. A total of 604 conservation actions are defined in section 2.4.2.6 of the MSHCP (RECON 2000 p 2.62) and may be implemented primarily on Federal and State lands within Clark County, Nevada, to mitigate for disturbance of habitat on private and municipal (county and city) lands. The Federal and State lands were categorized by the intensity of land management activities that would benefit the covered species. The categories are: Intensively Managed Areas, Less Intensively Managed Areas, Multiple Use Management Areas and Unmanaged Areas (figure 1). Definitions of the four conservation management categories may be found in the MSHCP (RECON 2000, p 2.74). The lands available for disturbance under the section 10 take permit include both private lands and lands within designated land disposal areas (figure 2) that may become private or municipal lands through actions by Federal Land Management Agencies.

This document, the 2006 Adaptive Management Report for the Clark County, Nevada MSHCP, is a status report on the effectiveness of conservation actions implemented by the DCP, land use trends, habitat loss, species population trends, and ecosystem health. Four Adaptive Management Program (AMP) tasks are defined in the MSHCP (section 2) and the Biological Opinion of the section 10 take permit (USFWS 2001b p 2.11). The tasks are:

a) provide an analysis of all land-use trends in Clark County to ensure that take and habitat disturbance is balanced with solid conservation,
b) monitor population trends and ecosystems health,
c) evaluate effectiveness of management actions at meeting MSHCP goals of conservation and recovery, and
d) track habitat loss by ecosystem.

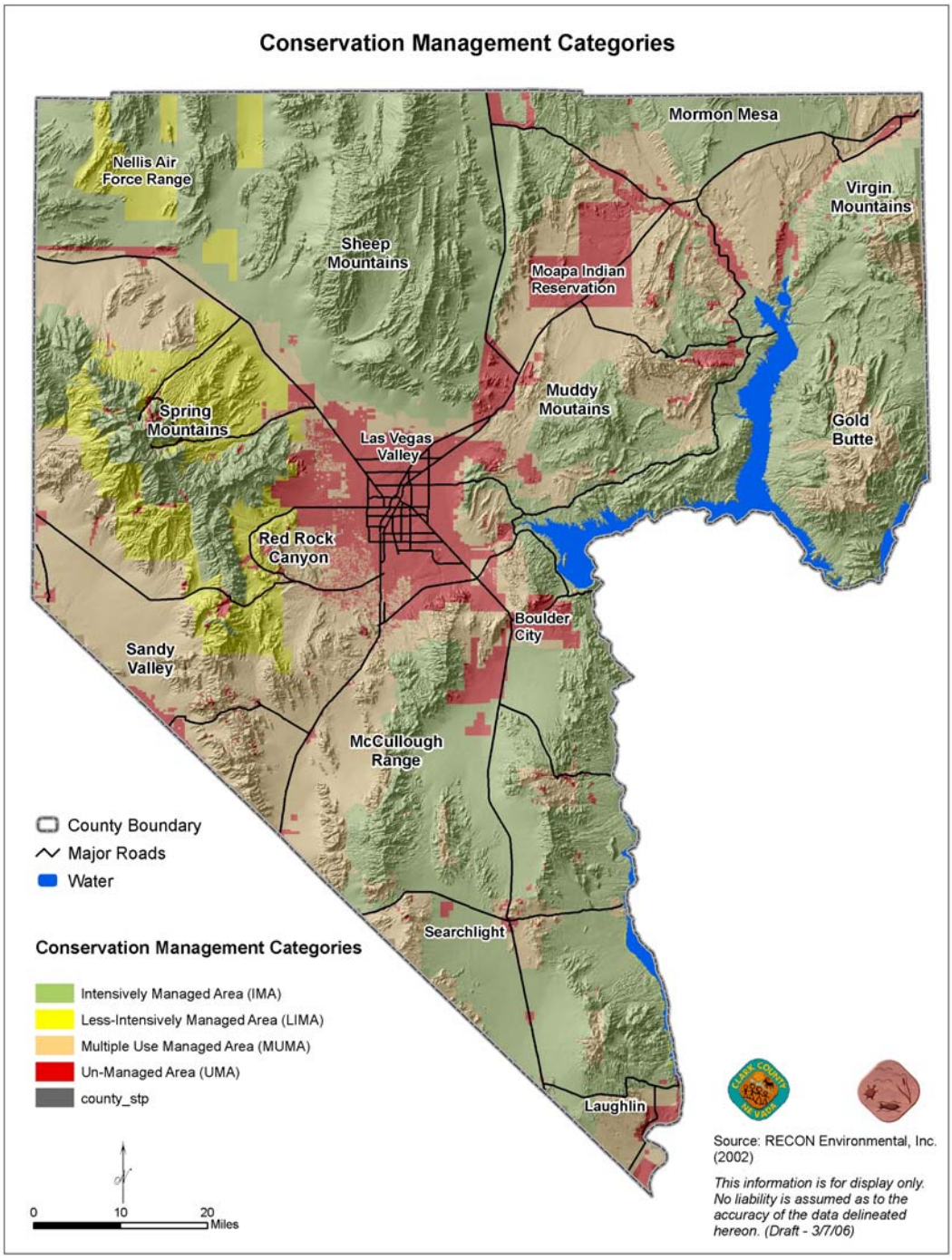


**Figure 1. Original MSHCP Conservation Management Categories**

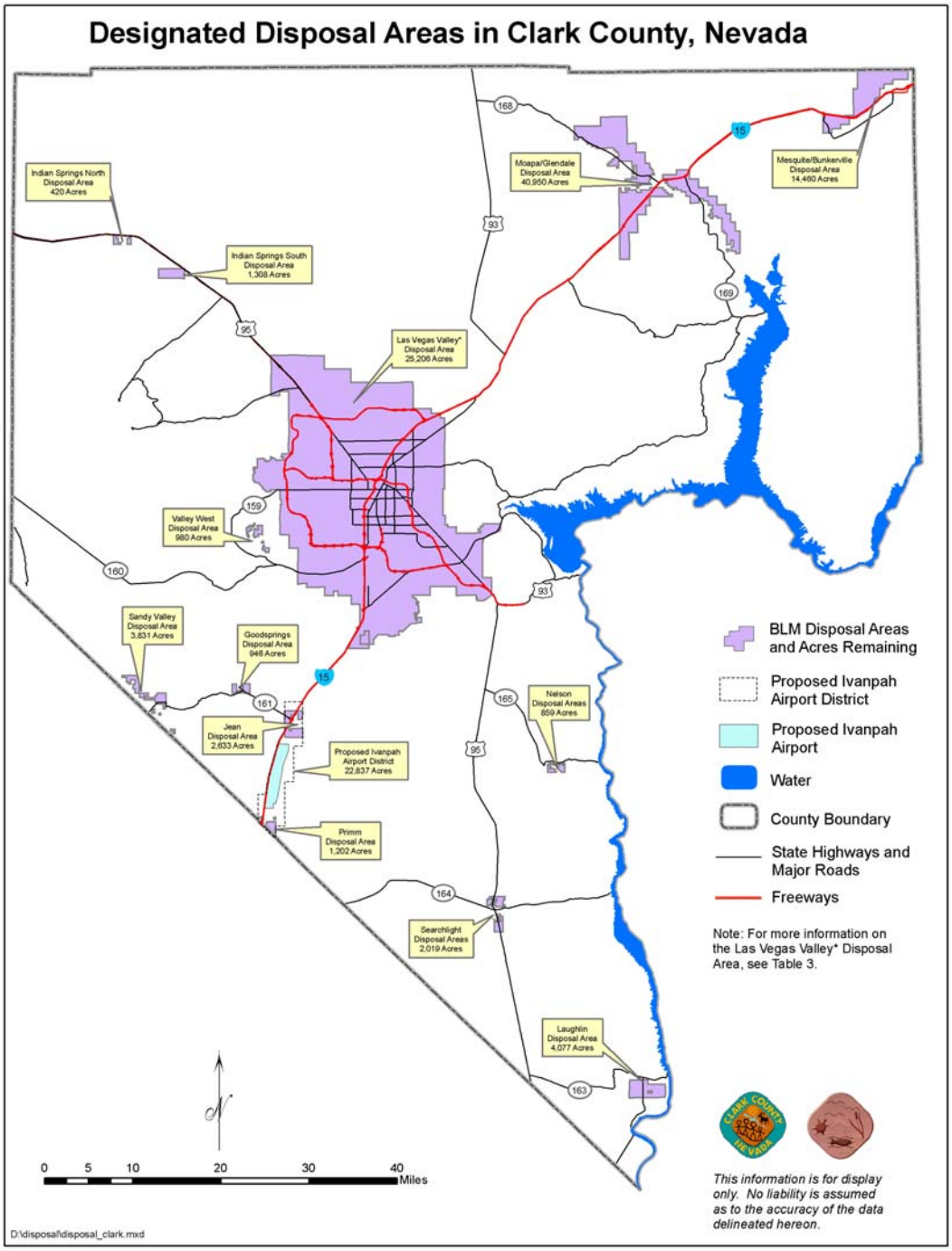


**Figure 2. Designated Disposal Areas in Clark County, Nevada**

## MSHCP MODEL

In winter 2005-2006, the Adaptive Management Science Team (AMST) and representatives from the Implementing Agreement signatory land and resource management agencies (Implementing Agreement agencies) worked with Bill Harris of Facilitated Systems to describe in model form the interactions among species, habitats, land use trends and actions funded in whole or in part to further implementation of the MSHCP. Appendix B contains an digital version of the model. The resulting model will be referred to throughout this document, and an overview is presented here to familiarize the reader with the broad categories of activities that comprise the DCP. This model is a first iteration of our assumptions and hypotheses upon which the DCP is based. The model should be seen as a tool to describe and explore the uncertainties and assumptions inherent in the development of the MSHCP, and its utility to the program should be evaluated in this fashion. The reader is encouraged to explore the digital copy of the model, in appendix B. The model should be examined, critiqued, and either discarded or enhanced as our knowledge grows and our assumptions and hypotheses change in the face of new information. Portions of the model may be expanded to explore those assumptions and hypotheses of most importance to the adaptive management of the DCP.

The AMST worked with Bill Harris to develop a preliminary system dynamics model of the MSHCP and DCP activities. This effort took place during and between the November 2005 and January 2006 AMST meetings. The original goals for the model development project were:

1) Development of a system dynamics model(s) of conservation actions for implementation of the MSHCP,

2) Use of the system dynamics model(s) to prioritize conservation actions to recommend for funding in the 2006 Adaptive Management Report, and

3) Use of the system dynamics model(s) to identify key uncertainties and information gaps to be recommended for funding in the 2006 Adaptive Management Report.

The following text box was extracted from the digital model file and describes the intent of the final model:

*In the past two biennia, the MSHCP's Adaptive Management Program (AMP) has described the need for conceptual models of species to better guide the monitoring of those species' status for the MSHCP. Conceptual models are a means of describing our understanding and hypotheses regarding how species are impacted by changes in their habitat and the surrounding ecosystem. These conceptual models will illustrate points of uncertainty in our understanding of how species may be impacted by take under the MSHCP (species and ecosystem status), as well as how they may be affected by our conservation actions (status as well as effectiveness monitoring).*

*Similarly, the AMP's products and recommendations may have some impact on how decisions are made in the MSHCP, thus affecting what implementation and species status projects are funded, and what questions or hypotheses are addressed with monitoring or research projects. These monitoring and research projects should produce data we can use to assess the status of species and habitat, which will lead to revised future AMP products and recommendations. System dynamics gives us the potential to see how our decisions might affect species in such a feedback system.*

*One might describe our model as a programmatic model of the MSHCP, as it is intended to assist the AMP in examining and describing to non-scientists the higher level interactions among research, species and ecosystem health monitoring, effectiveness monitoring, and the recommendations the AMP must make each biennium to assist the MSHCP in developing their biennial implementation plan and budget.*

*As in all models, this programmatic model is to be iterative. At this stage it is not intended to be a predictive model, but in time with more data it might become robust enough to allow for quantitative risk assessments, allowing us to model the potential impacts of being wrong in one or more of our hypotheses/assumptions. For this iteration, it will assist us in exploring the programmatic hypotheses of the MSHCP, and allow us another avenue to describe our prioritization of recommended projects for the 2007-2009 biennium of the MSHCP.*

The model is composed of five sectors (figure 3), and each sector contains a more detailed model fragment. Each sector and its model fragment are also connected to other sectors of the model. The five sectors and their relationship to the chapters in this Adaptive Management Report are described briefly below:

The DCP funds or augments agency budgets and contracts with independent parties to accomplish information gathering and implementation projects (MSHCP Actions sector) in order to achieve the measurable biological objectives for the 78 covered species and their habitats. These projects are initiated when best available science, data, and / or best professional judgment suggest that the projects are urgent or

important. In addition, recommendations are made regarding the effectiveness of the project's conservation actions, and alternative conservation actions may be suggested. The status of implemented DCP conservation actions and their effectiveness is discussed in chapters 5 and 6, respectively. Recommendations for future implementation are described in chapter 7.

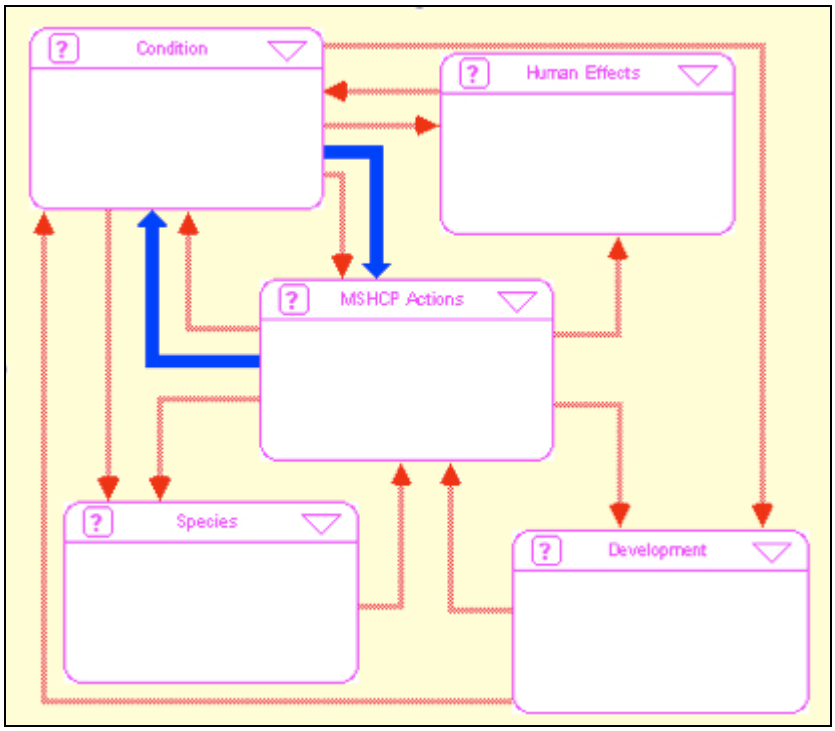


**Figure 3. MSHCP Model Sectors.**

The purpose of the DCP is to implement the MSHCP in order to maintain the section 10 take permit that allows incidental take for species and their habitats under the Endangered Species Act on private and municipal lands in the course of otherwise legal activities, as well as the activities of NDOT within Nevada south of the 38th parallel and below 5,000 feet of elevation. The process to issue land disturbance permits under the section 10 take permit does not discriminate among the types or conditions of habitat (*Habitat Condition* sector) for the 78 covered species (*Species* sector). The AMP is to track land disturbance under the section 10 take permit by habitat in order to better recommend implementation and information gathering projects that will mitigate for the land disturbance or minimize the direct and indirect impacts of the land disturbance, as discussed in chapter 3. The AMP also tracks trends in species population and ecosystem/habitat health over the term of the section 10 take permit, discussed in chapter 4.

The applications for land disturbance under the section 10 take permit are generated by development projects (*Development* sector), which are in turn generated by human population growth onto previously undeveloped lands in Clark County (*Human*

*Effects* sector). These two sectors of the model are not well developed, as the AMST did not have expertise in these areas. However, they do represent our basic assumptions regarding what drives the desire for land disturbance under the section 10 take permit. Included in this sector of the model are the direct and indirect impacts that human population growth in the urban and rural portions of Clark County has on the habitats of the covered species. This is described further in chapter 2. The data generated by monitoring these different yet interconnected components are used to adaptively manage the implementation of the MSHCP (*MSHCP Actions* sector). As described earlier, the status and effectiveness of implemented conservation actions are described in chapters 5 and 6. Recommendations for implementation during the 2007-2009 biennium are described in chapter 7.

The five model sectors are described and examined in greater detail below in the following order: Human Effects, Condition, Development, Species, and MSHCP Actions.

Human Effects

The Human Effects sector describes the direct and indirect impacts that human population growth within Clark County has on the habitats/ecosystems defined in the MSHCP, and the species that require those habitats. As population grows, there are indirect impacts on the remaining habitat (*Impact Per Desert Visit*) through use of its land area. The relationship among human population levels, the area per person that is developed, and the impacts of desert visits per resident are described in this sector of the model. While the model refers to *desert visits*, the model structure describes a generalized habitat that encompasses all eleven ecosystems as defined in the MSHCP (appendix C). Riparian and higher elevation systems and human impacts from use or visits to these areas are included in the generalized habitat sector of the MSHCP model.

The AMST discussed at some length whether the growth in population drives development or whether development drives the growth in population. Because this is not an area of expertise for the AMST and because this sector is not very detailed, it was decided to model development as an exogenous input representing the number of acres proposed for development each year, currently part of the MSHCP Actions sector. If permitted (i.e., if there is land remaining in the permit), then that drives the request for development of land in the Development sector and the take of land in the Condition sector. Ultimately, that take of land creates immigration into the County.

As with all sectors of the model, this is an oversimplification of the direct and indirect effects that the section 10 permitted actions have on species and their habitats. The model should be evaluated and tested for its utility in describing the activities of the DCP, assumptions of the MSHCP and section 10 take permit, and for providing users with insights into the dynamics of the MSHCP implementation system.

The final model sector for Human Effects includes more factors and the calculations and values used for the preliminary simulation. The sector (figure 5) is available for exploration in an ithink™ file included in appendix B of this Adaptive Management Report.

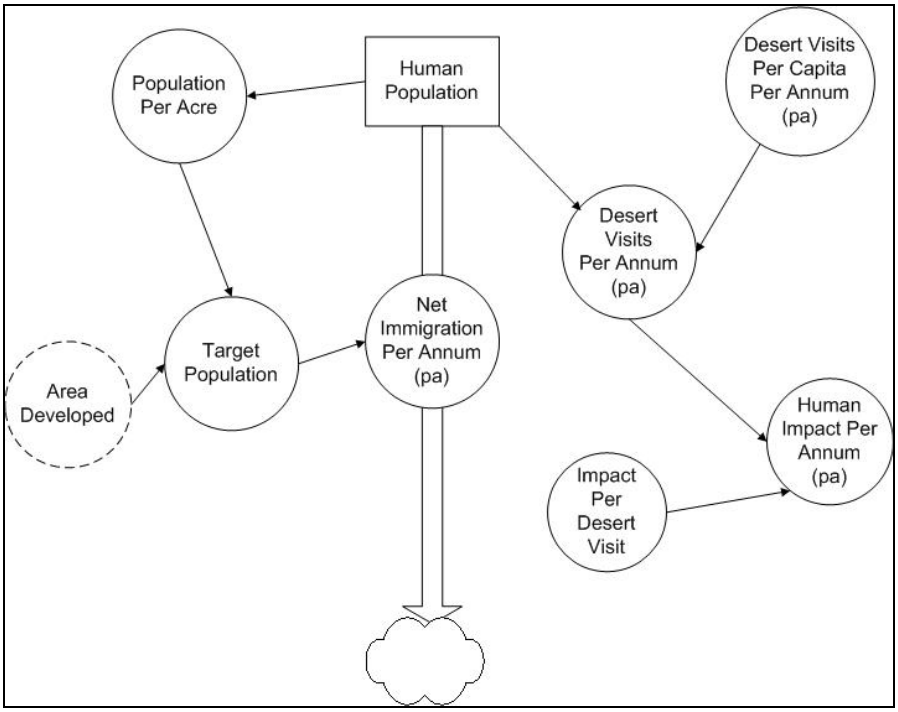


**Figure 4. Summary of Human Effects Sector of MSHCP Model**

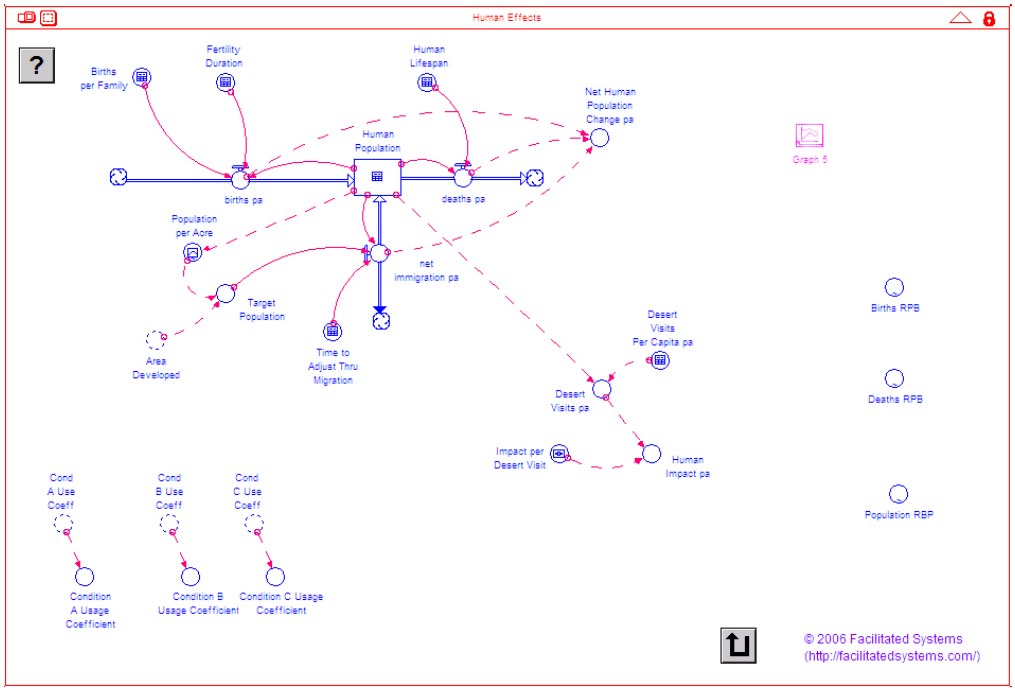


**Figure 5. Final Human Effects Sector of MSHCP Model**

Condition

The Condition sector represents the "condition" of the habitats described as ecosystems in the MSHCP (appendix C). Both habitat and species are modeled in a generalized fashion in this version of the model. The digital version of the model has the capacity to contain values for each species' habitat condition categories. The AMST discussed this sector of the MSHCP model at great length, starting with the conservation management categories defined in the MSHCP (Intensively Managed Areas (IMA), Less Intensively Managed Areas (LIMA), Multiple Use Management Areas (MUMA) and Unmanaged Areas (UMA)) and moving to four threat or stressor categories representing relatively untouched habitat, habitat that was mildly impacted by human activity but could recover on its own, habitat that was more severely impacted by human activity and would need active intervention to recover, and developed land. Those ideas were based on the state and transition model work of Westoby and others (Briske et al 2005), as recommended by one AMST member.

Ultimately, this attempt floundered for two reasons:

- what may be relatively untouched habitat for one species may be severely impacted habitat for another and especially favorable for a third, and
- seral developments and cyclic processes (e.g., fire, flood, drought, often referred to collectively as disturbances) make it difficult to determine what habitat state should be assigned to a particular area of land or water for all species.

The AMST determined that the key was the condition of a particular piece of land or water, as viewed from the perspective of the natural processes at that place as they acted on each species. As defined in table 1, condition A habitat is a place in which all natural processes are functioning, while natural processes in condition B or C habitat have been impacted to a lesser or greater degree.

**Table 1. Definitions of Habitat Condition in MSHCP Model**

| Habitat Condition Category | Definition |
|---|---|
| A | All natural processes are functioning. Seral developments will occur. Natural disturbances are to be expected. |
| B | Some natural processes have been impacted by human intervention, but the impacts can be reversed if the human impact is removed. Human reaction to dramatic natural events (e.g., fires) can lead to a transition of area from condition A into condition B (e.g., fighting fires). |
| C | Some natural processes have been impacted by humans, and this area needs a push to restore it to conditions B or A. |
| D | Developed Area includes commercial buildings, residential developments, streets and highways, and other area taken by humans for their primary use. |

Two interesting statements arise from such a division:

- An area in condition A for one species might be in condition B for another species. This may be because humans may have only impacted processes that impact certain of the species present. It is also possible that some of the species may have conflicting habitat needs, and condition C for one species may equate to condition A for another.
- Area in condition A is not necessarily better for a species than area in condition B or C. Areas in which humans have intervened to protect species are by definition in condition B or C; those interventions may (or may not) have created a more hospitable environment than the original condition A area. Even condition D area may be more advantageous for certain species (e.g., raptors) than condition A area.

As a result of the second statement, it becomes clear that restoring all habitat to condition A for a single species is not an obvious, intermediate-term objective. For example, until the reason for the apparent current decline in the desert tortoise population is understood and categorized as due to human actions, natural seral development, cyclical changes in habitat, or some combination thereof, the MSHCP and the section 10 take permit may require that area be kept in condition B or C, and

it is possible that it is more effective to have condition C as the current goal, even if condition A is the long-term goal.

In addition, the model includes the potential for restoration of condition D to condition C. This may appear to be an unlikely possibility, but the MSHCP contains a provision for acquisition of land from willing sellers and restoration of that land to benefit the covered species. Some lands disturbed prior to the issuance of the section 10 take permit were previously in agricultural use (condition D), have been purchased from willing sellers, and are currently being restored to condition C.

Given this categorization of land, the AMST currently cannot readily categorize a certain area as being in one condition or another. Thus the areas used in the model are selected as representative and sufficient to demonstrate the dynamics of conversion of areas from one category to another but not literally representative of specific acres of land in the County.

As with all sectors of the model, this is an oversimplification of the direct and indirect effects that land disturbance under the section take 10 permit may have on species and their habitats. The model should be evaluated and tested for its utility in describing the activities of the DCP, assumptions of the MSHCP and section 10 take permit, and for providing users with insights into the dynamics of the MSHCP implementation system.

The final model sector for Condition includes more factors and the calculations and values used for the preliminary simulation. The sector is shown in figure 7, and is available for exploration in an ithink™ file included in appendix B.

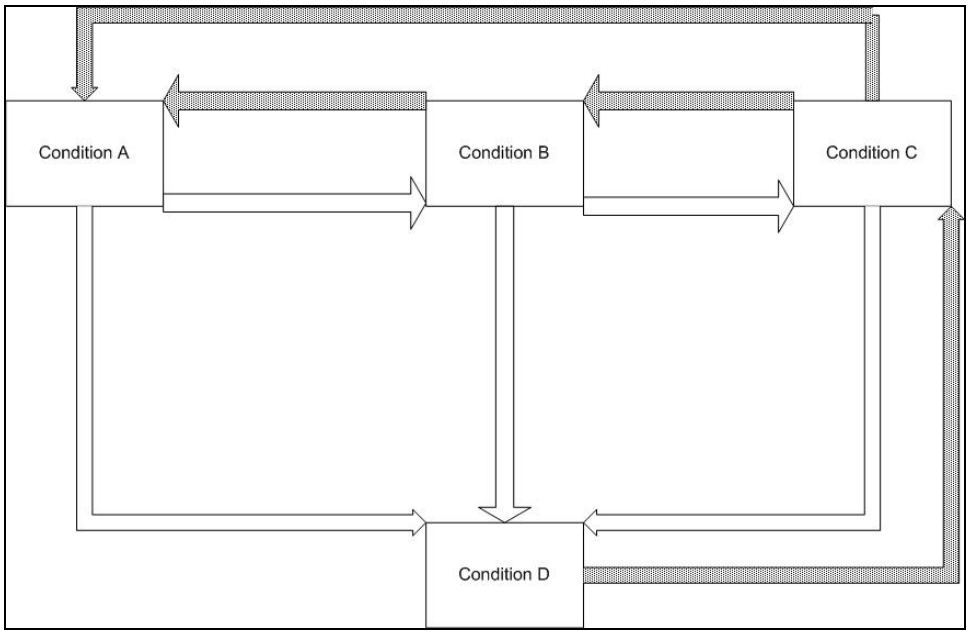

**Figure 6. Summary of Condition Sector of MSHCP Model**

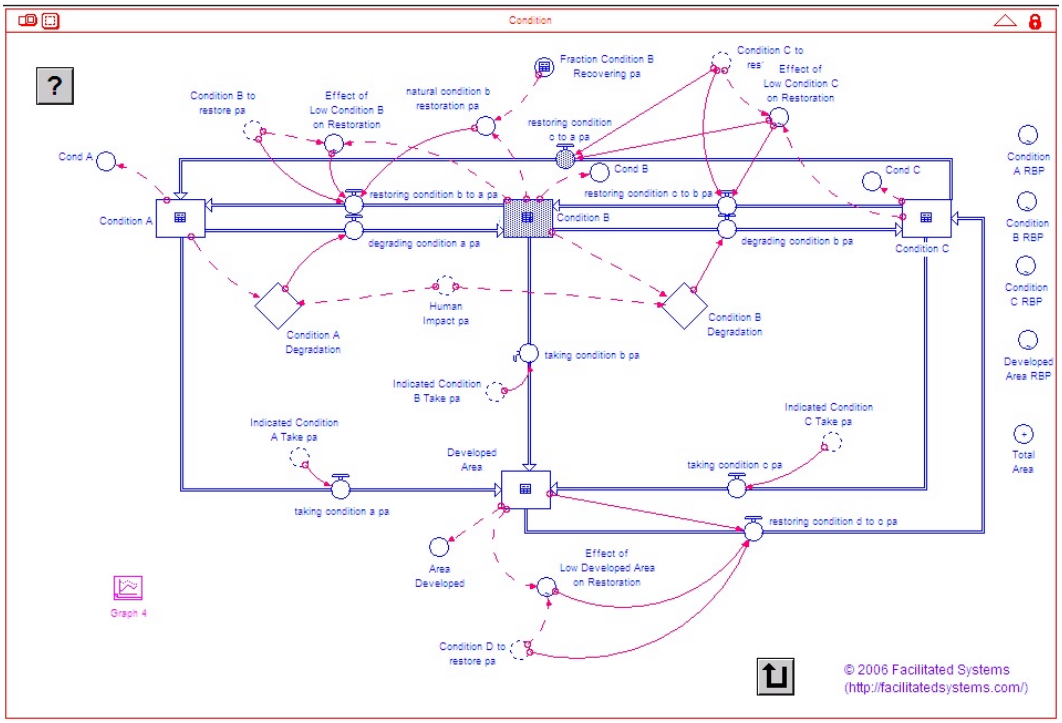


**Figure 7. Final Condition Sector of MSHCP Model**

Development

The Development sector depicts the relationship between issuance of land disturbance permits under the section 10 take permit and the habitats/ecosystems within which conservation actions take place. Figure 8 summarizes the key components of this model sector. Land to be developed is either taken in fixed proportions from areas of all three conditions or, alternatively, in the same proportion to the proportion of available acres in each condition under the section 10 take permit.

There is no mechanism in the MSHCP for a permittee to deny a land disturbance application based upon the habitat condition of any desired land that is eligible for disturbance under the section 10 take permit. This proportional disturbance and reduction of habitat results in different numbers of acres being removed from each category of habitat, based upon the available acres in each category. The person running the model can choose fixed proportions of take by condition or take proportional to the existing available land by condition, whichever is deemed to represent the current situation most appropriately. This is represented in the highlighted circles (*Indicated Condition [X] Take Per Annum*) in figure 8.

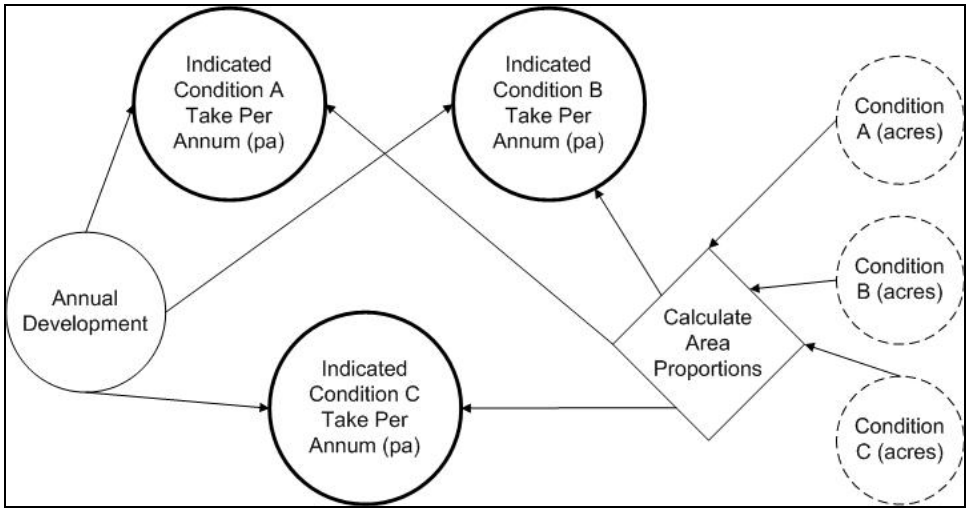


**Figure 8. Summary of Development Sector of MSHCP Model**

As with all sectors of the model, this is an oversimplification of the direct and indirect effects that the section 10 permitted actions have on species and their habitats. The model should be evaluated and tested for its utility in describing the activities of the DCP, assumptions of the MSHCP and section 10 take permit, and for providing users with insights into the dynamics of the MSHCP implementation system.

The final model sector for Development (figure 9) includes more factors and the calculations and values used for the preliminary simulation. The sector is available for exploration in an ithink™ file included in appendix B.

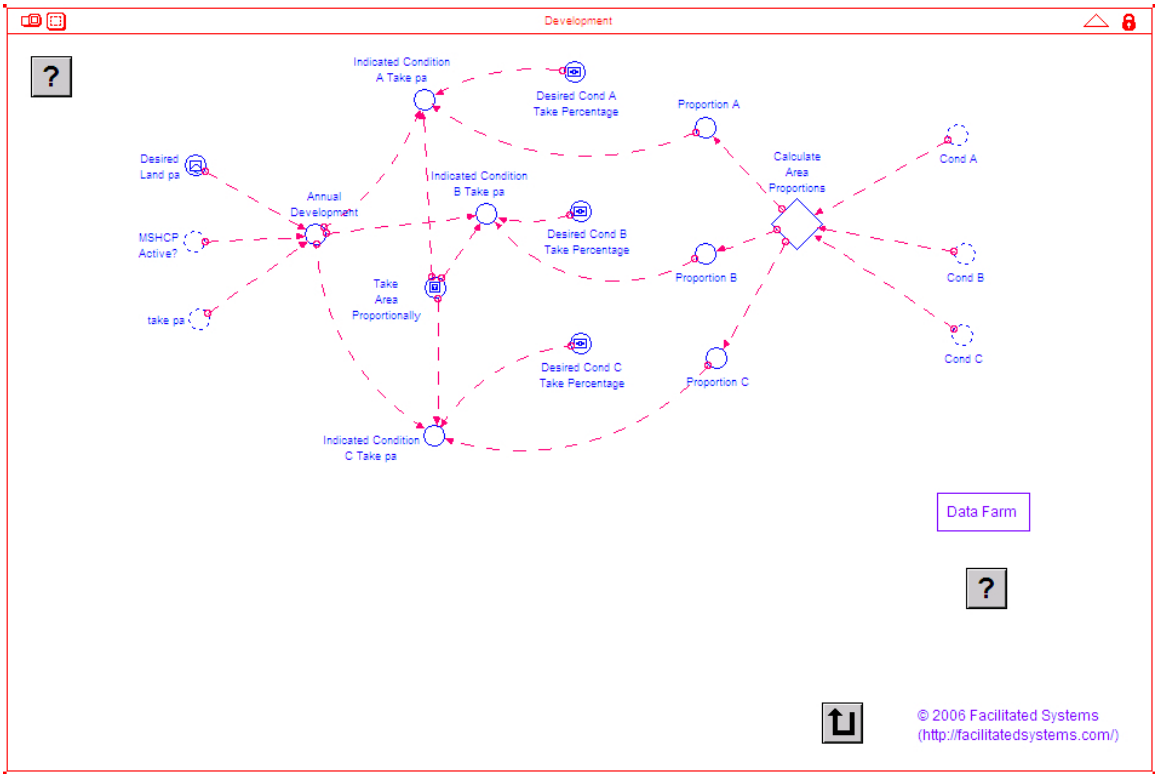


**Figure 9. Final Development Sector of MSHCP Model**

Species

The Species sector provides a very simplified model of how species populations are impacted by the amount of habitat in each condition category and thus are impacted by the overall "health" or condition of habitats in the County. Both habitat and species are modeled in a generalized fashion in this version of the model. The digital version of the model has the capacity to contain values for each species' habitat condition categories. The details of species autecology/life history/interactions with other species, their environment and landscape level ecosystem processes were not depicted in this generalized model.

We hypothesized in this model that there are fewer species per acre in lower quality habitat conditions, but allowed for the possibility that there may be some individuals residing in habitat conditions C and D. In addition, we also hypothesized that there are time lags in the response of species population levels to changes in the number of acres in each habitat category. In this way our model accommodates both the indirect effects of habitat loss over time, as well as the time lag of species population response to restoration and other mitigation activities. The five highlighted symbols and connecting arrows in figure 10 represent arrays of values, one value for each of the four conditions. That is, while the *Indicated Condition [X] Species Population* calculation is shown once for each condition category, the symbols shown in bold represent the set of values for those parameters in each of the condition areas.

As with all sectors of the model, this is an oversimplification of the direct and indirect effects that the section 10 permitted actions have on species and their habitats. The model should be evaluated and tested for its utility in describing the activities of the DCP, assumptions of the MSHCP and section 10 take permit, and for providing users with insights into the dynamics of the MSHCP implementation system.

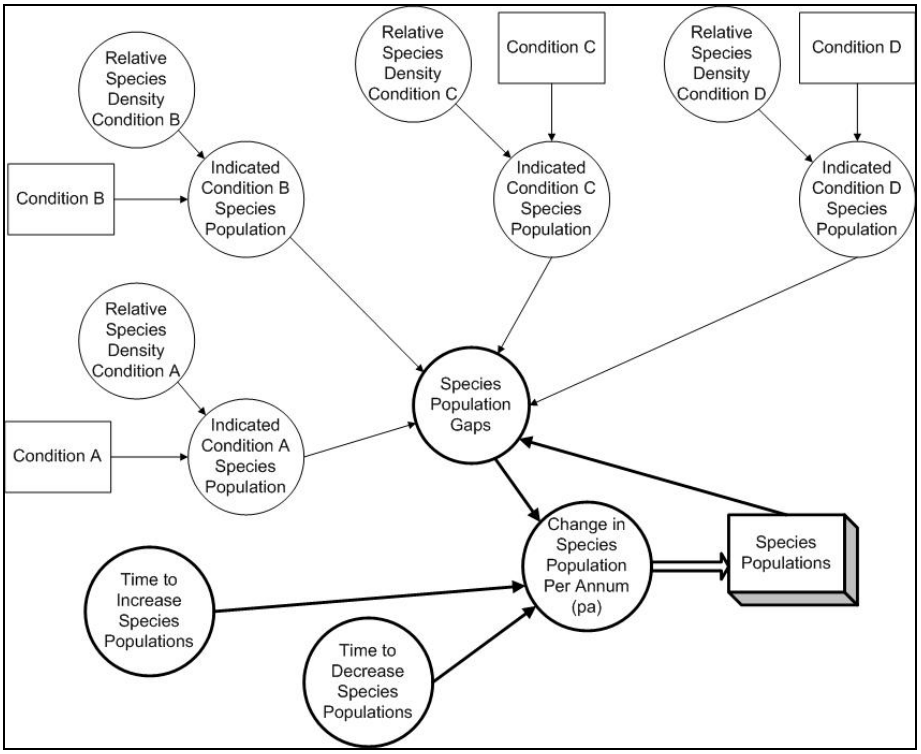


**Figure 10. Summary of Species Sector of MSHCP Model**

The final model sector for Species includes more factors and the calculations and values used for the preliminary simulation. The sector is shown in figure 11, and is available for exploration in an ithink™ file included with this Adaptive Management Report.

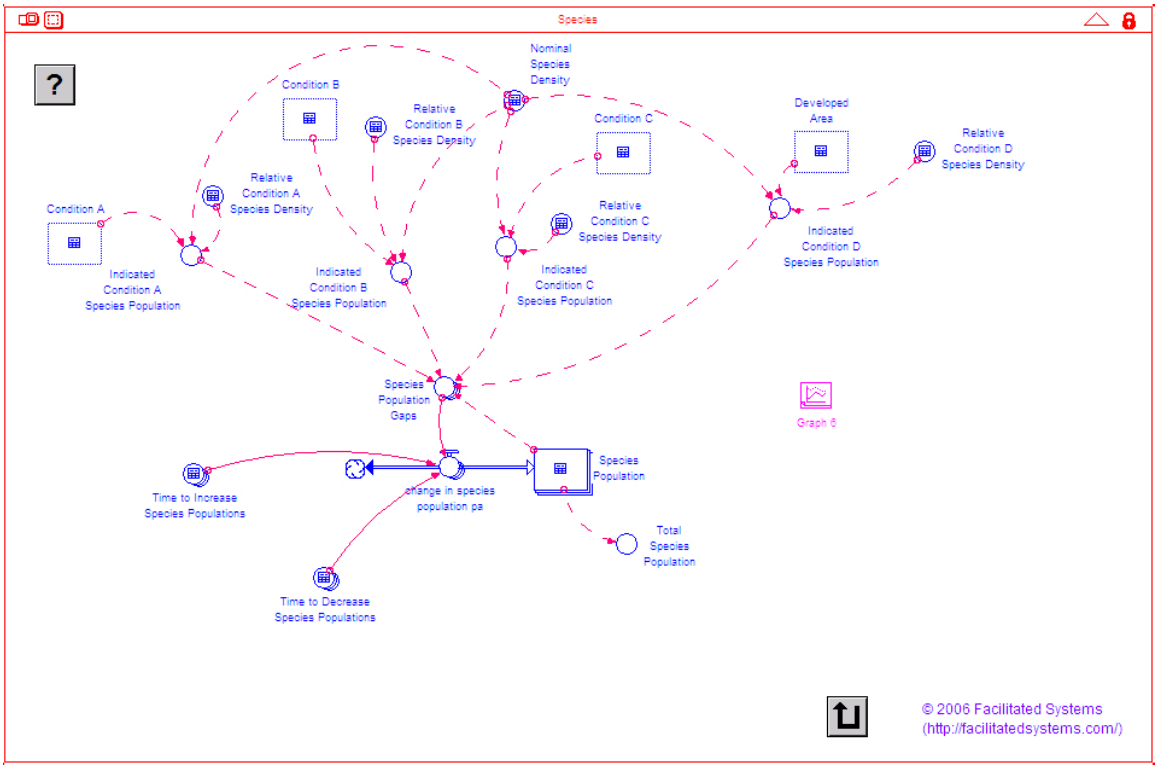


**Figure 11. Final Species Sector of MSHCP Model**

MSHCP Actions

This sector of the MSHCP model depicts the actions (land disturbance permitting and implementation of conservation actions) of the DCP that may impact the "health" or condition of the habitats/ecosystems defined in the MSHCP and the manner in which new information enters the adaptive management portion of the DCP. Conservation actions as modeled here include both actions to restore land from conditions B, C, or D as well as actions to restrict land use and thus restrict the further degradation of condition A or B area (by this model, condition C area will not degrade further). In general all conservation actions will fall into one of those two categories.

The upper right corner of figure 12 depicts the land disturbance permitting process. Applications for land disturbance are made to each municipality, and the County, as Plan Administrator, updates the cumulative disturbance report to the USFWS (*Cummulative Take*). The model does not simulate land disturbance beyond the current acreage cap of the MSHCP and section 10 take permit, which is 145,000 acres.

In the remainder of figure 12, the cycle of information flow in the AMP is depicted. The information flow begins with implementation of conservation actions, including monitoring (*Gathering Information*) and analysis of monitoring data (*Processing and Distributing Information*), flows through the development of the implementation plan

and budget for each biennium (*Funding Programs*) and influences both *Land Use* and *Restoration Plans*. The lower right corner of the model depicts the restoration of habitat conditions B, C, or D as determined by the values in *Restoration Plans*. The cycle in the MSHCP model is complete when new values are calculated for acres in each condition category. This portion of the MSHCP Actions sector simulates the time lag that occurs between the point of gathering data and the point in time where analyses of that data begin to influence management decision that impact conservation actions such as restoration plans and policies that influence land use.

As with all sectors of the model, this is an oversimplification of the direct and indirect effects that the section 10 permitted actions have on species and their habitats. The model should be evaluated and tested for its utility in describing the activities of the DCP, assumptions of the MSHCP and section 10 take permit, and for providing users with insights into the dynamics of the MSHCP implementation system.

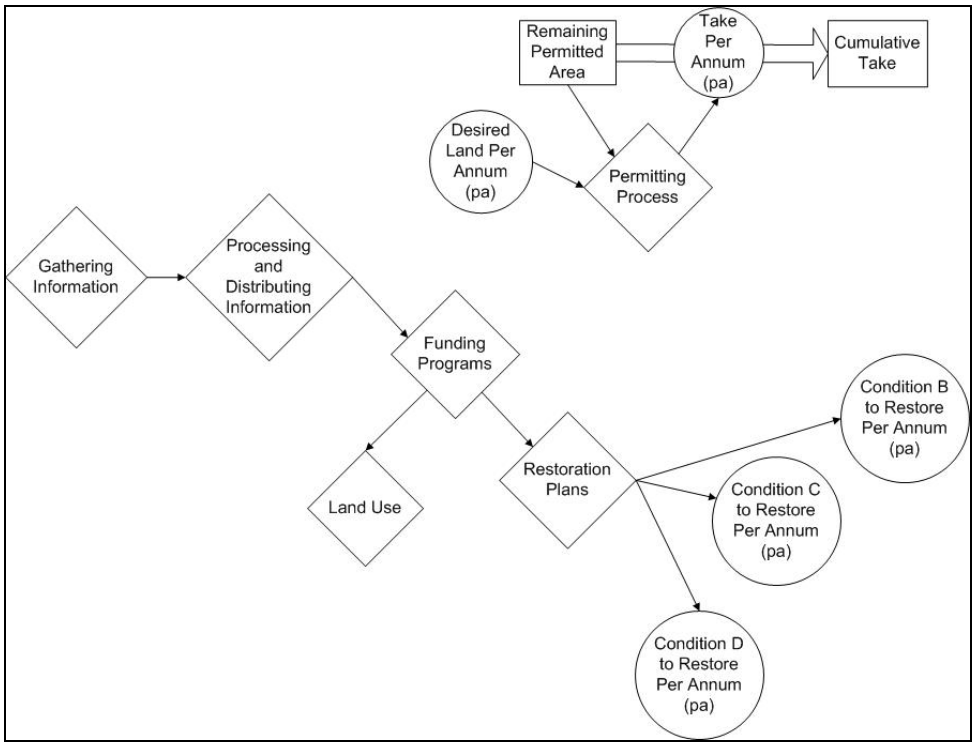


**Figure 12. Summary of MSHCP Actions Sector of MSHCP Model**

The final model sector for MSHCP Actions includes more factors and the calculations and values used for the preliminary simulation. The sector is shown in figure 13, and is available for exploration in an ithink™ file in appendix B.

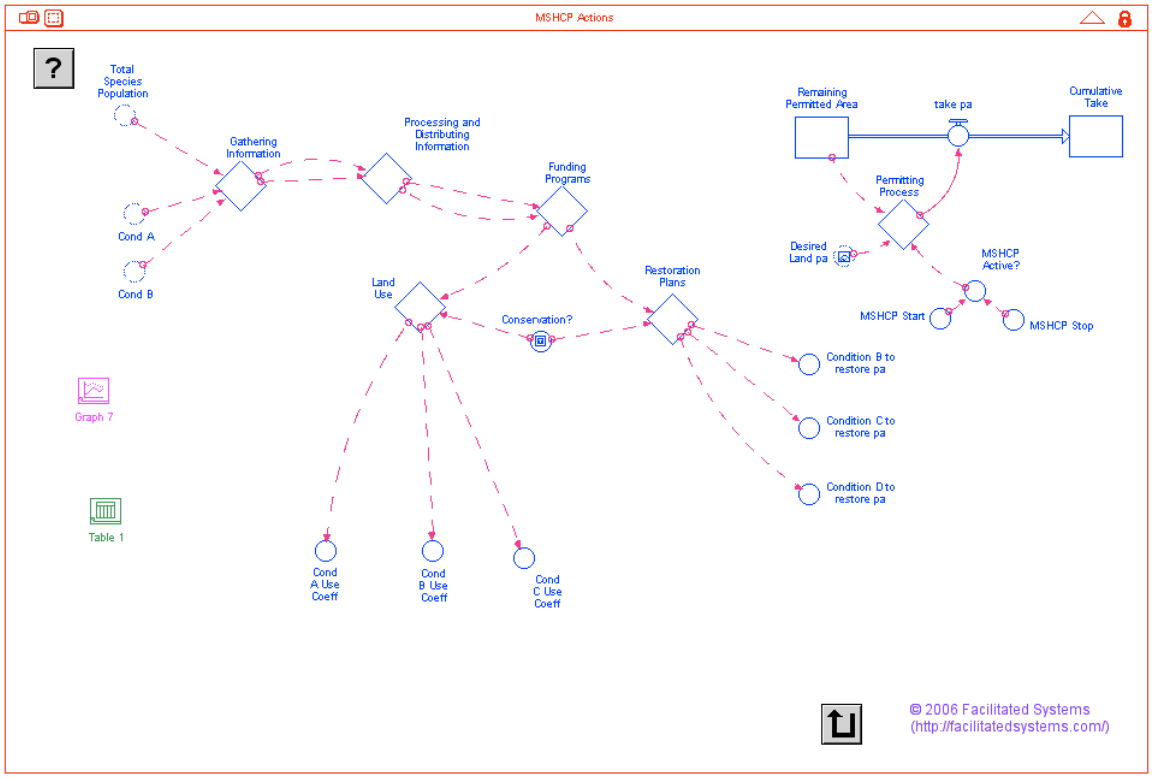


**Figure 13. Final MSHCP Actions Sector of MSHCP Model**

The MSHCP model can be used to describe and explore the relationships among the various facets of the DCP. The digital version of the MSHCP model (appendix B) includes the values set for each item in the model, as well as the equations that define the dynamic relationships between items. The person exploring the model can simulate different scenarios by editing the values in the digital version of the model. Of particular interest to many readers may be the ability to alter the hypothesized values of desired take per annum (land disturbance under the section 10 take permit per year) in the Development sector, percentage of condition C habitat restored to condition B in the Condition sector, and the time lags among the steps in the AMP information flow in the MSHCP actions sector. Exploration of the model and comparison of results with observed or expected outcomes can test the model as well as the hypotheses upon which it was built.

The sectors of this model may also be useful as a template for development of more explicit species or habitat specific sectors. Alternatively, the model sectors can be compared to other models that describe the MSHCP implementation. Techniques for involving both technical and stakeholder interests in development of similar models are described in the adaptive management literature (van den Belt 2004). The inclusion of both stakeholders and experts such as biological scientists in a facilitated

model development process can lead to more common understanding and agreement among the participants. Van den Belt describes a process that includes the use of system dynamics modeling methods, but the choice of modeling method should be driven by the objectives of the modeling project.

# CHAPTER 2 LAND USE TRENDS

*Co-authors Rob Mrowka and Sue Wainscott*

- **Land use trend tracking is a task of the Adaptive Management Program.**
- **Since the start of the Multiple Species Habitat Conservation Plan, anticipated land use trends and land uses have occurred.**
- **The pace at which these trends and uses have occurred is faster than anticipated.**

The Adaptive Management Program (AMP) for the Clark County Multiple Species Habitat Conservation Plan (MSHCP) was tasked with analyzing land use trends to The intent of this AMP task is to ensure that land disturbance under the section 10 take permit is balanced with implementation of conservation actions (RECON 2000 p 2.179 and USFWS 2001a p 2.6). Uses of land, both private and public, were expected to have both direct and indirect effects on the covered species and their habitats. These direct and indirect effects are described in the Environmental Impact Statement (EIS) for the MHSCP and the Biological Opinion for the section 10 Take Permit. Coordination between Clark County as Plan Administrator and the USFWS to better define this AMP task have been initiated and are continuing. The AMP will use the outcome of this coordination to define a process and regularly updated tracking system for land use trends that will better inform adaptive management of the MSHCP. For this Adaptive Management Report, this task was determined to be a general update to the EIS description of major land uses that might impact the covered species and their habitats, described in MSHCP section 2.3.2.2 (RECON 2000 p 2.36). Data on land use activities or planning documents that might indicate major changes in land use trends are also described in this section.

## AGRICULTURE

Both farming and ranching continue to occur within Clark County, but to a lesser extent than in the past. Ranching is discussed below under Livestock Grazing. Some farmed lands are planned to be or are being converted to residential and commercial uses in the Moapa Valley, Mesquite and Las Vegas Valley.

## FLOOD CONTROL

The Clark County Regional Flood Control District has implemented portions of the Regional Flood Control Plan as amended (Clark County 2004) in the Las Vegas Valley as well as in Mesquite and Moapa Valley.

## LIVESTOCK GRAZING

The Bureau of Land Management (BLM) continues to administer active grazing permits under the BLM's Las Vegas Field Office Resource Management Plan (RMP: BLM 1999) prescriptions and stipulations of section 7 consultations with the USFWS. Since issuance of the section 10 take permit for the MSHCP, additional grazing rights have been purchased and grazing will be retired pursuant to provisions of the Desert Conservation Plan (RECON 1994).

## WILD HORSES AND BURROS

No significant changes have occurred in this land use since issuance of the permit. BLM continues to manage wild horses and burros as provided by the Las Vegas Field Office RMP (BLM 1999). The U.S. Forest Service (USFS) also continues to manage wild horses and burros as provided by the Forest Plan for the Spring Mountains National Recreational Area (USFS 1987). The National Park Service (NPS) also continues to remove burros from lands in Lake Mead National Recreation Area (NRA) under the approved Management Plan (NPS 1999) and Burro Management Plan (NPS 1995) for the Lake Mead NRA.

## MINERAL EXTRACTION

No significant changes have occurred in this land use since issuance of the section 10 take permit for the MSHCP.

## OFF-HIGHWAY VEHICLE ACTIVITIES

No significant changes have occurred in this land use since issuance of the permit. The Rural Roads Adaptive Management Plan and the associated roads database described in the MSHCP are under development. The current status of the Rural Roads Adaptive Management Plan is discussed further in chapter 6.

## PARKS AND RECREATION

It might be hypothesized that increases in human populations (both residents and tourists who visit the area) correlates in some fashion with the rate of land use on the public lands surrounding the urban portions of the County. This is informative to the AMP because these public lands form the conservation management areas upon which much of the implementation of the MSHCP takes place. Thus, information was also sought on rate of public recreational use of the federal land management units. The Desert National Wildlife Refuge System estimates their lands are used by 68,000 visitors annually (USFWS 2005). In addition, the Las Vegas Visitors and Convention Authority recently released the results of surveys conducted on Las Vegas Valley, Laughlin and City of Mesquite visitor activities in 2004 (GLS

Research undated a, b, c). Las Vegas Valley visitor respondents, 31% reported visiting Lake Mead, 3% visited Valley of Fire, and 3% visited Mt. Charleston (GLS Research undated a). Survey results for Laughlin and City of Mesquite were also compared to results of a 2003 survey. There was an apparent decrease in the percentage of Laughlin visitor respondents that reported visiting Lake Mead (12% in 2004 compared to 16% in 2003) but this difference was not statistically significant (GLS Research undated b). Fewer City of Mesquite visitor respondents reported visiting Lake Mead (6 % in 2004 compared to 10% in 2003) and there was no significant change in the percentage that reported visiting Valley of Fire (8% in 2004 and 7% in 2003: GLS Research undated c.) Few additional data were available from a search of the Internet, and additional time was not dedicated to this search.

Updates are planned or completed for several of the Federal Land Management plans that informed the conservation actions listed in the MSHCP. These include the ongoing development of a Comprehensive Conservation Plan for the Desert Wildlife Refuge System (includes Moapa Valley National Wildlife Refuge and the Desert Wildlife Refuge), amendments to the GMP for Lake Mead NRA, and Red Rock Canyon National Conservation Area (NCA) Management Plan. Another ongoing land use planning effort is a USFS road designation effort for the Spring Mountains NRA and a Forest Plan revision has been initiated for the entire Humbolt-Toiyabe District. Since issuance of the section 10 take permit for the MSHCP, Lake Mead NRA also instituted an entrance fee for all users of the NRA. In 2002, Public Law (PL) 107-282 designated Sloan NCA, and BLM recently completed the Management Plan and EIS for this area.

PL 107-282 also designated Wilderness areas and released Wilderness Study Areas. Efforts are underway to determine the impacts that PL 107-282 and other land use designation changes that have occurred since the approval of the MSHCP may have on the MSHCP's general measurable biological goal for all covered species of no net unmitigated loss or fragmentation of habitat. These efforts are discussed below.

Summary of the BLM's MSHCP Land Designation Change Analysis.

BLM is undertaking an analysis of changes to the conservation management categories identified in the Clark County MSHCP). This analysis was prompted by passage of Public Law 107-282, the Clark County Conservation of Public Land and Natural Resources Act of 2002, which in part made changes to the boundaries of Wilderness, Wilderness Study Areas and the Las Vegas Valley disposal areas. The new Las Vegas Valley disposal area boundary is shown in figure 2. This analysis will include:

(1) identification of the species covered under the MSHCP that may be affected by changes in designation of Federal land management;
(2) the anticipated changes in land management in these areas;
(3) identification of the effects to the covered species resulting from management changes;

(4) lands that could be further protected to mitigate for loss of any protected lands; and
(5) recommendations for mitigation/protection.

A technical review team composed of the BLM, USFWS and the Plan Administrator of the MSHCP will review the design of the analysis as well as preliminary and final results.

Additional Public Land Use Trends

During the 2003-2005 biennium the AMP did not actively track land use trends on public lands. Additional mechanisms to efficiently summarize or spatially represent in map form public land use trends are not currently available. However, data do exist that could be better used to describe the uses of public lands that would be informative to the AMP. For instance, the BLM tracks permitted actions, such as installation of utility infrastructure, in a nationally standardized BLM Lands Records (LR) database called LR 2000 that contains the Master Title Plats for all rights of way, land, mineral and water rights as well as infrastructure on BLM managed lands. This database stores locations of permitted actions in a spatially explicit format, but it is not compatible with the Geographic Information System (GIS) software currently used by the DCP, nor is it tied to a relational database function that allows for summary queries of the content.

In addition, many Federal actions are taken with other than DCP-administered funds that may minimize or mitigate the direct and indirect impacts of the section 10 take permit, described in chapter 5. For instance, many agency actions funded by the Conservation Initiatives portion of the Southern Nevada Public Lands Management Act (SNPLMA) fund have been proposed, and several have been initiated or completed. A comprehensive report on how these actions may affect the 78 species and habitats covered by the MSHCP take permit is not currently available.

## RESIDENTIAL / COMMERCIAL / INDUSTRIAL DEVELOPMENT

Land Disturbance Report

Under the section 10 permit, implementation of the MSHCP is to mitigate for the take of habitat within Clark County, not to exceed 145,000 acres of previously undisturbed land. Of this sum, 15,000 acres were exempted from payment of the land disturbance fee. These exempt acres are to be used for community and local jurisdiction public purposes. Each permittee (Cities (see figures 14 and 15), County and Nevada Department of Transportation) administers land disturbance permits and fee collection for acres under their jurisdiction. The permittees regularly submit reports and fees to Clark County who administers an endowment fund for the collected section 10 fees. The County also tracks overall land disturbance statistics using the information contained in the reports from the other permittees. In these reports, the current Clark County Assessor Parcel Number for the acres permitted for disturbance

are provided. However, current databases do not allow for analyzing or displaying disturbed lands in a geospatial fashion. This limitation in current databases will be discussed in further detail in chapter 3, habitat loss by ecosystem.

The MSHCP describes a quarterly report to be provided by the County to the USFWS on the number of acres disturbed in the valley, and the land disturbance fees collected for this disturbance. The report has been delivered to the USFWS during regularly scheduled meetings of the stakeholder advisory group. The latest report was delivered to the USFWS on 25 January 2006 (appendix D). At this time, reported acres disturbed (minus the 15,000 acres exempted from fees for municipal use) were 44,148 over the life of the section 10 permit. This leaves approximately 85,842 non-exempt acres remaining for disturbance through the life of the permit. The rate of take is approximately 2,500 acres per quarter.

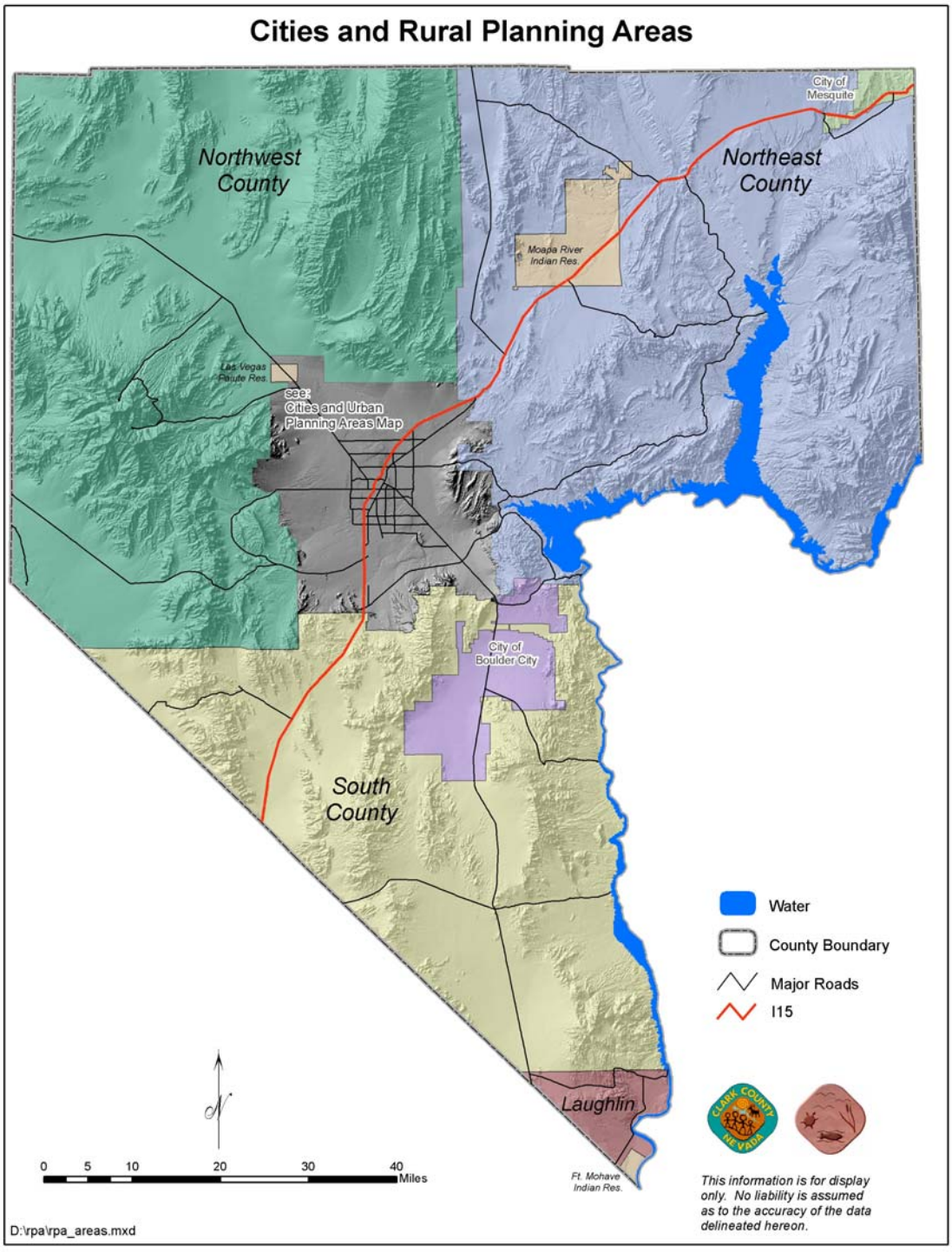


**Figure 14. Cities and Rural Planning Areas**

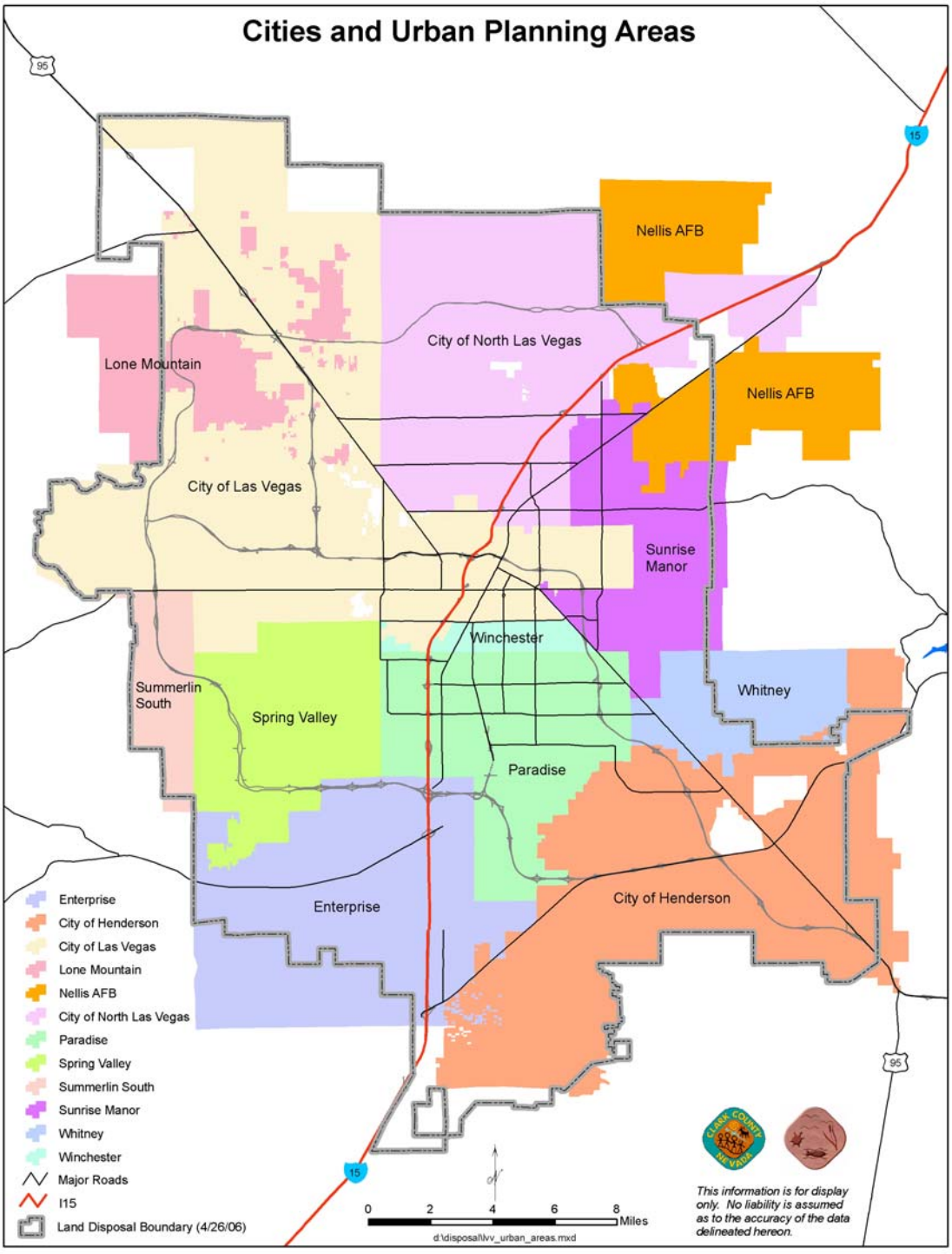


**Figure 15. Cities and Urban Planning Areas**

Private Land Development / Habitat Disturbance Patterns in Clark County

The Clark County Department of Comprehensive Planning maintains a database/tracking system of land use types within the eleven unincorporated Clark County Planning Areas (figures 14 and 15). This does not include those acres incorporated in the five cities within the boundaries of Clark County. In addition, these land use categories do not precisely correspond with disturbance under the MSHCP section 10 take permit. However, they can help detect patterns of land disturbance within the unincorporated portions of the County. As of July 1, 2004 there were a total of 4,791,397 acres in unincorporated Clark County. The figures for built land use, open space versus vacant lands in unincorporated Clark County are in table 2. Similar data may be available for the Cities, but these data were not compiled for this Adaptive Management Report.

**Table 2. Geographic Integrated Land Use and Information System Data. Source Clark County Department of Comprehensive Planning, July 1, 2004**

| Planning area | Built Acres[2] | Other Acres[3] | Vacant Acres | Total |
|---|---|---|---|---|
| Enterprise[1] | 9,755 | 3,883 | 29,313 | 42,950 |
| Lone Mountain[1] | 4,063 | 1,145 | 13,917 | 19,125 |
| Spring Valley[1] | 11,623 | 3,852 | 7,390 | 22,865 |
| Summerlin South[1] | 2,228 | 1,061 | 2,840 | 6,129 |
| Sunrise Manor[1] | 13,795 | 3,358 | 6,827 | 23,981 |
| Whitney[1] | 6,910 | 711 | 18,326 | 25,947 |
| Winchester / Paradise[1] | 21,207 | 6,048 | 3,066 | 30,321 |
| Northeast County | 38,955 | 106,694 | 1,563,107 | 1,708,756 |
| Northwest County | 11,418 | 5,467 | 1,693,857 | 1,710,742 |
| South County | 12,217 | 20,891 | 1,099,773 | 1,132,881 |
| Laughlin | 6,452 | 1,675 | 59,572 | 67,700 |
| Subtotals | 138,623 | 154,785 | 4,497,988 | 4,791,397 |

1 – Planning area is within Las Vegas Valley.
2 – Land Use Type categories: Single family, Multi-family, Neighborhood Retail, Community Retail, Regional Retail, Hotel, Office, Industrial, Non-Retail / Other, Schools, Open Space (inclusive of parks, trails, flood control facilities, conservation areas and golf courses).
3 – These areas include some rights of way (especially federal highways), easements, water features and minor improvements.

Land Available for Future Disturbance

As previously described, the availability of land for disturbance under the MSHCP section 10 take permit can be viewed as coming from two sources – privately held lands, and federal lands made available by Congress or the managing federal agency for disposal to private individuals for development. The land disturbance report submitted to the USFWS on 25 January 2006 (appendix D) shows that at least 44,158 acres have been disturbed under the current permit. This is almost twice that which was anticipated at this point in implementation of the 30 year section 10 take permit for the MSHCP. With 85,842 non-exempt acres remaining under the section 10 take permit, if the current pace of development were to continue, this would leave Clark County with nine to ten years worth of land that is "disturbable" or "developable" under this MSHCP's section 10 take permit. After the acreage cap is reachedfor the MSHCP's section 10 take permit, additional take of desert tortoise or its habitat would require the land owner to obtain a separate permit from the USFWS.

The MSHCP's permit currently addresses all previously undeveloped private lands in the County up to a total of 145,000 acres, regardless of the locations of these disturbed acres. This 145,000 acre cap is separate from and has no direct relationship to the SNPLMA and other Congressional and Administrative disposal area boundaries in Clark County. Lands disposed of by the BLM after the issuance of the section 10 take permit are included in the private lands that may be disturbed under the terms of the section 10 take permit on a first come first serve basis. In fact, there is more land available in the SNPLMA disposal boundary (including both existing undeveloped private lands with BLM lands identified for privatization) than is currently allowable for disturbance under the MSHCP permit cap. In addition, a recent federal law, the Clark County Conservation of Public Land and Natural Resources Act of 2002 (PL 107-282), changed the disposal area boundary for the Las Vegas Valley (figure 2). Passage of this law increased the number of BLM managed acres that might be nominated for disposal (sale) to private entities or to local governments for Recreation and Public Purpose (R&PP) leases. Additional impacts of PL 107-282 were discussed earlier in this document.

There are thirteen designated disposal areas throughout Clark County (figure 2). Table 3 below lists the congressionally and administratively designated disposal areas in Clark County, along with the current acres available for disposal in each of the areas. In addition, the proposed footprint of the proposed Ivanpah airport and congressionally designated airport district are depicted. Most disposal activity to date has occurred within the Las Vegas Valley and Mesquite disposal areas.

**Table 3. BLM Disposal Areas and Acres Remaining for Disposal as of January 01, 2006.**

| Disposal Areas | Remaining BLM Acres Available for Disposal |
|---|---|
| Goodsprings | 946 |
| Indian Springs South | 1,308 |
| Indian Springs North | 420 |
| Jean | 2,633 |
| Las Vegas Valley* | 25,206 |
| Laughlin | 4,077 |
| Mesquite/Bunkerville | 14,460 |
| Moapa/Glendale | 40,950 |
| Nelson | 859 |
| Primm | 1,202 |
| Sandy Valley | 3,831 |
| Searchlight | 2,019 |
| Valley West | 980 |
| GRAND TOTAL | 98,819 |

* Excludes BLM lands previously sold and known R&PP Leases

Private lands available within Clark County are a rapidly changing commodity, and the exact acre figure is difficult to pin down. In addition, the MSHCP Cap applies only to lands undisturbed at the time the permit was issued, a figure difficult if not impossible to derive from existing databases. The best estimate of privately available vacant land within the Las Vegas Valley is about 68,000 acres (including Tribal lands and Nellis Air Force Base) and outside the Valley the estimate is about 80,000 acres. The approximately 148,000 privately available acres plus the 98,819 acres remaining available for disposal totals 246,891 acres that could potentially apply for a land disturbance permit under the MSHCP.

Likely areas to see continued or increased private land development are the North, Northwest and Southwest portions of the Las Vegas Valley; Coyote Springs; Apex; Bunkerville; Mesquite; and the Moapa Valley area. Based on an analysis of the situation and applying professional judgment, it is estimated that over 100,000 acres

of currently available private or vacant land are likely to seek a land disturbance permit over the term of the existing section 10 take permit.

Planned Private and Municipal Land Uses

The Clark Growth Task Force found that nearly 1/3 of urban Las Vegas Valley is vacant land that has not yet been developed as built land use or designated as open space (Growth Task Force 2005). The MSHCP and section 10 take permit do not allow for denial of land disturbance permits under the section 10 take permit until the cap of 145,000 acres is reached. Undisturbed lands within the disposal areas are classified as MUMA. However, the MSHCP has a goal of no net unlimited loss or fragmentation of IMAs or LIMAs, or MUMAs where they represent the majority of habitat for a covered species (RECON 2000 p 2.7). Thus, MUMA acres isolated within an urban matrix may be of concern to the AMP if a covered species relies upon them for more than 50% of their distribution. The AMP may need more spatially explicit data to properly track the impact of land disturbance permits on the general measurable biological goal for all species of no net unmitigated loss or fragmentation in IMAs, LIMAs, and of MUMAs where MUMA (figure 1) represents the majority of a covered species' habitat. The data received with each permit for land disturbance under the section 10 take permit include the assessors parcel number for the area permitted. The potential to convert these data to a GIS compatible database for further analysis are discussed in chapter 4, and recommendations made in chapter 7.

In their 2005 report, the Clark County Growth Task Force recommended to the Clark County Board of County Commissioners that infill projects be given priority with special staff permitting and licensing teams and that infill parcels be "pre-zoned in order to reduce construction delays." (Growth Task Force Report 2005) The Task Force also recommended development and approval of a new zoning layer that would encourage more dense housing developments in high-rise buildings. These policies might encourage more population density within Las Vegas Valley, and encourage use of the vacant lands within the valley over disturbance of lands outside the valley, but these policies are in the planning and study phase, and have not yet been proposed for inclusion in the Clark County Comprehensive Plan (Clark County 2006b).

## SOLID WASTE FACILITIES

No significant changes have occurred in this land use.

## TRANSPORTATION

Many of the transportation construction, widening and expansion projects anticipated in the MSHCP have been initiated or completed. The Clark County Comprehensive Plan as amended (Clark County 2006b) includes plans for an additional outer beltway and road network expansion to the north and northwest of existing development in the Las Vegas Valley within or on the western, northern and eastern edges of the Las Vegas Valley disposal area, as well as expansion of the road system in the

southwestern portion of the disposal area. Additional expansions of the transportation system include a continuation of Rainbow Boulevard in the south portion of the Las Vegas Valley to a connection with state route 161 to the west of Jean, Nevada, and expansions of Interstate 15 and Highway 95. The Hoover Dam bypass Colorado River Bridge is in the design phase and the Boulder City bypass is in the planning phase. A new regional airport has been proposed for the Ivanpah Valley area, and the project is in the EIS analysis phase. This regional airport is proposed to be located in same area as the cargo handling airport assessed in the Biological Opinion for the MSHCP section 10 take permit. A proposed general aviation airport near the City of Mesquite is being studied and a draft EIS is being developed. A proposed rail system in the Las Vegas Valley and proposed high-speed train from California to Nevada that were described in the MSHCP have not progressed to the planning phase.

## UTILITIES

Several utility infrastructure projects have been implemented in Clark County since issuance of the section 10 take permit. These include the Kern River natural gas pipeline, as well as installation of power lines and associated infrastructure in several parts of the Las Vegas Valley. In addition, PL 107-282 included realignment of the BLM utility corridor along highway 95 in the Coyote Springs Valley. This element of the Comprehensive Plan (Clark County 2006b) is scheduled for an update in 2006, and could inform a more systematic assessment of this land use.

## WATER AND SEWAGE FACILITIES

New pipeline projects within Clark County have been implemented since the issuance of the section 10 take permit. In addition, the Southern Nevada Water Authority (SNWA) is studying a variety of options to ensure the future availability of water for anticipated growth in Southern Nevada. Options in the SNWA Water Resource Plan (SNWA 2005) include Colorado River water as well as in -state non-Colorado River water such as Las Vegas Valley groundwater rights, Las Vegas Valley shallow groundwater, Muddy River surface water rights and Virgin River surface water rights.

## HUMAN POPULATION GROWTH TRENDS IN CLARK COUNTY

In addition to the land use trends described in section 2.3.2, the MSHCP 2.3.3 described human population growth trends and forecasts. An update is provided below.

Nevada Revised Statutes require that local governments provide a population estimate annually to the Nevada Department of Taxation for tax distribution purposes. These estimates are produced for the date of July 1 of each year. The five cities and the Clark County Department of Comprehensive Planning cooperatively produce estimates for Clark County. The population estimate for July 1, 2004 was 1,747,025

(Clark County 2005a). Of this population, 1,685,197 residents were in the Las Vegas Valley area (Clark County 2005a). In addition to these annual population estimates, the University of Nevada Las Vegas Center for Business and Economic Research (UNLV-CBER) produces an annual population forecast for a sliding 30-year timescale. Using a regional econometric model developed by Regional Economic Models, Inc., calibrated specifically for Clark County, UNLV-CBER has produced the projections for population growth in the County shown in table 4. However, the forecasts used by most local municipalities and agencies to anticipate growth have been exceeded year after year. Note that the econometric model growth rates decrease over time. According to the projection documentation, "This represents convergence to the national average annual rate, which is projected to stabilize at 1 percent after 2020." (UNLV-CBER 2005.) To date, the assumption that the Clark County human population growth rate would gradually converge to the national average annual growth rate has not been supported. Thus, the projections in table 4 may be conservative.

**Table 4. Clark County, Nevada Population Forecast. (UNLV-CBER 2005).**

| Year | Population forecast | Population Growth Rate (percent change) |
|---|---|---|
| 2005 | 1,833,500 | 4.9 |
| 2010 | 2,281,340 | 4.1 |
| 2015 | 2,687,055 | 2.8 |
| 2020 | 2,999,953 | 1.9 |
| 2025 | 3,228,140 | 1.3 |
| 2030 | 3,410,332 | 1.0 |

Even with this conservatively projected rate of growth of the human population, continued private land disturbance for development under the MSHCP section 10 permit is certain. Unless the ways in which we utilize disturbed land under the take permit changes, it is reasonable to predict that the rate of take will remain the same per capita.

The MSHCP model described in chapter 1 explores the relationship between human population and per capita land disturbance under the MSHCP (figures 4 and 5) to enable future modeling efforts to explore this relationship in more depth. The MSHCP model also includes a function that allows users to alter the acres disturbed per capita.

## SUMMARY

Land use trends appear to be consistent with the anticipated land uses analyzed in the Biological Opinion for the section 10 take permit for the MSHCP, but the rate of human population growth and the pace of anticipated land uses are greater than anticipated. Clark County, Nevada continues to be among the fastest growing areas

in the Nation, and is likely to remain so. In fact, the forecasts used by most local municipalities and agencies to anticipate growth have been exceeded year after year. As the human population of Clark County continues to grow, we can expect land disturbance under the section 10 permit to continue. Status and trends in habitat loss by ecosystem are discussed in chapter 4. The increasing human population also exerts an increasing demand on public lands, including those lands used to mitigate for land disturbance under the section 10 take permit. The direct and indirect impact these actions may have on covered species and their habitats are discussed in chapter 4.

# CHAPTER 3 HABITAT LOSS BY ECOSYSTEM

***Author Sue Wainscott***

- **Habitat loss by ecosystem tracking is a task of the Adaptive Management Program.**
- **Habitat loss is equivalent to land disturbance under the section 10 permit.**
- **The Desert Conservation Program tracks land disturbance under the section 10 take permit, but not in a spatially explicit fashion.**
- **As of 25 January 2006, 44,158 acres of non-municipal land had been disturbed under the section 10 take permit.**
- **Because land disturbance is not tracked in a spatially explicit fashion, the Adaptive Management Program is not currently able to track habitat loss by ecosystem.**

The AMP is tasked in the MSHCP and Biological Opinion for the section 10 take permit with tracking habitat loss by ecosystem in order to ensure balance between take and conservation. Thus, it can be inferred that habitat loss is equivalent to take, or land disturbance under the section 10 take permit. As described in the MSHCP model (figures 6 and 7), no mechanism exists in the MSHCP to deny permits for land disturbance based upon the location of the permits. Thus, this AMP task appears to direct the AMP to recommend that mitigation (implementation of conservation actions) be focused on ecosystems that are experiencing greater rates of land disturbance under the section 10 take permit.

The County tracks overall land disturbance statistics using the information contained in the land disturbance reports received from its planning department and the other permittees. As of 25 January 2006, 44,158 acres of non-municipal land had been disturbed under the section 10 take permit (appendix D). In the reports provided to the DCP, the current assessor parcel number for the acres permitted for disturbance are provided. However, current databases do not allow for analyzing or displaying disturbed lands in a geospatial fashion. Spatially explicit tracking of land disturbance under the section 10 take permit might become necessary in the future.

As described in chapter 2, private lands within the disposal areas are UM, and undisturbed lands within the disposal areas are classified as MUMA. For 20 of 78 covered species, the MSHCP has a goal of no net unlimited loss or fragmentation of the species' habitat within IMAs or LIMAs, or MUMAs where MUMAs represent a substantial portion of habitat for a covered species (RECON 2000 p 2.7). Thus, habitat on Federal or State lands within a disposal area (MUMA) that are isolated within an urban matrix may be of concern to the AMP if a covered species relies upon MUMA for more than 50% of their distribution. The AMP may need more spatially explicit land disturbance data to properly track the impact of land disturbance permits

on the general measurable biological goal for all species of no net unmitigated loss or fragmentation in IMAs, LIMAs, and of MUMAs where MUMA (figure 1) represents a substantial portion of a covered species' habitat. The data received with each permit for land disturbance under the section 10 take permit include the assessors parcel number for the area permitted.

At least two County departments track actual land uses geospatially in a fashion that superficially appears to coincide with land disturbance under the section 10 permit; Assessor's Office and Department of Comprehensive Planning. The Assessor's Office tracks "build" in the County for the purposes of assessing property and other taxes. However, "build" is not equivalent to land disturbance resulting in take under the section 10 permit. In addition, the Assessor's Office information is tracked at the assessor's parcel unit level, and a single action that triggers the value of "build" affects the entire parcel, regardless of the size of that action. Also, a parcel may be assigned a new "build" date several times, each time an action is taken to potentially alter the tax value, while disturbance under the section 10 take permit occurs only once. The Department of Comprehensive Planning also tracks land use in the County, but the categories tracked do not correspond to presence or absence of land disturbance under the section 10 permit. Although these dataset are not useful for tracking habitat loss, they are useful to describe land use trends and are provided in chapter 2.

Currently no department in the County tracks disturbance under the section 10 permit in a form that is compatible with the GIS software used by the DCP. The most recent land disturbance report delivered to the USFWS (appendix D) showed that approximately 15,000 acres exempted from fees for municipal use and 44,148 acres of private land had been disturbed under the section 10 take permit. The overlap with the eleven ecosystems as originally described as surrogates for covered species' habitat in the MSHCP is unclear at this time. In addition, new data are now available to refine our estimates of the extent of these ecosystems in Clark County. These new data and recommendations for their use by the AMP are described in chapter 7.

## SUMMARY

As of 25 January 2006, 44,158 acres of land had been disturbed for non-municipal uses under the MSHCP's section 10 take permit. It is unclear how those disturbed acres overlap with the 11 ecosystems described in the MSHCP. Currently, no spatially explicit database tracks the land disturbed under the section 10 take permit. Because these 11 ecosystems are hypothesized to be surrogates of habitat for the 78 covered species, it would be useful to know what proportion of each ecosystem had been disturbed under the section 10 take permit. In addition, the 20 covered species that have a measurable biological goal of no net loss or fragmentation of habitat in IMA, LIMA and MUMA make spatially explicit tracking of habitat loss by ecosystem necessary.

# CHAPTER 4 SPECIES POPULATION TRENDS AND ECOSYSTEM HEALTH

***Co-authors Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear and Dick Tracy***

- **The Multiple Species Habitat Conservation Plan (MSHCP) has biological goals for each covered species.**
- **Species must be monitored to determine if these goals have been obtained.**
- **A framework for monitoring is described.**
- **A recommended strategy for species' status reporting is described.**
- **The adopted strategy for species' status reporting is described.**
- **The program continues to seek surrogates or indicators for use in ecosystem health tracking.**

## SPECIES POPULATION STATUS AND TREND

The MSHCP has the explicit biological goals for each covered species of providing the federal and state resource managers with assistance in managing for a stable or increasing population trend and for no net unmitigated loss or fragmentation of habitat. These are explicitly scientific determinations that must be addressed by inventory, monitoring and research. These activities have common characteristics listed below, and the special needs for monitoring rare and elusive species are given in bullets in the essay about rare and elusive species:

1. All monitoring should be hypothesis driven. In other words, all monitoring should be experiments to test pre- and post-management actions
2. Data on habitat and threats should be collected as part of tortoise density monitoring so as to extend the scope of density analyses.
3. There should be formal and informal coordination among personnel to conduct monitoring as a means to have a formalized process for data collection, quality control, and data archival. Standardized data collection and data sharing will allow collaboration so that meta-analyses can be done. All parties who collect monitoring data should have an agreement for data sharing/pooling as well as agreements on publication of the data/analyses.
4. There should be imposed inter-agency coordination and data sharing to acquire all necessary data for analyses.
5. There should be continued work to modify distance sampling to get the most precise estimates possible. This includes, for example, improving detection rates and adding environmental covariates in models of population density.

6. There should be an attempt to determine the maximum rate of growth or decline detectable by the most optimistic methods. This would produce an answer to the question, “in the best of all worlds, is there power to detect a certain level of decline?” (see appendix W).

The monitoring of population status and trend, assessment of the amount, quality and occupancy of habitat, the extent of habitat fragmentation and the actions to mitigate or minimize decrements need to be regularly reported in Species Status Reports. The species' status report for each species must at a minimum:

- summarize the known distribution,
- review current taxonomic status,
- create an habitat model that predicts the possible distribution in order to guide inventory efforts,
- summarize known natural history and autecology of the species,
- analyze all available inventory, monitoring and other data to describe population status and trend,
- summarize the known threats to the species,
- identify gaps in our knowledge of this species and propose projects to fill those gaps,
- summarize the conservation and other actions taken to benefit this species,
- identify needed actions to address threats, and
- list and archive all information resources (published, peer-reviewed papers, reports, locality information, implementation project description, etc.)

The species' status reports need regular review and update as information becomes available but at least every two years as a key component of the BAMR to provide Clark County, the Fish and Wildlife Service and the IMC with evidence of the progress made in conserving species or to identify where additional action is required. The analysis and summary of the threats monitoring, population trend monitoring, and research are scientific functions and in some cases may require assembling experts for workshops, seminars, symposia or conferences. The species' status reports should be made available to all on the MSHCP database. The responsibility to produce species' status reports falls within the charge made in the MSHCP, but few such reports were specific assignments or budgeted tasks through the 2003-2005 biennium. Many more species' status reports are likely to be described deliverables in the 2005-2007 biennium contracts (based on approved proposals), however as the complexity of species' status reporting is realized it is likely that less that adequate products or only partial products will be produced at the current approved budget levels. The Desert Tortoise Recovery Plan Assessment Committee Report (available at http://www.brrc.unr.edu/) is the model for Species Status Reports and the process followed by this committee in producing this report is the model for how the appropriate scientific expertise is harnessed to produce a Species Status Report. Species status reporting should continue to be a priority in the next biennium.

## SPECIES KNOWLEDGE GAPS, RISK AND UNCERTAINTY

To conserve and manage species adaptively it is necessary to have knowledge of the distribution, habitat requirements, natural history, threats and management options. To adapt management it is necessary to monitor population trends or some indicator of trend and filter environmental noise from the signal. Published, peer-reviewed literature on these topics provides the greatest confidence in the reliability of the knowledge, internal reports, best professional opinion and anecdote are less reliable sources of information. The MSHCP presented limited reviews of the available literature, reports, best available, local professional and amateur opinions on the distribution, habitat requirement, natural history, threats, management options and population trends. In assembling and updating a Species Status Report the first step is to review the recent published, peer-reviewed literature, reports, opinions of experts, and recent anecdotes. For the 2004 BAMR we reviewed standard literature citation sources, where possible secured reprints of the papers or, at least the abstracts, added these to the MSHCP website database and cited these papers in the draft Species Status Report by species (appendix Z). The recent internal reports of inventory and monitoring and the data on which they were based for many of the Covered Species by local and regional agencies have not been provided to the Clark County Database and we were unable to cite these and use them to update and inform the draft Species Status Report. The current analysis updates that review and notes where risk and/or uncertainty have changed.

For each of the Covered Species we gave a numerical score of 1 = little or no knowledge and 5 = considerable or sufficient knowledge with intermediate values representing intermediate states. This process was somewhat subjective and reflected a professional level of confidence in the current state of knowledge. For example, a species that is well known within the professional community to occur in one or a few locations, and that has been the object of considerable professional field searches would score a 4 or 5 on knowledge of distribution. An example of such a species highlighted in the 2004 BAMR was the Blue Diamond cholla *Opuntia whipplei* var. *multigeniculata*, that as of the 2004 BAMR was thought to inhabit only the Blue Diamond area. Since then there have been anecdotal reports among the botanical community of additional populations elsewhere. This has raised the level of uncertainty until there is proper scientific review of these putative new populations and their taxonomic status. A species that is more widely distributed but with a patchy and poorly understood distribution such as the long-nosed snake, *Rhinocheilus lecontei lecontei*, might receive a score = 2. Such a scale is subjective and experts might, or probably would argue over tenths of points. However such a categorization is useful in describing gaps in our knowledge and prioritizing projects to fill those gaps. In this analysis if new threats have come to light or it has be determined that the previous analysis misjudged the state of knowledge, then scores were modified. We summed all of the values for each species and assigned priorities of Highest, High, Moderate and Low (appendix G).

In 2004 no Covered Species ranked in the Highest Priority category which would have suggested that nothing was known about the species and that it probably should not have been covered. In the current analysis 6 Covered Species have ranked in the Highest Knowledge Gaps, Risk and Uncertainty-Priority category. The reason for each of thee elevation are noted in the attached spreadsheet but generally more information has come to light that populations are declining or being lost and that the level of management to address threats has been overestimated. In 2004 54 species ranked as High Priority for having knowledge gaps and this analysis finds 55 species in this category. Undoubtedly reports exist and data is in the possession of agencies and experts that have not been submitted to the MSHCP Database that would have lowered the Priority ranking for some those species. This illustrates one of the problems of the program that is inhibiting our ability to document permit compliance and conservation progress.

One approach to prioritize actions for species when there are gaps in our knowledge, limited resources, and threats that are poorly understood is to establish a the highest priority for the combination of greatest risk due to known threats and the greatest uncertainty about risk, biology or management options. When there is greater knowledge or the threats are not as severe then the priority should be less. In the 2004 BAMR we conducted such an analysis on the Covered and Evaluation species based on best professional judgment and the information contained in the MSHCP and the scientific literature and here we updated that analysis and noted those species for which the risk/uncertainty score has changed since 2004 (appendix G). Such an analysis is subjective but it provides a basis for comparing relative levels of risk and uncertainty. A manager may be willing to tolerate a higher level of uncertainty for a widely distributed species than for one that is narrowly distributed and that difference would be felt as a difference in the relative risk. This analysis gives considerable weight to uncertainty in establishing management priority and this can be useful in adaptive management scenarios where collecting information (reducing uncertainty) is a significant part of the “next actions” decision-making process. The change in the risk/uncertainty score is an indication of changed threat or management circumstances or better knowledge. The current analysis shows an increased risk/uncertainty score for 30 species. This is a surprising and disturbing finding and suggests that there are increasing unmitigated threats and a higher level of uncertainty about the status of species, threats and management options

<u>Recommendation:</u>
Our increasing knowledge of at least anecdotal information of population losses or declines and previously unknown threats and the paucity of the information necessary to produce adequate and informative Species Status Reports on the Covered Species is a serious deficiency in the DCP. We repeat our 2004 BAMR proposal for a Species Status Report Initiative that would use existing Knowledge Gap analysis and input from species experts to prioritize and create a timelines for filling the knowledge gaps for Covered Species and other species of concern. Further we believe this action should occur in the next 3 months and the resulting priorities be incorporated into a directed actions request for proposal to fill critical knowledge gaps and emergency

management actions where the failure to act may result in serious population impacts.

## EDITOR'S NOTES:

Difficulties in Monitoring Rare or Elusive Species

Many of the 78 covered species appear to be rare, but this may be due to difficulties in detecting the species in their habitats. This difficulty in detecting individuals may lead to erroneous estimates of population size, or produce enough variance in estimates over time that trends in population status are not statistically detectable at levels that are informative to land and resource managers. The difficulties in monitoring rare or elusive species are described in an essay provided by Dr. Dick Tracy, found in appendix X.

Search for Surrogates and Indicators

The MSHCP describes shortcuts to monitoring that may be used to track population trends and ecosystem health (RECON 2000 p 2.184). These shortcuts include identifying surrogates for species' status such as indicator species or ecosystem components. The status of the AMP's search for surrogates and indicators is discussed in chapter 5. Efficiencies in species' status reporting may be attained through the use of surrogates for species' status being used to document species' status, and through combinations of species' status being addressed by a single contractor in a single document, if the AMP determines this is appropriate based on best available science.

During 2003-2005 the Ecosystem Indicators contract with UNR-BRRC shifted its focus from a search for surrogate species indicators to remote sensing data analysis techniques that might identify surrogates of ecosystem health (Clark County 2005b). The final report for this contract had not been provided in time to inform this Adaptive Management Report, but the potential utility of this contract's final report is discussed in chapters 6 and 7.

The search for efficiencies in monitoring is also evident in the use of eleven ecosystems (appendix C) to categorize habitat associations for the 78 covered species. This approach was adopted out of necessity, as little was known of the habitat requirements for several of these species. The Biological Advisory Committee that informed the MSHCP used the literature, museum records, Nevada Natural Heritage Program data and expert opinion to describe what was known at that time for the 79 species proposed for coverage in the MSHCP. Using this ecosystem data was based on the best available science at the time the MSHCP was written. However, the ecosystem categories were replete with assumptions or hypotheses regarding the habitat requirements for the species. Recommendations are made in chapter 7 regarding opportunities to refine habitat models for several covered species.

Species Population Trends

The 2004 Adaptive Management Report (UNR-BRRC 2004) stressed the need for data that would inform species' status reporting. In response to this need, during the 2003-2005 biennium, the AMP undertook an inventory of data that may have been produced by all projects receiving DCP funding over the term of the section 10 take permit (appendix E). This list was created by UNR-BRRC as Science Advisor contractor from information supplied by contractors and agencies receiving DCP funding to the Implementation Database. Three Science Advisor contractor technicians, under supervision of Senior Scientist Dr. Hoff, gleaned this information from the project or proposal descriptions, quarterly reports and final reports within the implementation database. In August 2005 the GIS Database Manager augmented and verified this list with information from the contract files and past Biennial Progress Reports (Clark County 2001, 2003). The GIS Database Manager broadened the search to include all GIS compatible data that may have been produced by all projects receiving DCP funding. The version of the table used to track incoming datasets is included in appendix E. A total of 91 projects by 31 contracted entities were found to have potentially produced data that were GIS compatible or that might inform species' status reporting. A comparison to the contents of the DCP Central Repository was made, and those data not currently in the Central Repository were requested from the contracted entities.

Although very few of these data sets were defined deliverables of the past and present contracts, as of January 5, 2006, 41 of 160 data sets had been delivered by agencies and past contractors. In all cases, these data were collected at a time when the MSHCP did not have a draft data management standards plan in place. In addition, most of these data were collected for a project-specific purpose, and were not part of an MSHCP programmatic data collection effort. Thus, these data were not in a form that could inform species' status updates for this Adaptive Management Report. However, the AMP has provided lists of the responses and datasets received from the contracted entities to the Science Advisor contractor for review, and has also provided copies of datasets as requested by the Science Advisor contractor for specific examination. A primary focus of the AMP in 2005-2007 will be to assess the quality of these datasets and others received to compile a database to inform AMP analyses including species' status and ecosystem health reports.

While the Science Advisor describes the contents of the species' status database above as containing initial draft species' status reports (appendix Z), they characterized the species database differently during a meeting of the Adaptive Management Science Team, September 7, 2006. At this time, the value of the species database was affirmed by the AMST, and it was noted that it was not a status database, but instead was a robust species information summary database that could provide the foundation for species' status reporting. Specific note was made by the AMST that the species database was not a status database.

Of the 57 species' status reports listed in the UNR-BRRC's MSHCP literature database, 47 addressed a total of 25 covered species. Of these, only two had been comleted in the last six years (2001 for *Penstemon albomarginatus* and *Astragalus oophorus clockeyi*). Thus, it appears that all 78 covered species are in need of updated status reports. To address the need for species' status reports, the DCP also worked with the AMP to gather comments from experts including the AMST, the Implementation and Monitoring (I & M) Committee and the I & M Committee's Rare Plant Working Group regarding the outline for species' status reports recommended by UNR-BRRC as Science Advisor contractor in the 2004 Adaptive Management Report. The final outline was submitted to the USFWS on 6 January 2006, (appendix F) with a proposal to produce or update species' status reports on a rotating basis, with a third of the covered species receiving reports or updated report each biennium. The initial three biennia species' status reporting will address those species ranked most at risk by the matrix developed by UNR-BRRC as Science Advisor contractor and published first in the 2004 Adaptive Management Report (UNR-BRRC 2004, appendix 9), and presented in appendix G of this Adaptive Management Report. Thus, the most at risk third of the covered species are recommended to be addressed in the 2007-2009 biennium. In the 2009-2011 biennium, the next third most at risk ranked species that remain at that time will be addressed, and the remaining third addressed in the 2011-2013 biennium. Species status reports produced through other funding sources may also be recommended for review by the AMP for consistency with the species' status report outline and for acceptable use of best available science by AMP to determine if they can be used to inform the DCP's obligation for species' status reporting. In the 2013-2015 biennium, the reports will be updated in a similar fashion, with recommendation from AMP on which reports may need more frequent updates. The DCP has not received a response from the USFWS on this approach to species' status reporting.

Ecosystem Health

Ecosystem health was not explicitly defined in the MSHCP, and was not addressed during the 2003-2005 biennium. New data are now available that can refine our understanding of habitat for the 78 covered species and the spatial extent of those habitats in Clark County. These new data are from the Southwest Regional Gap Analysis Program (GAP) assessment project and are based on land cover images from 1998, a time closer to the issuance of the section 10 take permit for the MSHCP. These new data and potential uses of these data to inform ecosystem health status tracking are discussed in chapter 7.

# CHAPTER 5 IMPLEMENTATION STATUS

*Co-authors Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear, Dick Tracy and Sue Wainscott*

- **The Multiple Species Habitat Conservation Plan (MSHCP) is in its sixth year of implementation, but actions to implement the MSHCP began in 1999.**
- **DCP expenditures to implement the MSHCP have grown from 8.1 million dollars in 1999-2001 to an anticipated 35 million dollars in 2005-2007.**
- **Implementation projects, their time frames and the MSHCP actions they intended to implement are depicted.**
- **To date, actions have been taken to implement 18 of the 22 permit conditions, and the remaining 4 represent ongoing policies.**
- **To date, actions have been taken to implement 459 of the 604 conservation actions described in the MSHCP.**

## MSHCP IMPLEMENTATION STATUS

The MSHCP and Biological Opinion for the section 10 take permit described both permit conditions and requirements and 604 Conservation Actions to be considered for implementation over the term of the permit. This is depicted in the MSHCP Actions sector (figure 13) of the MSHCP model described in chapter 1. The MSHCP and Biological Opinion for the section 10 take permit both state that not all of these 604 actions were to be implemented over any predetermined time period, rather, these conservation actions represented the initial suite of actions that could be taken based upon AMP findings or DCP processes for including new conservation actions.

For every non-municipal acre permitted for land disturbance under the section 10 take permit, the permittees collect a fee of $550 and deposit those fees with the County as Plan Administrator. The County administers the section 10 endowment fund on behalf of all permittees and provides regular reports on disturbance and fees collected to the USFWS, as described in chapters 2 and 3. The most recent land disturbance report is included in appendix D. A minimum expenditure of 2.05 million dollars per year (4.1 million dollars per biennium) is required from the section 10 endowment fund, adjusted each biennium for cost of living increases. In addition, the DCP administers section 7 funds for desert tortoise mitigation actions as requested by the USFWS. The DCP also has sought opportunities to secure additional funding from the SNPLMA fund. The expenditures of the DCP are shown for each biennium's IPB in figure 16. The Implementation Agreement agencies have also expended a variety of funds, including internal agency operating funds and SNPLMA funds, to address

many of the conservation actions listed in the MSHCP. These additional expenditures are not currently tracked by the DCP, and are not depicted in figure 16.

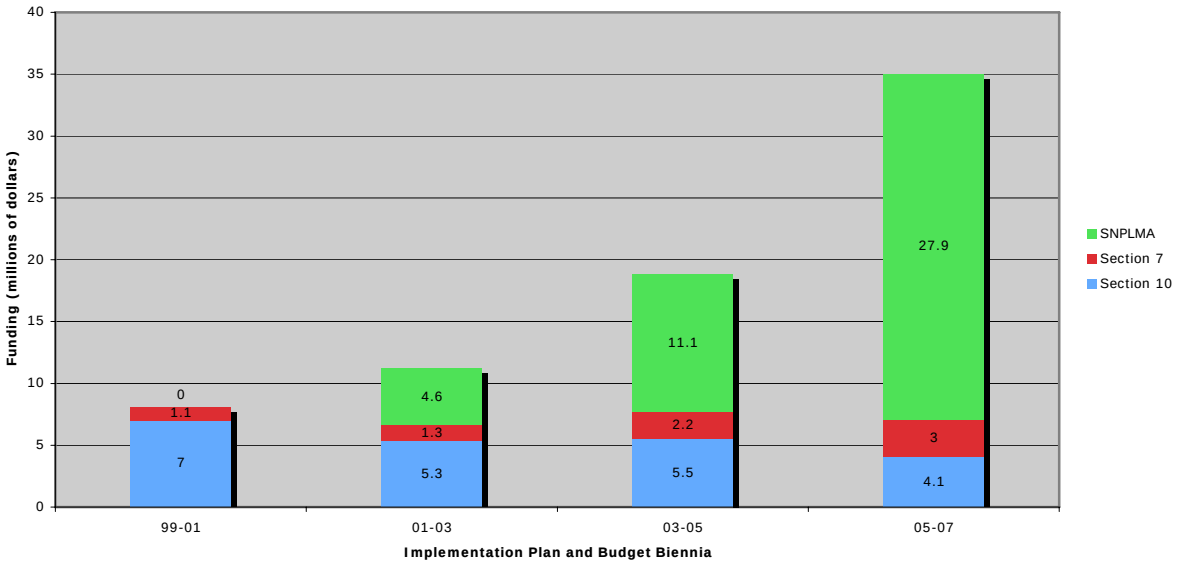


**Figure 16. Desert Conservation Program Expenditures by Biennium. Does not include SNPLMA 10% contingency funding.**

Although the section 10 take permit was signed in late 2000, conservation action implementation began in 1999, and has continued through three biennia (1999-2001, 2001-2003, 2003-2005). The program has initiated 6 contracts to fund 10 section 10 projects and 3 contracts to fund 4 section 7 projects for the 2005-2007 biennium, and has recently received final approval from the Department of Interior for SNPLMA funding of an additional 59 proposed projects in 2005-2007. As of March 1, 2006 the program was also managing approximately 45 contracts from the 2003-2005 biennium that are not yet complete. The 2005 Biennial Progress Report (Clark County 2005b) contains detailed information on all DCP projects and contracts managed by the DCP during the 2003-2005 biennium. A summary of the progress to date in implementation of the MSHCP is provided below.

It must be noted that the implementation status report presented below for conservation actions is based solely on the self-reported data contained in the Implementation Database or in conservation action spreadsheets received from the Implementing Agreement Agencies. Few quantitative data were available to the program to conduct implementation status verification checks, and the DCP did not have the staff capacity during the 2003-2005 biennium to conduct active project management (Kirchhoff & Associates, Inc. 2005) for all contracted projects and confirm the extent of implementation for the DCP contracts nor to confirm the agency

conservation action spreadsheet responses. Thus, no verification could be made at the time this Adaptive Management Report was produced regarding the extent to which these conservation actions were implemented. This is particularly important to confirm data extracted from the implementation database, for the self-reported conservation action data were entered at the time the project was proposed for funding consideration, and were not updated at the time of contracting or completion of the contract. Effectiveness of these actions in achieving the goals and objectives of the MSHCP is discussed in chapter 6.

Permit Requirements

The MSHCP, Biological Opinion, and section 10 take permit included several additional actions to be taken that are commonly referred to within the DCP as "permit requirements". These are listed in table 5. These permit requirements are tracked internally by the DCP, and were also tracked in part by several of the Working Groups of the I & M Committee. Information from DCP project descriptions and contracts were used to validate those tracking lists, and are presented in Gantt chart form in appendix H. MSHCP permit requirement numbers 13, 14, 15 and 18 are policies that are complied outside the scope of funded projects, and have been adhered to throughout the term of the section 10 take permit. They are not tracked on the chart in appendix H, due to the lack of a specific funding source for their implementation.

Several DCP projects have advanced completion of these permit requirements, in particular the production of conservation management plans (now termed Conservation Management Strategy (CMS) documents by the DCP.) No CMS documents had been completed as of 1 January 2006. The production of CMS documents was also tracked by the Planning Working Group of the I & M Committee, and their most recent status list is included in appendix I.

**Table 5. MSHCP Section 10 Take Permit Conditions**

| CODE | PERMIT CONDITION TEXT |
|---|---|
| MSHCP(1) | J1a. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 1. Low Elevation Uplands: a) Piute Eldorado Desert Wildlife Management Area (DWMA) |
| MSHCP(2) | J1b. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 1. Low Elevation Uplands: b) Coyote Springs Valley DWMA |
| MSHCP(3) | J1c. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 1. Low Elevation Uplands: c) Mormon Mesa DWMA |

## Table 5. (Continued)

| | |
|---|---|
| MSHCP(4) | J1d. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 1. Low Elevation Uplands: d) Gold Butte DWMA |
| MSHCP(5) | J1e. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 1. Low Elevation Uplands: e) catclaw habitats |
| MSHCP(6) | J2a. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 2. Desert Riparian Habitats: a) Muddy River riparian habitat |
| MSHCP(7) | J2b. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 2. Desert Riparian Habitats: b) Virgin River riparian habitat |
| MSHCP(8) | J2c. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 2. Desert Riparian Habitats: c) Meadow Valley Wash riparian habitat |
| MSHCP(9) | J3a. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 3 Low Elevation Springs: a) amphibian and aquatic snail species |
| MSHCP(10) | J3b. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: 3 Low Elevation Springs: b) bats |
| MSHCP(11) | J4. The Permittees, in cooperation with the AMP contractor and the Service, shall participate with the land management agencies in development and/or revision of conservation management plans that identify the management and monitoring actions needed for the following areas or Covered Species: Low Elevation Plant Species |
| MSHCP(12) | K1. The following conditions apply to covered avian species listed in section 2.1.6 of the MSHCP: 1. Take, with the exception of Peregrine falcon (*Falco peregrinus anatum*) and phainopepla (*Phainopepla nitens*), under this permit is conditioned upon the acquisition of private lands in desert riparian habitats along the Muddy and Virgin Rivers, and Meadow Valley Wash. The total number and location of acres to be acquired within each watershed will be identified in the conservation management plan (I.2 above) through the AMP and agreed to by the Permitees, the land management agencies, and the Service. |

**Table 5. (Continued)**

| | |
|---|---|
| MSHCP(13) | K2. The following conditions apply to covered avian species listed in section 2.1.6 of the MSHCP: 2. No lethal take is authorized. Take of active nests is not permitted at any time. |
| MSHCP(14) | K3. The following conditions apply to covered avian species listed in section 2.1.6 of the MSHCP: 3. This section 10(a) permit also constitutes a Special Purpose Permit under 50 CFR 21.27 for the take of those Covered Species Subject to Incidental Take which are listed as threatened or endangered under the Act, and which are also protected under the MBTA. Such Special Purpose Permit shall be valid for a period of 3 years from the effective date, provided the section 10(a) permit remains in effect for such period. Such Special Purpose Permit shall be renewed, provided that the Permittees and MSHCP Participants continue to fulfill their obligations under the MSHCP and Implementation Agreement. Each such renewal shall be valid for the maximum period of time allowed by 50 CFR 21.27 or its successor at the time of renewal. |
| MSHCP(15) | L. Special restrictions apply to wetland species: Incidental take of Covered Species due to mortality or habitat loss within U.S. Army Corps of Engineer's (Corps) jurisdictional wetlands is not authorized by this incidental take permit. Incidental take authorization for projects that affect such jurisdictional wetlands shall be authorized through future section 7 consultations between the USFWS and the Corps under the Act, pursuant to section 404 of the Clean Water Act. Incidental take of wetland associated or dependent species outside of jurisdictional wetlands will be in accordance with the MSHCP and the IA. |
| MSHCP(16) | M. Tortoise Translocation Program and other Handling Programs. The Permittees shall continue the desert tortoise translocation developed and implemented under the DCP, and described in section 2.8.3.8 of the MSHCP, for so long as desert tortoise translocation is in effect. On an annual basis, the Permittees must request, in writing, authorization for handling and moving tortoises under this program. Individuals who handle desert tortoises in association with the translocation program or other programs permitted under the MSHCP (as described in section 2.8 of the MSHCP) must be authorized in writing by the USFWS or be under the direct on-site supervision of authorized personnel. The Permittees will be responsible for quarterly inspection of the fence around the translocation site. In addition, during the tortoise active season (March 1 to October 31), fence inspection will be conducted within 72 hours of a major precipitation event (any rain event that would cause water to flow across the landscape causing soil erosion) and within 10 days during the desert tortoise inactive season (November 1 to February 28). All breaches shall be corrected within 72 hours during the active season and within 10 days during the inactive season. |
| MSHCP(17) | N. Highway and Road Fencing. The Permittees will continue to retrofit, repair, and construct desert tortoise proof fencing along highways and roads within Clark County in accordance with section 2.8.3.7 of the MSHCP. Each biennial budget shall include the location, number of miles, and dollars allocated to fencing during the next biennium. The Permittees shall be responsible for quarterly inspection and repairs of the highway and road fences in accordance with the provisions identified in item L above when breaches are found. |
| MSHCP(18) | O. Coyote Springs Valley. Pursuant to this permit only those conditions carried forward from the DCP for the take of desert tortoise will apply to the properties identified in the DCP and MSHCP as Aerojet, which is located in the Coyote Springs Valley. |

**Table 5. (Continued)**

| | |
|---|---|
| MSHCP(19) | P. Boulder City Conservation Easement. The Permittees shall ensure that any future development or use of the 85,000-acre conservation easement be consistent with the goals outlined in the DCP which are to protect and manage the desert tortoise and its habitat. Furthermore, the Permittees shall take measures necessary to ensure maintenance in perpetuity, of connectivity for desert tortoise and other Covered Species, within the Boulder City Conservation Easement, including an adequate North-South corridor for the desert tortoise, as determined through the AMP. |
| MSHCP(20) | I. The Permittees shall ensure that a science-based Adaptive Management Process (AMP) is developed and implemented as specified in the MSHCP and IA. A Memorandum of Agreement will be developed within 9 months of the issuance of the permit among the signatories to the IA conducting conservation actions funded under the MSHCP, and Clark County, to ensure that any management or conservation action that may potentially affect the Covered Species are reviewed by AMP for their effectiveness in the conservation of the species and their habitats. |
| MSHCP(21) | Is referenced in the Biological Opinion, but is not reiterated in the permit. Public Information and Education (PIE) is a permit condition. |
| MSHCP(22) | Is referenced in the Biological Opinion, but is not reiterated in the permit. Purchase grazing allotments and interest in real property and water, and maintain and manage allotments, land, and water rights which have been acquired |

Conservation Actions

As described earlier, the MSHCP (RECON 2000) described 604 conservation actions that would be considered for implementation over the term of the permit. Descriptions of each conservation action can be found in appendix J). The entries for each project in the implementation database were used to inform a status report of implemented conservation actions. In the 2001-2003 Implementation Plan and Budget (IPB) development process, proposal proponents were asked to indicate the specific conservation actions they proposed to implement via each proposed project. This was also a component of the 2003-2005 and 2005-2007 IPB development process. No such data were available for the 1999-2001 projects. The available data were used to build upon the analyses contained in the 2004 Adaptive Management Report (UNR-BRRC 2004). As with all materials in the implementation database, these data are self-reported, and the standards used to choose which conservation actions to report for each project were not equal across all proponents. The conservation action data for each contracted project were coupled with contract start and end dates to populate a data set.

To this data set were added the data received from Implementation Agreement (Clark County 2000) signatory agencies (Federal and State) in response to a request by the AMP to update the conservation action spreadsheet from the 2004 Adaptive Management Report (UNR-BRRC). The responses received from the agencies are in appendix J. It should be noted that while all agencies contacted by the AMP did respond, neither U.S. Air Force (USAF) nor Nevada State Parks (NSP) were contacted. This error of omission should be corrected in future AMP efforts to describe the implementation status of the MSHCP. In addition, these data are also self-reported, and the standards used to choose which conservation actions to report

for each agency were not equal across all respondents. Several of the agency staff contacted for this report indicated a desire to work with the DCP to improve the method by which these data were gathered. This is described further in chapter 7. In addition, there were few quantitative data available to the AMP for this Adaptive Management Report to compare self-reported, non-DCP-funded implementation efforts to actual implementation efforts.

Appendix K contains a Gantt chart depicting the implementation of conservation actions by the DCP. From these data, it appears that some effort has been expended by the Implementing Agreement agencies and DCP to address 459 of the 604 conservation actions. Additional analyses of the implementation status of the MSHCP should be conducted once these self-reported data have been supplemented with more quantitative and spatially explicit data.

As described in chapter 4, more quantitative and spatial data have since been received by the DCP (appendix E), and additional data sources have been indicated by the Implementing Agreement agencies (appendix J). The availability of these data poses both an opportunity and a challenge for the DCP and AMP: to most efficiently utilize those data within their limitations. In other words, these data were collected for very project-specific purposes, and in most cases should not be used to draw conclusions at a programmatic level. These data can likely be used for project-specific implementation verification monitoring, but their applicability for programmatic assessment of implementation may be limited. Implementation verification (*aka* compliance monitoring) provides information regarding the actual actions implemented, the methods used, as well as the spatial and temporal extent of those actions. This information is an important component of effectiveness monitoring. (personal communication to Sue Wainscott by Barry Mulder, 17April2006).

The utility of data mining (using data from past projects, or project-specific data gathered in a non-standardized manner) was described by Dr. Jill Heaton, University of Nevada Reno, Department of Geography, during the AMST's 7 September 2005 meeting. As she described, these data may provide a valuable source of information that can be used to detect patterns and make observations that guide the design of conceptual models to guide more rigorous project and programmatic implementation monitoring design and analysis within an adaptive management framework. A preliminary map of those spatially explicit data received to date for restoration projects is shown in figure 17. This map is a preliminary illustration of the geographic scope of some of the implementation projects funded to date by the DCP. Becaues MSHCP funds are used to augment agency budgets, and agency jurisdictions may cross county boundaries, some of the restoration projects that MSHCP funds augment may includes some locations outside of Clark County.

The data used to generate figure 17 have not been subjected to quality assessments by the DCP, and no attempt is made by presentation of this map to imply that these efforts were or were not effective in meeting the objectives of the MSHCP. They are displayed here to describe the spatial extent of DCP efforts to date to implement weed

control and restoration efforts. No additional conclusions regarding degree of effort or effectiveness of these actions should be drawn from this depiction as the map is based upon a preliminary and incomplete set of data. Additional recommendations regarding the utility of these data for programmatic purposes can be found in chapter 7 of this document.

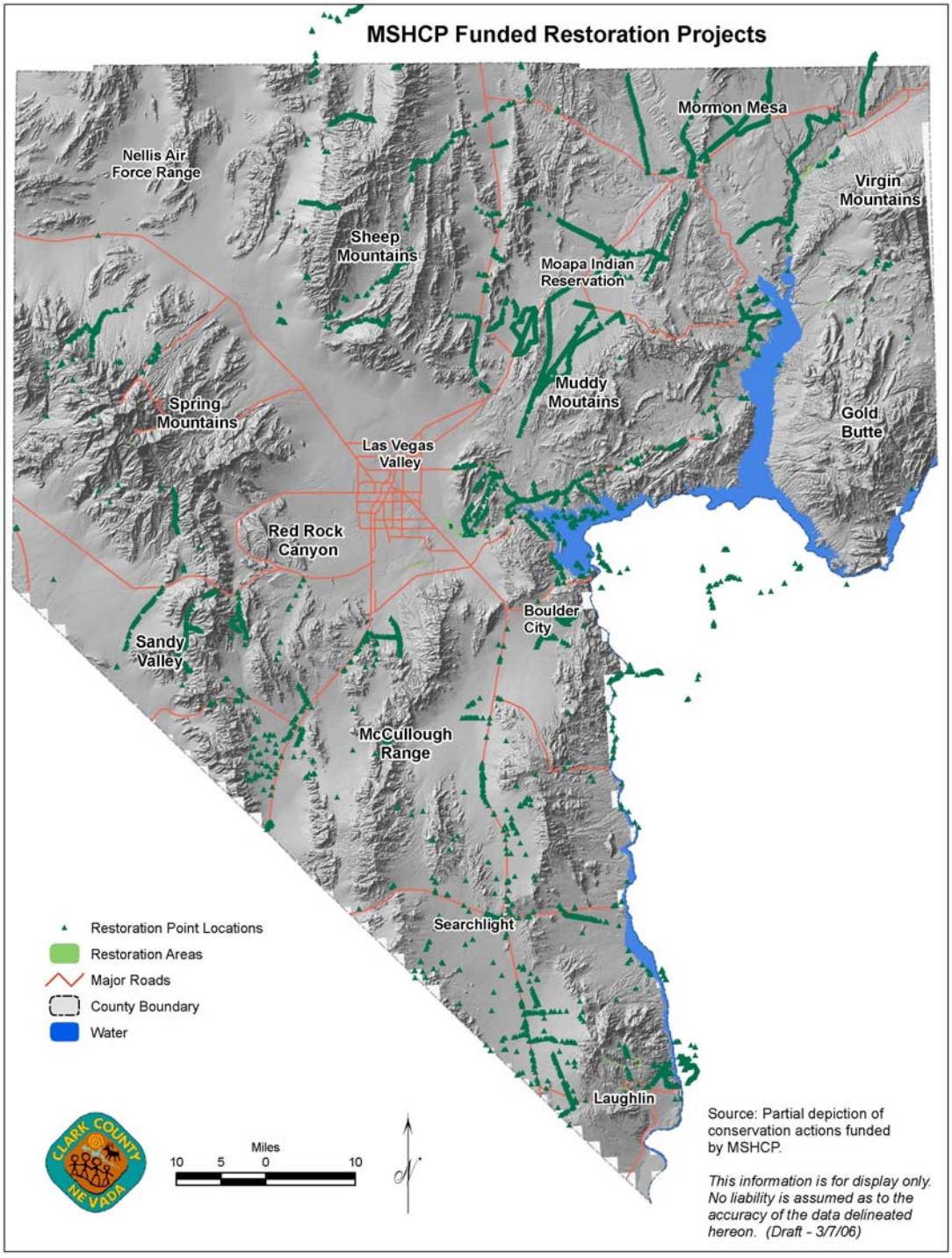


**Figure 17. MSHCP Funded Restoration Projects**

*The following materials were provided by the Science Advisor, and are co-authored by Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear and Dick Tracy.*

## PROGRAMMATIC SELF-REPORTING ON SPECIES AND THREATS

The MSHCP has set specific, quantifiable goals for each of the covered species:

- Allow no net unmitigated loss or fragmentation of habitat in IMAs and LIMAs (or MUMAs where they represent the majority of habitat for the species);
- Maintain stable or increasing population numbers; and
- Develop, through the AMP, appropriate detailed and quantifiable population or habitat goals for each Covered Species or, if possible, associated with the quantifiable goals for an appropriate indicator (ecosystem measure or key, umbrella, flagship species).

In addition the MSHCP set as one of its requirements that funded conservation action(implementation actions) will be scientifically assessed for effectiveness (RECON 2000: p. 2.179)

> "The Clark County MSHCP will implement an AMP designed to provide an objective, quantitative evaluation of the effectiveness of (a) management actions in attaining program goals and (b) inventory, monitoring, and research results and interpretation. The AMP is intended to provide a scientifically sound approach, which is preferred by many resource managers when funding and scientific resources are available."

The MSHCP lists among its initial actions for minimization and mitigation more than 600 threats or actions to address threat from the resource manager's extant planning documents (RECON 2000: pp. 2.201-274). To date the DCP has depended upon self-reporting by project proponents to establish threats and species addressed by the project, indicators of success and the extent of implementation of the plan and compliance with the permit.

The 2004 BAMR reported that approximately one quarter of the items on the conservation actions lists had been addressed by MSHCP projects of some kind in 1999 and 2001 biennia, but because citing the MSHCP Conservation Actions in project descriptions was not required in all cases for the 1999 and 2001 biennia, this figure may have underestimated the intent and actions of the land and resource managers. Reference to Conservation Actions was required in 2003, and large inventories (surveys) were initiated in 2003, thus the number of Conservation Actions cited in the descriptions was higher. The trend appears to have abated slightly in 2005.

Many additional Conservation Actions were not addressed by 2003 projects funded by non-HCP sources. There was no formal reporting on these projects in 2003 and again none in 2005 despite the MSHCP requirement that Implementation Agreement signatories report on their programs to the Implementation and Monitoring Committee(IMC), so that during the MSHCP budget process, the IMC will be able to

assure that the budget recommendation to the Clark County Board of Commissioners complies with the MSHCP requirement that projects "augment, but not replace Federal and State land manager budgets."

## HOW PROJECT DESCRIPTIONS RELATE TO MSHCP THREATS

Species Threats

Of 150 individual projects funded in 1999-2003, most do not claim to address threats to species in the 17 general threat categories. The threat category that is addressed by the greatest number of projects encompasses threats from recreation activities. The largest number of threat categories addressed by any project is seven. 126 of the 150 MSHCP projects funded since 1999 list no threat categories as addressed.
Projects from earlier biennia were not required to identify the threat that would be addressed, it is nevertheless clear that a greater proportion of threats in the 17 categories were addressed by 2003 projects than have been in the past. The system for tracking threats was modified for the 2005 projects to examine the sub-categories for the 17 main threat areas (appendix Y). The total number of claims of species threat addressed was markedly lower in 2005 (672) than in2003 (1225) and 28 categories of threats claimed to be addressed in 2003 were not addressed in 2005. There has been a concern that some projects were exaggerating the number of threats and species the project would address. Proponents were cautioned that all claims in the proposal would require quantitative reporting. This may have reduced exaggerated claims for most proposals. However, Clark County Proposal #605, a volunteer project, claims to address 220 species and more than 50 threats.

Ecosystem Threats

Of the 150 projects funded in 1999-2003, most (139) of them do not claim to address threats to ecosystem categories that fall under the 17 specified threat categories. The greatest number of threats to ecosystem addressed by any one project was three. Of 97 projects funded in 2003-2005 nearly half (43) did not claim to address threats to ecosystem categories that fall under the 17 specified threat categories. The greatest number of threats to ecosystem addressed by any one proposal is 12, the average is 2.1.The total number of ecosystem threats claimed addressed declined slightly from 2003 (911) to 2005 (896) (appendix Y)

Species Addressed

For the 2004 BAMR we enumerated the number of projects that addressed each MSHCP species. The counts were generated by MSHCP database query of descriptions of projects by the project proponents. Because many of the projects claimed to be working on many more species than might be reasonable to report on in a manner that could inform species' status, we assumed that the intent of those projects was to address ecosystems. We did not include projects that claimed to affect more than 10 species in the species analysis.

In 1999-2003 total of 182 of 232 identified species (78%) had no projects addressing them. This can be broken down to 53 of 79 of the Covered Species (67%), 29 of 38evaluation-high species (76%), 10 of the 11 evaluation-low species (91%), 51 of the 53 evaluation-medium species (96%), and 39 of the 51 species on the watch list (76%), are without focused activity of any sort. In 2003-2005 a total of 85 of 232 listed species (37%) had no projects addressing them. This can be broken down to 8 of 79 of the Covered Species (10%), 20 out of 38 of the evaluation-high species (53%), 5 out of the 11 evaluation-low species (45%), 31 of the 53 evaluation-medium species (57%), and 21of the 51 species on the watch list (40%). For the 67 of the identified 232 species (28%)were not addressed by projects (appendix Y).

Overall, additional requirements for project description for the 2003 and 2005 biennium resulted in many more projects being linked to MSHCP species and threats. This reflects the intent of the project proponents to address threats and species, but it does not necessarily result in reliable information provided to the MSHCP that will inform species' status or quantify threat reduction.

The central thesis of the MSHCP is that funded projects on federal lands will have a measurable conservation benefit based on published data or widely accepted and demonstrable metrics. The alternative is that funded projects will be implemented as an hypothesis that can be tested for measurable benefits. A project that is determined, by testing an hypothesis, not to have provided a species benefit is an adaptive management success since it informs next management decisions. Most of the projects funded in the2003-2005 biennium did not adequately describe the rationale for the project providing benefits or advancing the MSHCP goals. Most of the proposals for 2005 did not describe the rationale for the project providing benefits or advancing the MSHCP goals

In some cases, final reports on projects that addressed single species contained sufficient reliable information to inform species' status but most projects had broader and more diffuse goals, and incomplete reporting, and there was little effectiveness monitoring to document management efficacy. For 2003-2005 there were no projects that directly quantified the mitigation intended to balance take.

The Desert Conservation Program has been slow to conform to this requirement of the MSHCP and the Permit. To address this deficiency and to improve the quality of proposals for the 2005-2007 biennium the U. S. Fish and Wildlife Service and Clark County directed the Science Advisory Team to convene a monitoring workshop for the Implementation and Monitoring Committee and DCP participants. The workshop provided an introduction to monitoring for managers and DCP participants. In addition, there was an opportunity for management professionals to engage in a dialogue with monitoring professionals about the projects that were determined in the review process to be technically deficient. The results of these discussions were to have been incorporated into the project descriptions.

One of the concerns expressed by project proponents and many others is that every management project should not have to include effectiveness monitoring, especially if it is described to be similar to other projects. This is a legitimate concern. Fencing projects by PIC, NDOT, BLM and NPS to exclude tortoises from roads or gravel pits or other dangerous situations should not each be required to demonstrate that fencing is effective. The program should address this by justifying fencing using existing literature, best professional scientific opinion, tortoise density monitoring, and, if necessary, programmatic monitoring. The proponents of similar management projects need to meet with the County, appropriate Working Groups and the Science Advisory Team to design programmatic monitoring. Such an effort for current and proposed weed eradication and restoration projects led by the University of Nevada Cooperative Extension currently includes SNRT, USGS, UNR, USFWS and other participants. Such cooperative, programmatic monitoring and effectiveness research efforts offer the best opportunity for adaptive management success.

Recommendations

The DCP goals and objectives, quantifying effectiveness of conservation actions, documenting species' status and trends, have not been advanced by the current system of self-reporting. Despite many project proposals asserting that proposed actions would benefit species by addressing species or ecosystem threats or would inform species' status reporting there is little quantitative evidence to support these assertions and it is difficult to defend the current system as effective for reporting MSHCP and permit compliance. The current system of soliciting poorly described proposals and allowing proponents to define the value of the actions and self-report on their success should be abandoned. The program should conduct an emergency review of critical priorities prior to the next funding cycle to identify and precisely define next actions and these should constitute the scopes of work for a directed call for proposal. It seems apparent that circumstances for many species have become more threatening and management options are less obvious. It seems that the next funding cycles should emphasize information gathering projects for species or threats that appear most critical. It also seems clear that continuing implementation actions for which not effectiveness assessment has been initiated cannot be defended. No implementation actions without objective, independent effectiveness monitoring should be funded.

## EDITOR'S NOTES:

During the 2003-2005 biennium, UNR-BRRC as Science Advisor contractor worked closely with the law enforcement officers to develop a prototype data collection devise that would more efficiently collect data necessary for law enforcement officers' internal reporting requirements as well as DCP reporting requirements for funding. The data collected with this devise would inform implementation monitoring and could also be used to design and inform effectiveness monitoring of law enforcement that addresses specific MSHCP goals and objectives for law enforcement efforts. Dr. Kenneth Nussear, USGS as subcontractor to UNR-BRRC as

Science Advisor contractor, submitted a draft description of the prototype data collection devise and its development on 20 December 2005. This description is appended to this Adaptive Management Report in appendix L.

In addition to the above DCP funded desert tortoise exclusionary fencing projects, the Nevada Department of Transportation continued to install desert tortoise exclusionary fencing during the course of their planned highway projects. The fencing implementation tracking list, and the most recent version (November 2005) is presented in appendix M. A composite map of all desert tortoise exclusionary fencing projects was complied by HDR under contract to the DCP, and it is shown in figure 18.

From the spatial, quantitative data received to date by the DCP, a map was generated to present the spatial extent of those projects funded to date by the MSHCP that have also submitted implementation data in a spatial format (figure 18). The data used to generate this map have not been subjected to quality assessment by the DCP, and no attempt is made by presentation of this map to imply that these efforts were or were not effective in meeting the objectives of the MSHCP. They are displayed only to partially depict the spatial extent of DCP efforts to date to implement weed control and restoration efforts.

During the 2001-2003 biennium, the DCP contracted with Strategic Solutions to conduct an effectiveness evaluation of PIE to determine whether PIE was successful in achieving the three program-specific objectives described in the MSHCP. The final report for this evaluation was included in appendix 11 of the 2004 Adaptive Management Report (UNR-BRRC). The effectiveness of the PIE program will be discussed further in chapter 6 of this document.

On the Ground Mitigation Projects

In addition to the above implementation status information provided by UNR-BRRC as Science Advisor contractor, the following can be extracted from the 2005 Biennial Progress Report (Clark County 2005b) regarding on-the-ground mitigation projects funded by the DCP.

During the 2003-2005 biennium, the DCP continued funding for the U.S. Department of Agriculture - Animal, Plant, Health, Inspection Service to provide wildlife damage control services for two specific threats to covered species: feral cats and ravens. Feral cat predation is a hypothesized threat to the Palmer's chipmunk, known only from the Spring Mountains. The project traps and euthanizes feral cats and monitors them for diseases. Raven predation on juvenile desert tortoises is a hypothesized threat to the recovery of the species. The project controls raven populations at targeted sites where the raven population is artificially augmented by human activities, such as landfills and dairy facilities. Biological and tissue samples are taken from ravens, and are used in an effectiveness monitoring program that includes

DNA analysis. The final report and data for this project were not available to inform this Adaptive Management Report.

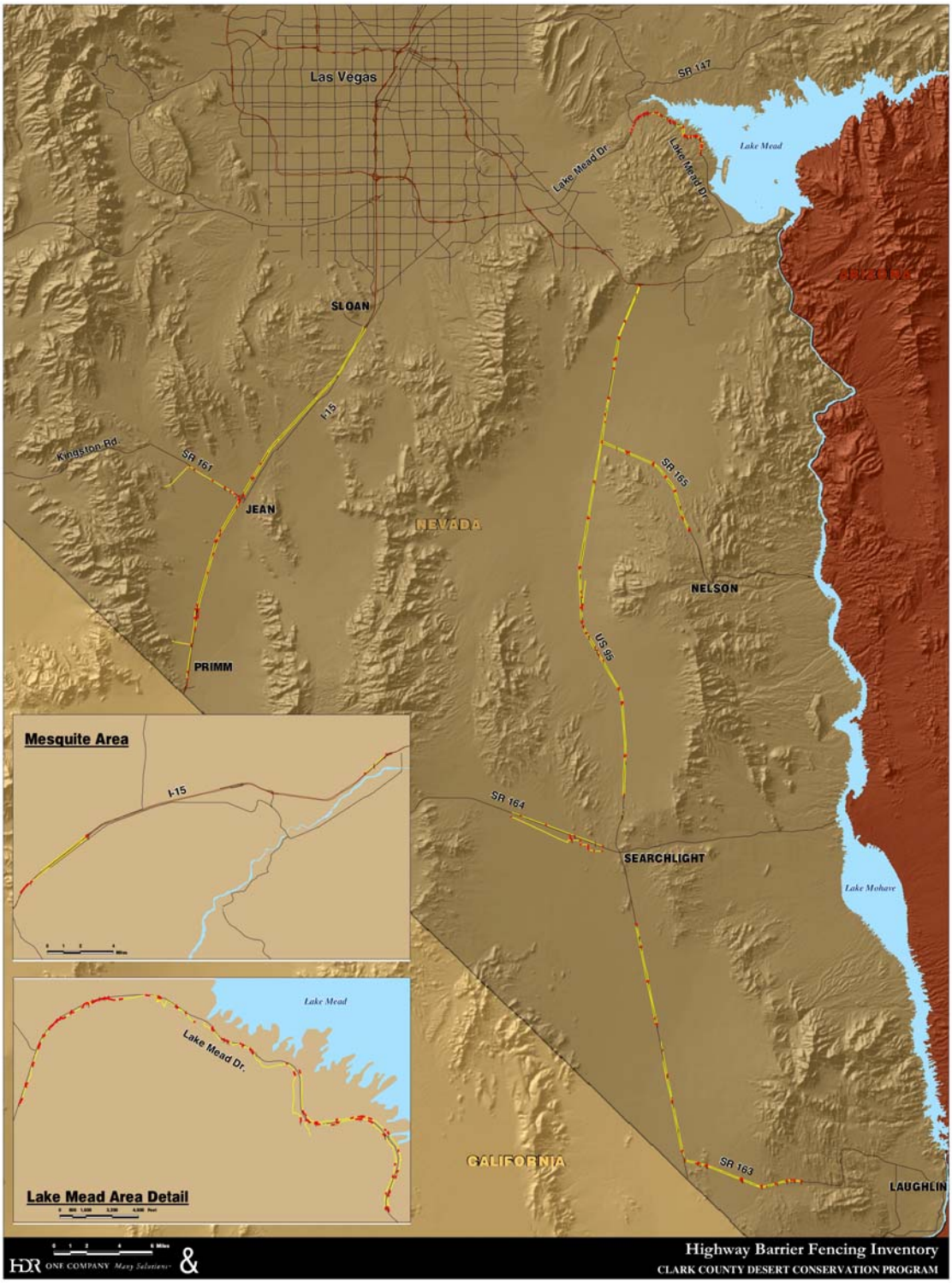


**Figure 18. Desert Tortoise Exclusionary Fencing Installed to Date.**

## AMP Implementation Status

The AMP as originally described in the MSHCP had five areas of focus; development of Geographic Information System (GIS) capacity, indicator and surrogate identification and evaluation, evaluation and management of roads and off-highway vehicle (OHV) activity, management of species that appear most likely to be listed without proactive action and statistically defensible species' status reporting and monitoring. Progress and barriers to progress for each of these categories is described below. Recommendations for the AMP are found in chapter 7.

### Development of GIS Capacity

During the 2003-2005 biennium the DCP augmented funding for several Implementing Agreement agency staff positions and one Clark County staff position to manage and analyze GIS data that were generated by DCP funded projects or that can otherwise inform the AMP. In addition, the 2005-2007 IPB includes recommended funding for a Nevada Natural Heritage Program position dedicated to processing the species distribution data generated by DCP funded projects over the past six years.

In addition, in August, 2005, the DCP requested all data generated under past and present contracts. As described in previous chapters, 41 of 160 datasets requested had been received as of 5 January 2006. Compilation of these data into a Central Repository is a key function of the DCP GIS Database Manager position.

The GIS Working Group of the I & M Committee created draft Data Management Plan Development Guidelines for the DCP to increase standardization of the data collection funded by the DCP. These guidelines are found in appendix O.

### Indicator and Surrogate Identification and Evaluation

The MSHCP emphasized the utility of shortcuts to monitoring (RECON 2000 p 2.184), and the DCP continues to seek appropriate surrogates as a more efficient means to provide status reporting for species and habitat health via threats monitoring. In 2003-2005, the UNR-BRRC Ecosystem Indicators project continued, wrapping up the search for species that might be appropriate surrogates for status of covered species, and found that the expense of monitoring the indicator species was equivalent to or greater than the cost of measuring the MSHCP covered species. In addition, the scientific literature now is replete with failed attempts to find suitable monitoring surrogates for species' status and threats monitoring (USGS 2004). Towards the end of the 2003-2005 contract, the UNR-BRRC Ecosystem Indicators project shifted its focus from a search for indicator species to a search for surrogates of ecosystem health (Clark County 2005b). The project began testing the use of remote sensing techniques to detect status and trends of threats such as weed

infestations and linear disturbances such as road incursions. These types of data may be useful to infer the status of ecosystem health. This is discussed further in chapter 7.

### Evaluation and Management of Roads and OHV Activity

BLM and cooperators have made progress on mapping trails and roads within and surrounding designated Desert Tortoise Areas of Critical Environmental Concern. This process included frequent reports to and comments from the I & M Committee's Roads Working Group. The roads designation process is currently in review by the Nevada State Historic Preservation Office for compliance with cultural resource laws and regulations. Appendix N contains a copy of BLM's January 2006 progress report to I & M Committee.

Additional BLM efforts included further development of a more efficient means to evaluate non-speed OHV event permit applications for previously used and approved route segments. To date, ten routes have been identified and volunteers from the OHV event community have been identified to mark those routes with carsonite signs. A map of the routes is being developed (appendix N).

### Management of Species that Appear Most Likely to be Listed Without Proactive Action

During the 2003-2005 biennium, UNR-BRRC as Science Advisor contractor conducted a preliminary Risk Assessment for the covered, evaluation and watch list species addressed by the MSHCP. Materials for this section of the Adaptive Management Report were requested of UNR-BRRC as Science Advisor contractor on 8 September 2005. A description of the methods and results of this assessment were not received by the DCP in time for inclusion in this report. The potential utility of the preliminary Risk Assessment is discussed in chapter 7.

### Species' Status Reporting

As described in chapter 4, during the 2003-2005 biennium a final species' status report outline was submitted to the USFWS on 6 January 2006, (appendix F) with a proposal to produce or update species' status reports on a rotating basis, with one third of the covered species receiving reports or updated report each biennium. The initial three biennia species' status reporting will address those species ranked most at risk by the matrix developed by UNR-BRRC as Science Advisor contractor. It is presented in appendix G of this Adaptive Management Report. Thus, the most at risk third of the covered species would be addressed in the 2007-2009 biennium. In the 2009-2011 biennium, the next third most at risk ranked species that remain at that time will be addressed, and the remaining third addressed in the 2011-2013 biennium. Species status reports produced through other funding sources may also be recommended for review by the AMP for consistency with the species' status report outline and for acceptable use of best available science by AMP to determine if they

can be used to inform the DCP's obligation for species' status reporting. In next biennium the reports will be updated in a similar fashion, with recommendation from AMP on which reports may need more frequent updates.

The risk to species will be determined by the most current species risk list developed by the AMP. The most current matrix is that provided by UNR-BRRC as Science Advisor contractor for this Adaptive Management Report (appendix G). The methods used to compile this matrix are described in chapter 4.

Statistically Defensible Rare and Elusive Species Monitoring

The AMST review of 2005-2007 proposals recommended that all species monitoring proposals be improved prior to funding. These conditions for funding were included in the 2005-2007 IPB, and proposal proponents were notified of these conditions during the spring of 2005. To assist Implementing Agreement agency and not-for-profit organization proponents address these technical conditions, UNR-BRRC as Science Advisor hosted a Rare Species Monitoring Workshop on 14 and 15 March 2005. Several subject-matter and experimental design experts participated in a panel review of the proposals. The experts were Drs. Vicky J. Meretsky, David F. Parkhurst, James S. Sedinger, David M. Theobald and Kenneth E. Nussear. Each of the proposals addressed by this workshop were required to address these proposal conditions prior to funding of these projects. The AMP is currently evaluating the responses of all 2005-2007 SNPLMA recommended proposal proponents to these funding conditions. In addition, Dr. Dick Tracy provided an essay on the difficulties of monitoring rare or elusive species, found in appendix W.

Species Information Database

The January 2006 AMST meeting recommendations for the future direction of the AMP included continuation of a species information database that compiles and summarizes what is known about the covered species. During the AMST's 7 September 2005 meeting, Dr. C. Richard Tracy, UNR-BRRC as Science Advisor contractor, presented plans for the further development of the species information database maintained by UNR-BRRC as Science Advisor contractor. The current species summaries are found in appendix Z.

Evaluation of the Means to Enhance Cost-Effectiveness of Existing Species and Habitat Conservation Actions

The AMP continued efforts by UNR-BRRC as Science Advisor contractor to improve the DCP's approach to effectiveness monitoring. UNR-BRRC as Science Advisor contractor hosted a Workshop and Practical Forum on Monitoring and Adaptive Management on 14 and 15 April 2004. Ten 2003-2005 contracts reported on either development of an effectiveness monitoring strategy or gathering of effectiveness monitoring data in the 2005 Biennial Progress Report (table 6). Of these ten projects, several of these projects are not yet completed, and none of the final reports

were submitted to the DCP in time for review and inclusion in this Adaptive Management Report.

Since the last Adaptive Management Report (UNR-BRRC 2004), little new quantitative information can be brought to bear on the four questions posed by UNR-BRRC as Science Advisor in the 2004 Adaptive Management Report. These questions were posed for each MSHCP conservation action and MSHCP project:

> 1) Does the project description address the goals of the MSHCP to (a) maintain the long-term net habitat value of the ecosystems in Clark County with a particular emphasis on Covered Species and (b) recover listed species and conserve unlisted Covered Species?
> 2) Is documentation available that supports the assertion that the goals of the MSHCP are addressed; that is, are there reports and/or maps as appropriate?
> 3) If the project is an implementation of conservation measures, are the goals and objectives sufficiently clear that it is possible to design a monitoring program to gauge the effectiveness of those conservation measures?
> 4) If the project is itself described as monitoring, does it contain the elements of a useful monitoring program?

Data generated by many past DCP funded projects have only recently been received by the DCP, and many datasets have not yet been received (appendix E). As of 5 January 2006 approximately one quarter of the datasets generated from past projects had been delivered to the DCP, and preparation of these data to inform design of programmatic effectiveness analysis will take considerable effort. The need to prepare and analyze these data is reflected in the recommendations for AMP priorities, discussed in chapter 7.

Table 6. 2003-2005 Projects That Addressed Effectiveness Monitoring.

| Project Title: | Effectiveness monitoring product: |
|---|---|
| Upland Restoration in Critical Desert Tortoise Habitat (Sect 7 BLM) | Effectiveness monitoring strategy |
| Increasing Effectiveness and Economy in Density Monitoring of the Desert Tortoise (Sect 7 UNR) | The results of this project will be published in the U. S. Fish and Wildlife Service review of range-wide tortoise monitoring in late 2005. |
| Development of a Range-wide Desert Tortoise Monitoring Training Program (Sect 7 UNR) | The results of desert tortoise monitoring (range-wide) are used to evaluate the effectiveness of this training effort and changes incorporated for next year's workshop. One could expect to see the results of this evaluation in the U. S. Fish and Wildlife Service review of range-wide tortoise monitoring in late 2005. |
| Law Enforcement (Sect 10 BLM) | Effectiveness monitoring strategy |
| Restoration of Fragmented Upland Habitats on Federal Lands (Sect 10 BLM) | Effectiveness monitoring strategy |
| Spring-fed Wetlands and Riparian Restoration (Sect 10 NPS) | Effectiveness monitoring and scientific research were integrated into the project to address specific needs. |
| Clark County Multiple Species Habitat Conservation Plan (MSHCP), Adaptive Management Coordination, Science Advice and Effectiveness Monitoring Strategy Development (SNPLMA Clark County) | Science Advisor contract products and this Adaptive Management Report |
| Lake Mead National Recreation Area Data Collection and Analysis (SNPLMA NPS) | These data are needed to gauge effectiveness of conservation measures outlined in the MSHCP and to provide information to guide planning and development in Clark County. |
| Wildlife Inventory Monitoring and Management (SNPLMA NPS) | Rare and sensitive species living on the recreation area must be monitored in order to detect problems which require management attention, and to determine the effectiveness of ongoing management activities. |
| Assist in Development of Wildlife Damage Management for Threatened Endangered Species from Predation or Parasitism (SNPLMA USDA_ADC) | Effectiveness monitoring, involving gut content analysis, has been included in the project. Effectiveness monitoring is being altered to include gut content analysis and possible DNA marker coding. |

Over the last two years, progress was made to improve the quality of information coming to the AMP from contractors. Efforts to coordinate data collection, data management and data sharing among contractors, including the Implementing Agreement agencies, and the AMP have continued during the 2003-2005 biennium. The I & M Committee's GIS Working Group created a draft Data Management Standard (appendix O) that is compatible with Federal Geospatial Database standards and is responsive to the needs of the DCP. A draft design for a new DCP geospatial database - the Central Repository - has been completed, and capacity on County staff was created to administer the Central Repository. Efforts to better coordinate the implementation database, species information database, literature database, Central Repository, DCP document library and other data storage systems will be a focus of

the AMP in the 2005-2007 biennium. In addition, discussions continue between the DCP and Implementing Agreement agencies regarding coordination with the Interagency Geospatial Database being developed by University of Nevada Las Vegas' Public Lands Institute for the Federal Implementing Agreement agencies.

In the call for proposals for funding in the 2005-2007 biennium, proponents were requirement to indicate which species and threats their project would address. The inclusion of this requirement in the implementation database allows us to make a preliminary assessment of question 1 above from a programmatic standpoint. These data were extracted from the implementation database for all projects that were ultimately recommended for funding in the 2005-2007 IPB. These data are summarized in appendices P, Q, and R. No distinction was made between implementation and information gathering projects for this summary.

This preliminary summary of the recommendations for projects to be funded in the 2005-2007 IPB indicates that each species was to be addressed by at least one project that was recommended for funding in the 2005-2007 IPB (appendix P). Several species and ecosystem threats were addressed by projects recommended for funding in the 2005-2007 IPB (appendices Q and R, respectively.)

The 2005-2007 IPB also included a funding recommendation for 18 projects to address covered species monitoring, 6 to address evaluation or watch list species monitoring and 3 projects that included an effectiveness monitoring design. In addition, a major focus of the AMP during the 2003-2005 biennium was to enhance the rigor and adaptive management information value of species population and status monitoring. These efforts were discussed in chapter 4.

### Law Enforcement Prototype Digital Data Collection and Reporting System

UNR-BRRC as Science Advisor contractor developed a prototype digital data collection and reporting system to improve the efficiency of LE efforts augmented by MSHCP-administered funding, and to allow for better data collection to improve implementation and effectiveness monitoring for these conservation actions (appendix L). This is described in greater detail in chapter 6.

## Additional AMP Accomplishments

In addition to the progress made on the above five areas of focus, the program has addressed the following:

### *Adaptive Management Science Plan*

In August of 2003, the Adaptive Management Science Plan (AMSP) was finalized (appendix S). This document established the Adaptive Management Science Team, an Adaptive Management Program Coordinator, and formally described the roles of these entities and the role of the Science Advisor contractor.

*Adaptive Management Science Team*

As described in the AMSP, the AMST was established in late 2003. Their first task was review of 65 of the 95 submitted 2005-2007 proposals for funding. This review resulted in written technical and scientific recommendations for each proponent to address prior to receiving funding. UNR-BRRC as Science Advisor contractor submitted a written summary of the AMST reviews (appendix S) and the proposal-specific review comments. Many of these review comments were used by the DCP to craft conditions for funding of these proposals. Proposal proponents received these conditions during the spring of 2005 and they were asked to respond with modifications to their proposals. The responses to these conditions for SNPLMA proposals are currently under review by the AMP.

A draft charter for the AMST was produced in June 2005 (appendix T), and several meetings of the AMST were held in 2005 and early 2006 under this charter's operating guidelines. The primary focus of the AMST during 2005 was the design and content of this 2006 Adaptive Management Report. Several assignments were made to AMST members to produce materials for the report. In addition, members of the AMST were asked to review DCP products from contracts for their utility to inform this Adaptive Management Report. In addition, the AMST worked with Bill Harris of Facilitated Systems to develop a model of the MSHCP and the DCP, which is described in chapter 1 of this document and included in appendix B.

*Adaptive Management Coordinator and GIS Database Manager*

In response to the AMSP, in 2004 the County advertised an RFP for an Adaptive Management Coordinator project. No qualified bids were received, and the DCP developed two staff positions to address the tasks originally addressed by the RFP. In April 2005 the position of Adaptive Management Coordinator was filled by this author, and in May 2005 the position of GIS Database Manager was filled. After an unexpected vacancy in the GIS Database Manager position in October 2005, the position was once again filled in February 2006. The tasks that will be undertaken by these positions are described in the AMSP (appendix S).

*Science Advisor*

In 2005 the Adaptive Management Coordinator and the Science Advisor contractor developed a list to catalog, describe and track the wide variety of activities undertaken by the Science Advisor contractor during the 2003-2005 biennium. A sample of this tracking list is provided in appendix U. Many of the activities on this list have been described elsewhere in this Adaptive Management Report, as they are related to development of the AMP as described in the MSHCP.

In addition, on 21 January 2006 Dr. C. Richard Tracy, UNR-BRRC as Science Advisor contractor, provided to the Plan Administrator the following cumulative

summary of UNR-BRRC research accomplishments over the life of the MSHCP section 10 take permit and the preceding permits for the Short Term Habitat Conservation Plan (RECON 1991) and Desert Conservation Plan (RECON 1994).

**Major Research Accomplishments for the CCMSHCP from UNR-BRRC**

***Accomplishments for Desert Tortoise:***

The BRRC staff represents the world authority on desert tortoise ecology and conservation, and it serves the MSHCP and the FWS in bringing the highest quality of conservation planning and implementation to Clark County. BRRC has conducted research that has provided solutions to the major dilemmas of how to manage native desert tortoises in Clark County, and what to do with desert tortoises retrieved from harm's way in areas of urban development. The major hurtles for managing desert tortoise are the following:

• identify the threats to persistence of natural tortoise populations
• understand the biology of well enough to indicate management prescriptions
  - for natural populations
  - for individuals translocated from harms way due to urban development
• monitor the efficacy of management actions

*To meet those needs:*

• BRRC directed the reassessment of the recovery plan for the desert tortoise and guided implementation of recovery actions for desert tortoise for the MSHCP. Threats especially pertinent to Clark County, and identified by research by BRRC, have resulted in specific management actions (e.g., fencing highways to recover habitat near roads, reduce competition between tortoises and domestic grazers)
• BRRC has conducted research proving the efficacy of translocation as a means to dealing with the more than 10,000 tortoises displaced by urban development in Las Vegas Valley. That research has shown that tortoises can be very successfully translocated only to areas of suitable habitat. The site where Clark County programmatically translocates tortoises currently supports population densities of more than twice natural levels, and BRRC research has shown that those densities produce no discernable short-term problems for individuals or populations of tortoises.
• The Desert tortoise was originally listed as threatened due, in part, to an upper respiratory disease causing alarming mortality in some parts of the species range. BRRC has conducted research on the individual, and population, consequences of this disease in natural populations and in tortoises managed within the CC translocation program. This research has produced necessary information leading to programmatic reductions in threats to tortoise populations managed as part of the MSHCP, and it is also necessary in order to design a program less cumbersome than putting translocated tortoises into a holding corral. The MSHCP has a goal of managing desert tortoise in a way that ultimately will not require a translocation facility. To meet the goals of the MSHCP, BRRC has:
- Developed a genotyping method to assess the genetic strain of tortoises in Clark County. BRRC has identified five separate strains of desert tortoise in Clark County and knowing from which strain individual tortoises are associated is critical information to the program in order ultimately to move tortoises from harm's way into natural areas in Clark County.
- Developed a new ELISA test to assess health status in desert tortoise. This test is ten times more sensitive than previous tests allowing health assessment even with poor blood samples.
- Experimentally assessed the conditions under which tortoises transmit upper respiratory track disease to healthy tortoises.
- Experimentally assessed the potential negative effects of corralling tortoises in a translocation site where tortoise densities become abnormally large.
- Developed new methods for tortoise monitoring that include monitoring tortoise presence and absence throughout Clark County, monitoring tortoise densities, monitoring habitat quality, monitoring threats, monitoring health status of individuals. These methods have increased the quality of information from monitoring, and led to economies in monitoring.

- Developing methods to assess stress and the relationship between stress and disease
- Conducted tortoise monitoring (of all kinds) throughout Clark County
- Developed training facilities and curricula for field technicians involved in tortoise monitoring

***Accomplishments for Other MSHCP species:***

• BRRC research has assembled a database of existing information on MSHCP species. This database includes approximately 7,300 references including peer-reviewed and gray-literature reports as well as agency reports, and manuals. This database provides a baseline of information for all projects on MSHCP species.
• BRRC has researched the very rare and sensitive Gila Monster and developed a habitat model that can serve as a basis for protecting this species and avoiding a federal listing.
• BRRC has researched the needs of butterflies and birds in the Muddy River Riparian Ecosystem. This research has led directly to prescriptions for weed abatement in that ecosystem.
• BRRC has researched the difficulty of generalizing from data on species whose ranges in Nevada are at the edge of their global distribution. Data on phainopepla illustrates that year–to–year variation in distribution and abundance of marginal species can provide misleading information vis-à-vis management for those species.
• BRRC has assessed the role of wild horses to spring biodiversity in the Spring Mountains. Surprisingly, horses use very few springs, and protecting natural springs from wild horses should be relatively easy. Elk, on the other hand, tend to visit more springs and protecting against the negative effects of elk will be more difficult.
• BRRC has researched the means by which rare and/or elusive species can be monitored. This is a very challenging as statistically defensible approaches are nearly non-existent. Nevertheless, it is challenging and counterintuitive that monitoring rare and/or elusive species is so difficult. BRRC continues to research the limits to analyses of monitoring for rare and/or elusive species.

***Accomplishments for Developing Indicators of Ecosystem Health:***

• BRRC research has shown that disturbance to desert scrub ecosystems by off-highway vehicles always reduces biodiversity. However, some species respond positively to disturbance and others do not tolerate that kind of disturbance. The purpose of this research was a search for biological indicators of positive and negative effects to anthropogenic change to Clark County ecosystems. Biological indicators definitely can be used to indicate ecosystem health, but they are too expensive to use. Thus, we have now launched a new approach in the search for ecosystems indicators, which uses remote sensing from aerial imagery. Initial results shows that remote sensing will allow us to detect changes to native and weedy ecosystems adequate to assess trends in progress and regress in effectiveness of MSHCP projects.

***Accomplishments in support of the MSHCP:***

• BRRC has developed tools in support of the MSHCP:
- BRRC has developed a web-accessible database supporting essentially all aspects of the MSHCP program. It contains integrated databases containing information on projects, proposals, reviews, meeting reports, species, ecosystems, threats, management actions, and more (approximately 50 databases containing all the information required in the MSHCP.
- BRRC has offered educational workshops to convey contemporary science techniques and paradigms for researchers and practitioners in the MSHCP.
- BRRC has developed an objective and defendable review process for MSHCP proposals.
- BRRC has developed new methods for effectiveness monitoring for some projects. For example, BRRC has helped move Law Enforcement forms into PDA computers making the process of Law Enforcement more efficient, and also allowing for effectiveness assessments of the project.
- BRRC has provided GIS support for numerous MSHCP projects for which no other GIS support is available.
- BRRC has provided field support for numerous projects in the MSHCP including training and technician support for MSHCP contractors including agencies such as NDOW, and private organizations such as PIC.

- BRRC has provided scientific support to all technical working groups as needed. This has included attending all working group meetings to be on hand to help when needed.

Summary

Many efforts have been taken both with MSHCP-administered funding and with other funding sources to implement the MSHCP Permit Conditions and Conservation Actions, and to further the development of the AMP. Few quantitative data on the efficacy and effectiveness of these efforts were available for this Adaptive Management Report. More data have since been received by the DCP, and availability of additional data sources has been indicated by several Implementing Agreement signatory agencies. The availability of these data poses both an opportunity and a challenge for the DCP and AMP, which is to most efficiently utilize those data within their limitations. In other words, the data in most cases should not be used to draw conclusions beyond the purposes for which these data were collected. In most cases this purpose was solely to document the location, time, and methods implemented, which will enable the DCP to verify and evaluate the status of implementation of past projects. These data might also appropriately be used to detect patterns and make observations that guide the design of more rigorous data collection and analysis within an adaptive management framework. Additional recommendations can be found in chapter 7 of this document.

The Adaptive Management Program has been restructured, as described in the Adaptive Management Science Plan, and now includes several roles that are filled by both contractors to the DCP and DCP staff. The myriad activities of the Science Advisor contractor have been documented, and the AMP can now be more easily be evaluated for progress towards the development of the AMP as described in the MSHCP.

# CHAPTER 6 EFFECTIVENESS MONITORING

*Co Authors Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear and Dick Tracy*

- **Tracking the effectiveness of the actions taken to implement the Multiple Species Habitat Conservation Plan (MSHCP) is a task of the Adaptive Management Program.**
- **Effectiveness monitoring plans require four elements: 1) goals and objectives for management actions, 2) conceptual models, 3) indicator selection, and sampling design.**
- **To date, there is little available quantitative data that support or refute the effectiveness of implemented actions.**
- **Ten of the 2003-2005 projects collected information on effectiveness of the implemented actions.**
- **Few of these projects had been completed and the Adaptive Management Program received none of these data in time to analyze for this report.**
- **The Public Information and Education program has specific objectives defined in the MSHCP, and has been shown to be effective in meeting those objectives.**

## INTRODUCTION

Monitoring is not passively or casually watching things happen. Monitoring is not simply counting. Monitoring is not measuring in the absence of a clear management context. Properly conducted monitoring will provide information that can help us explain phenomena that concern us. Monitoring in environmental management has been described as the "measurement of environmental characteristics over an extended period of time to determine status or trends in some aspect of environmental quality." The difficulty in implementing such a program is determining which characteristics and over what time scale monitoring should be implemented.

The Multiple Species Habitat Conservation Plan (MSHCP) administration is concerned with compliance monitoring, to track or verify implementation of a management plan, compliance with a contract or regulation, or performance on a commitment to restore or enhance a resource or otherwise undertake conservation actions. Effectiveness monitoring, by contrast, evaluates status and trends of a system and its components that result from a management action in an effort to determine whether the action has achieved the desired target or outcome. Effectiveness monitoring is the primary focus assessment tool for the Clark County MSHCP Adaptive Management Program. Finally, monitoring population, or metapopulation status and trend and habitat or ecosystem condition (i.e., extent of habitat and level of fragmentation) are measures of the explicit biological objectives of the program.

For the MSHCP to use monitoring information in the adaptive management program (AMP) for decision-making the monitoring efforts must be accurate and precise and consistent with the best scientific methods. Most ecologists and resource managers have at least some idea of what monitoring is and what it can accomplish: the HCP requirement that monitoring provide the basis for quantification of mitigation over a specified landscape demands a rigorous and standardized paradigm. The elements of credible monitoring program have been described in the MSHCP, in various reports and in the 2004 Biennial Adaptive Management Report are repeated here to emphasize the four necessary elements:

1) clearly stated goals and objectives for management actions,
2) well-defined conceptual models,
3) good justification of the selection of indicators, and
4) sampling designs that adequately address scope and resolution.

In addition, this essay will address the current status (completed and current projects and approved proposals) and future needs for programmatic effectiveness monitoring for the four major categories of implementation (conservation action) currently funded by the Clark County MSHCP.

## REQUIREMENTS FOR EFFECTIVENESS MONITORING

### Goals and Objectives for Management Actions

Monitoring programs should be capable of determining whether current or proposed management practices are maintaining the ecological integrity of the target environmental system and the ability of the system to deliver expected goods and services (for example, numbers of chuckwallas or erosion control by riparian vegetation). Certainly no universal set of goals or objectives characterizes a “high quality” environmental state or can apply to all ecosystems subject to management and monitoring. But each proposed management action (or ongoing management action for which new monitoring is being proposed) should be accompanied by a set of specific project goals that guide the development of monitoring objectives. Management goals may take many forms – for example, a target number of desert tortoises, a restored mesquite bosque with a specific species composition and structure, or a Muddy River floodplain of predetermined extent inundated for an expected time period. Those goals may be articulated in response to a legal mandate, for example recovery goals under the Endangered Species Act or as attainment goals under the Clean Water Act. Whatever the basis for the management goal, the goal should be articulated in such a manner that clear, quantifiable objectives can be identified and direct the monitoring design.

### Conceptual Models

Barriers to the attainment of management goals and the success of restoration efforts are inevitable. These barriers arise from both human-generated and natural

environmental "stressors." Stressors are physical, chemical, or biological phenomena that cause deleterious effects on ecosystems and their constituent elements. Stressors include a wide variety of environmental disturbances, such as wildfires, invasions of exotic species, stream diversions, and conversion to agricultural land use. Stressors have defining characteristics, including frequency of occurrence, extent of occurrence, magnitude (intensity and duration), selectivity (elements of the system on which they act), and variability, which allow them to be categorized during development of a monitoring plan. Stressors that act on managed ecosystems must be described in terms of causes and effects. That description is best presented as a conceptual model that links environmental stressors to environmental attributes of concern.

Well-designed conceptual models enable a monitoring program to investigate relationships between environmental perturbations and likely consequences. Conceptual models outline the connections among ecosystem elements and environmental stressors, the strength and direction of those links, and attributes of the system that can be used to characterize the state of resources. Conceptual models show how environmental systems function and emphasize anticipated responses to natural and human-caused stressors. A conceptual model that describes the managed system is absolutely necessary to design an effective monitoring program. Although a thorough narrative description of an ecosystem of concern can serve as a conceptual model, conceptual models are most useful when presented as visual representations of the relationships among factors that contribute to ecosystem function. Conceptual models should explicitly link ecosystem attributes, which include both abiotic and biotic elements and inputs, to system stressors. The expected cause-and-effect relationships that result in ecosystem changes identified in the conceptual model serves to assist selection of candidate indicators for measurement in the monitoring program.

Indicator Selection

Because ecosystems are complex, monitoring programs cannot possibly measure all of their attributes. The functioning of ecosystems, their responses to restoration, and their susceptibility to long-term change therefore must be assessed using a limited set of indicators (sometimes referred to as performance measures or performance metrics). The theory and practice of indicator selection is demanding; selection of ineffective indicators will cause a monitoring program to fail.

A conceptual model provides a basis for selection of candidate indicators, the responses of which are expected to reflect ecosystem changes that may result from management actions or environmental stressors. Indicators are expected to provide information on other resources from and attributes of the same ecological system. The most effective indicators respond in a fashion similar to the dynamics of the ecosystem that supports them and respond rapidly to changes in their environment. The changes in status of effective indicators can be accurately measured, their natural variability is sufficiently limited that changes in response to management can be

differentiated from background variation, and they can be measured in a cost effective manner.

There are at least three categories of indicators that can be useful for monitoring:

1) Function or process indicators measure ecosystem processes and their rates. Processes include but are not limited to primary productivity, nutrient cycling, sediment accumulation, and water flows;

2) Indicators of ecosystem structure are used to assess ecosystem structure at any spatial extent and resolution, from local patches of vegetation to patch distributions and connectivity across the landscape; and

3) Species-based indicators – an important category of indicators for the HCP given its focus on at-risk and listed species – typically are members of taxonomic groups that are important to ecosystem function (predators, pollinators, decomposers), provide insight into the integrity of the ecosystem (that is, they may serve as umbrella species, keystone species, or ecological engineers), are direct targets of management (because they are recognized as threatened or endangered), or are sensitive to ecosystem change.

Candidate indicators for monitoring should provide a clear "signal," alerting managers to the true state of the system in time to respond with appropriate action. The most effective indicators are those whose mechanistic behavior in response to a specific stressor is well understood. Because no standing body of information exists that can *a priori* guide and assure selection of the best indicators in all management scenarios, best professional judgment must be used, along with available empirical data and pertinent literature, in evaluating potential indicators in many management scenarios. Subsequent data collection will be the means by which the effectiveness any given indicator is proven. The UNR Indicators project funded by the Clark County MSHCP has taken advantage of remote sensing technologies and the ongoing UNR Desert Tortoise Baseline Density Monitoring project, also funded by the MSHCP to identify and select from a range of environmental variables those that provide correlations with remote sensing signatures. Desert tortoise monitoring field crews that are walking tortoise density transects, randomly distributed in desert upland, are also collecting information on ecosystem health and human impacts. These data along desert tortoise density data are analyzed with remote sensing imagery to identify indicators. Preliminary studies in 2005 identified several important relationships that require further testing. The UNR Indicators project in the 2005-2007 biennium, due to begin in the spring of 2007 and the UNR Reptile and Amphibian Distribution project and the UNR Desert Tortoise Baseline density project will provide the necessary field validation of the remote sensing signatures. The coordination among these projects and the synergies created are an example of how the Adaptive Management Program was envisioned to work by the writers of the MSHCP.

The MSCHP calls for identification of indicator species (RECON 2000, p. 2.282) as surrogates of population or ecosystem processes of concern. The MSHCP further defines an indicator species as a species, an ecosystem component, or characteristic of

the landscape that can be easily measured and that exhibits dynamic changes or responses that parallel those of more difficult to measure populations or processes. It is recommended that a new term, Ecosystem Indicators, be adopted, as Indicator Species captures only one of the three components put forth in the above definition. Ecosystem Indicator is broader and encompasses species and ecosystem components and characteristics of the landscape (i.e. ecosystem pattern and process). From this point forward Ecosystem Indicators will be used in place of Indicator Species. Examples of each type of indicator potentially important to Clark County include desert tortoise, road density and distribution, and aeolian sediment transport.

In many cases, scientific evidence is lacking as to the qualifications of a factor for indicator status. As such, the identification of ecosystem indicators should be based upon scientific evidence. In addition, the identification and most importantly the monitoring of selected indicators should be heavily coordinated with ongoing projects. Due to the potential cost effectiveness of remote sensing technologies, they should be employed whenever possible for the identification or monitoring of indicators. However, before choosing a remote sensing research or monitoring track it is important to match the scale of the ecosystem pattern or process with the suitability of the platform. Phinn *et. al.* (2003) recommend a six-step approach to ensure appropriate matching of need with remote sensing platform or tool. This framework provides an objective mechanism for the identification of relevant aspects of a monitoring problem and environmental characteristics for selecting the appropriate remotely sensed data and analysis techniques.
The main steps include:

1. identification of information requirements for the monitoring or management problem;
2. development of ideal image dimensions;
3. exploratory analysis of existing remotely sensed data using scaling techniques;
4. selection and evaluation of suitable remotely sensed data;
5. selection of suitable spatial analytical techniques to meet information requirements; and
6. cost-benefit analysis.

Failure to follow this framework, or similar, may result in the expenditure of money on data and information not appropriate to the scale or format necessary to answer the original research or monitoring question.

It is important to recognize that remote sensing techniques and methods are not always the solution to identification and/or monitoring of ecosystem indicators. In some cases, more traditional techniques or methods may be necessary. For example, biological soil crust, an important indicator of soil stability and in some areas the main party responsible for nitrogen fixation, are not easily detected or monitored by remote sensing techniques. This is due to the fact that the scale at which soil crust are distributed across the landscape is far below the spatial and spectral detection capabilities of most sensors. More traditional techniques, such as field surveys for validation may be required. Such is the case with the collaboration between the UNR

Indicators Project and the Desert Tortoise Baseline Density Monitoring Project and the UNR Reptile and Amphibian Distribution Project.

Once an ecosystem indicator has been identified as important to the health or well being of another species, habitat quality, and/or maintenance of important ecosystem functions its suitability for remote monitoring must be determined. The following species, ecosystem patterns and/or processes are obvious examples of factors suitable for remote sensing detection and/or monitoring: vegetation with either a distinct spatial or spectral pattern, anthropogenic activities that result in distinct or obvious spatial or spectral scaring of the landscape such as roads, mining, agriculture, urban growth, etc., and natural fluvial or aeolian processes that manifest themselves through distinct spatial or spectral patterns on the landscape. The key to the above is the identification of ecosystem indicators that can be distinctly identified and thus monitored by either their unique spatial or spectral signatures. Often overlooked, but no less important, especially in harsh arid environments, is the temporal dimension. This is especially important when considering vegetation species as ecosystem indicators. The phenology of individual species will not only drive the spectral and spatial properties of the chosen remote sensing platform, but also the timing of its acquisition. Inappropriately timed imagery is a complete waste of resources.

Despite the overall cost effectiveness of remote detection and monitoring of ecosystem indicators, there is significant opportunity for cost-sharing. This will require coordination between existing projects and agencies responsible to the MSHCP such as is occurring among the Indicators, Tortoise Density and Reptile and Amphibian Distribution projects. The identification of projects and agencies' projects or activities that will provide such collaborative opportunities must initially be done by the County as part of its AMP Coordination responsibility. It is also advisable that the County consider purchasing most if not all remote sensing imagery and sharing among the cooperating agencies. This will ensure that appropriate license levels and use restrictions are purchased, minimize duplicate purchases and facilitate the availability and use of imagery by current and future projects

Sampling Design

Designing a sampling plan for monitoring after indicators are selected is a complex task that varies greatly with the nature and scope of the management action that is monitored. However, several key issues must be addressed. First, it is necessary to estimate the status and trend(s) of an indicator with appropriate precision; this demands substantial statistical expertise. Essential to the monitoring program is establishment of expected values (or trends) of indicators as benchmarks against which the indicator states are compared following management actions. Second, values that will be used to trigger management responses must be identified. This requires information on, or assumptions about, what constitutes an ecological effect sufficiently great to warrant management response or amendment – the effect size – as well as a sampling scheme that is adequate to detect that effect. Only by identifying appropriate trigger points (a value or distribution of values) for management intervention is a monitoring plan made operational. Third, a substantial

number of practical issues of design and analysis pervade the development of a sampling frame – boundaries to the ecosystem and area subject to management must be defined; the temporal resolution and extent of sampling must be established; a sample size appropriate to estimate the value of the indicator must be identified; a survey design that responds to spatial heterogeneity needs to be constructed; and units of measure for each indicator must be chosen.

## TYPES OF EFFECTIVENESS MONITORING

When designing an effectiveness monitoring for a specific management question, it is important to distinguish between retrospective monitoring and prospective monitoring. Retrospective monitoring (sometimes referred to as effects-oriented monitoring) attempts to identify effects of management on ecosystems by monitoring changes in the status of an environmental attribute, such as the population size of a sensitive species or the composition of a vegetation community. Retrospective monitoring strives to detect environmental changes after they have occurred, and attempts to attribute causation when an effect is found. Prospective or predictive monitoring (also referred to as stressor oriented monitoring), differs from Retrospective monitoring in that it attempts to detect factors that cause responses by elements of an ecosystem before undesirable effects occur or before effects become serious.

Both retrospective and prospective monitoring approaches have some utility and can be complementary in a diversified monitoring program that assesses the effects of multiple management actions in a complicated field setting. But retrospective and prospective monitoring activities are not equally appropriate or useful in every assessment effort. When risks or costs of a failed management action are relatively low, the probability of detecting changes in the system is high, or the lag time between a cause and effect is short, retrospective monitoring may prove effective and may be less expensive than alternative options. However, when risks and costs are high, the ability to detect changes is comparatively low, and lags in system responses are relatively long, prospective monitoring is required. If there are substantial numbers of at-risk species in its purview, the HCP must respond to perceived environmental needs quickly, using focused restoration efforts that capitalize on the best available technical information and immediately replacing management actions that prove to be less than successful with more effective actions.

The 2004 BAMR reported that in some cases, final reports on projects that addressed single species contained sufficient reliable information to inform species' status, but most projects had broader and more diffuse goals, and incomplete reporting, and there was little effectiveness monitoring to document management efficacy. There were no projects that directly quantified the mitigation intended to balance take. Since the 2004 BAMR no projects have been explicitly directed to provide thorough quantitative reports of the effectiveness of conservation or presumed conservation actions taken as part of the MSHCP, albeit several projects have produced data of importance in assessing effectiveness. This is especially the case for projects on

desert tortoise, relict frog, and the database project was assembling information of importance in assessing progress for the MSHCP.

The Desert Conservation Program has been slow to conform to this requirement of the MSHCP and the Permit. To address this deficiency and to improve the quality of proposals for the 2005-2007 biennium the U. S. Fish and Wildlife Service and Clark County directed the Science Advisory Team to convene a monitoring workshop for the Implementation and Monitoring Committee and DCP participants. The workshop addressed monitoring of rare and elusive for managers and DCP participants, especially those proposing projects that ostensibly would provide information that would inform species' status and trend. In addition, there was an opportunity for management professionals to engage in a dialogue with monitoring professionals about DCP projects. The invited outside experts reiterated the need for science-based and hypothesis driven inventory, monitoring and research projects.

One of the concerns expressed by project proponents and many others is that every management project should not have to include effectiveness monitoring, especially if it is described to be similar to other projects. This is a legitimate concern. Fencing projects by PIC, NDOT, BLM and NPS to exclude tortoises from roads or gravel pits or other dangerous situations should not each be required to demonstrate that fencing is effective. The program should address this by justifying fencing using existing literature, best professional scientific opinion, tortoise density monitoring, and, if necessary, programmatic monitoring. The proponents of similar management projects need to meet with the County, appropriate Working Groups and the Science Advisory Team to design programmatic monitoring. Such an effort for current and proposed weed eradication and restoration projects led by the University of Nevada Cooperative Extension currently includes SNRT, USGS, UNR, USFWS and other participants. Such cooperative, programmatic monitoring and effectiveness research efforts offer the best opportunity for adaptive management success. These considerations were not incorporated into the County's 2005-2007 program.

The status of effectiveness monitoring for the proposed conservation actions funded through the MSHCP is that there is not yet documentation of credible evidence that any actions taken for and funded by the MSHCP for any of the "Covered" species have been effective in meeting the biological goals of the program, a stable or increasing population trend and no net unmitigated loss or fragmentation of habitat. It is possible that some of the presumed conservation actions have met the program goals, but the requirement that an Adaptive Management Program demonstrate scientifically that the goals have been met has not been implemented.

## CURRENT OR PLANNED PROJECTS TO ADDRESS PROGRAMMATIC EFFECTIVENESS MONITORING

TO date no MSHCP projects have demonstrated that any other MSHCP project or actions have been "effective". However, the UNR Indicators project, the UNR Reptile

and Amphibian Distribution project, the UNR Desert Tortoise Baseline Density Monitoring project and the TNC Effectiveness Monitoring for saltcedar and knapweed control on the upper Muddy River Project for the 2005-2007 biennium (scheduled to start sometime late in 2006) have been specifically designed to address the effectiveness of programmatic actions or specific actions.

Installation of Tortoise-Proof Fencing or Barriers Along Major Roadways

The MSHCP has had the obligation to erect tortoise proof fencing along busy roads and highways in tortoise habitat. More than 250 miles of such tortoise-proof fencing has been erected to meet this goal. It is generally presumed with-in the tortoise conservation community that tortoise-proof fencing is beneficial but there is little empirical evidence to support this supposition. Further, tortoise populations in all of the areas identified in the MSHCP as Intensively Managed Areas (IMAs) and Less Intensively Managed Areas (LIMAs) for tortoises are continuing the declines observed in the 1980's and 1990's despite the actions taken to mitigate the direct and indirect impacts of the growth of the human population and in Clark County. Tortoise populations are not stable or increasing and habitat is being increasingly degraded and fragmented without clearly quantifiable mitigation. The evidence for this is expected to be documented in the forthcoming 2001-2005 Summary Report for Range-wide Monitoring of the Desert Tortoise.

The UNR tortoise density monitoring project, the UNR reptile and amphibian distribution project and the UNR indicators project will provide a preliminary assessment of tortoise and other reptiles' occurrence as a function of distance from highways equipped with tortoise barriers and those without. The indicators project will examine correlations among the tortoise and reptile data and other indirect measures or indicators. This will provide the first level assessment of tortoise fencing effectiveness.

Habitat Restoration: Including Exotic Plant Removal and Re-Vegetation of Vehicular Incursions

Weeds (plants and animal) may represent a threat to many of the Covered Species and ecosystems of Clark County. The management agencies have recognized this threat and have mature eradication programs as well as restoration programs to follow on eradication efforts and other sources of disturbance. The Southern Nevada Restoration Team (SNRT), a multi-agency organization that operates primarily on public lands including along the Virgin and Muddy Rivers, Meadow Valley Wash and along the shores of Lake Mead and has received part of its funding from the DCP. MRREIAC is a rural-based organization that contracts for Division of Forestry supervised prison crews to perform weed eradication efforts on the Muddy River. The conservation benefits of weed eradication and restoration vary depending on the weed or disturbance and the species presumed to benefit. In addition, the method of eradication and restoration may influence the how species experience the benefit. The Virgin River, the Muddy River and the Meadow Valley Wash are the subjects of

current or future planning efforts. Weed eradication activities need to be prioritized on the basis of the threat posed to a Covered Species. The TNC Muddy River project will directly evaluate the weed eradication efforts on the Muddy River. The UNR indicators project will also address riverine weed and native vegetation signatures to remotely identify threats and track recovery. The UNR reptile and amphibian distribution project will indirectly assess restoration projects for the occurrence and density of covered reptile species. The NPS weed sentry project to identify weed occurrence and to do selected eradication efforts along roads and trails may provide additional information useful in assessing effectiveness. Finally, the USGS Virgin River project is a basic research study of riverine processes and may provide information on the effectiveness of large-scale riverbank restoration efforts.

Law Enforcement

The MSHCP and previous plans have identified and funded law enforcement as a management priority. The resource managers assert that law enforcement is an essential conservation action. Approximately half of the MSHCP section 10 budget goes to law enforcement. The Law Enforcement Needs Assessment documented the increased need for public lands law enforcement with increases in the human population. Increasing MSHCP law enforcement funding in conjunction with that population will rapidly consume all of the section 10 funds without providing any scientifically reliable information about benefits to species or habitat and without the quantification of mitigation to balance take that is required by the USFWS incidental take permit to Clark County. The first step in assessing the effectiveness of law enforcement is quantifying the components of law enforcement that may provide covered species or ecosystem benefits or mitigate threats has been taken by NPS law enforcement officers. The Science Advisory Team has been working closely with NPS rangers to develop an electronic data collection system that will assist officers in recording relevant data and simplify the heavy reporting requirements officers have. This effort may provide the spatial data necessary to evaluate various aspects of law enforcement activities that may provide significant conservation benefits. Continuation of this collaborative effort between the Science Advisory Team and NPS rangers is critical to developing conservation effectiveness metrics for law enforcement. However, this effectiveness monitoring project requires the BRRC database as a means to collate data collected on forms with data in the database. Unfortunately, the database project has been terminated, so it is not clear how the effectiveness of law enforcement will be determined.

Public Information and Education

The PIE program is a requirement of the MSHCP and the permit, but it also consumes program resources without producing quantified benefits to species or habitats. The Strategic Solutions PIE Program assessment has so far provided substantial guidance to improving the reach of PIE projects, but the assessment is not intended as effectiveness monitoring for species benefits. Although the effect of PIE programs may be indirect and slow to develop, the program should nevertheless be able to

document benefits to species as justification for substantial expenditures of the conservation program. Like the law enforcement program, it should be a goal to pursue effectiveness monitoring through the formulation of clear conservation goals and a conceptual model for effectiveness of public information and education activities in reaching those goals. Designing approaches to the evaluation of the conservation effectiveness of PIE activities will require the addition of educational and social science expertise into the science program advisory staffing for the MSHCP.

## LIMITATIONS OF EXISTING AND PLANNED PROJECTS

There are several projects mentioned above that may indirectly inform assessments of some specific conservation actions and some programmatic actions. Several projects are necessary preliminary steps that can lead to well-designed studies of management effectives monitoring. No projects directly assess specific or programmatic actions that will explicitly inform the program biological goals of stable or upward population trend and level of habitat fragmentation and the need for mitigation. The following classes of management action or landscape activities need such explicit studies:

- law enforcement,
- road/vehicle impact restoration,
- road vehicle traffic impacts,
- recreation (hiking, OHV, skiing), and
- public information and education activities.

## RECOMMENDATIONS

The current projects that are preliminary steps toward programmatic effectiveness monitoring; those that provide indirect measures of effectiveness should be continued. They are:

- Desert tortoise density monitoring,
- Reptile and amphibian distribution,
- Ecosystem Indicators,
- Effectiveness of Muddy River salt cedar and knapweed removal and native vegetation restoration, and
- Virgin River restoration effectiveness research.

The following classes of management action or landscape activities need explicit studies:

- development of a law enforcement reporting system and preliminary effectiveness monitoring study,
- road/vehicle impact restoration effectiveness study,
- road vehicle traffic impacts study,

- recreation (hiking, OHV, skiing) impacts study (these should include study of informal recreation activities as well as planned expansion of facilities to expand recreational opportunities), and
- study of the effectiveness of public information and education programs for conservation of MSHCP species and habitats.

## EDITOR'S NOTES:

As the conservation actions listed in the MSHCP were extracted from approved agency management plans and other agency guidance documents and were reviewed for inclusion in the MSHCP by USFWS and others, it is a reasonable to assume that expert opinion and available data at the time supported some probability that implementation of these actions would in some manner benefit to of the species covered by the MSHCP to some degree or at the least not preclude the recovery of any of the species covered by the MSHCP or listed under the Endangered Species Act. The AMP does have information from recent project proposals regarding which conservation actions were planned, but has only begun to receive and process data to verify implementation. Implementation verification (*aka* compliance monitoring) provides information regarding the actual actions implemented, the methods used, as well as the spatial and temporal extent of those actions. This information is a crucial component of effectiveness monitoring. (personal communication to Sue Wainscott by Barry Mulder, 17April2006).

However, the MSHCP clearly describes the need for explicit effectiveness monitoring for implementation of conservation actions. The AMP has recommended effectiveness monitoring be initiated in past Adaptive Management Reports (UNR-BRRC 2002, 2004). Of the ten 2003-2005 projects that addressed effectiveness monitoring (table 6), several of these projects are not yet completed, and none of the final reports were submitted to the DCP in time for review and inclusion in this Adaptive Management Report. As described in chapter 4, the DCP and GIS Data Manager have actively sought data from past MSHCP-funded projects and contracts to inform species' status reporting. These data requests have also included data that can be used for implementation verification, as described in chapter 5. Some of these data may also be useful to inform the design of effectiveness monitoring. However, as stated in chapters 4 and 5, these data were gathered for project-specific purposes, and they must be used with caution for more programmatic purposes. Few of these data were collected to address the effectiveness of the project in an explicit fashion. Thus, the program now faces both an opportunity and a challenge. The opportunity is to depict and analyze in a spatially explicit format what implementation has been accomplished. The challenge is to avoid the temptation to blindly seek correlations between past implementation actions and some indicator of threat, ecosystem health or species' status and attempt to make statements regarding the effectiveness of those actions in achieving the measurable biological goals of the MSHCP.

In this phase of the AMP, it is imperative that we seek both technical expertise in adaptive management effectiveness monitoring design and local expertise on the

conservation actions implemented to build *a-priori* (before the fact) hypotheses and design monitoring projects to measure both project-level and programmatic effectiveness monitoring. As described in the 2004 Adaptive Management Report (UNR-BRRC) and the adaptive management literature (USGS 2004, Shenk and Franklin 2001) the creation of conceptual or other models to describe the current knowledge of the relationships among species, habitats, threats and conservation actions is the first step in this process. The data received by the DCP and additional available data indicated in the spreadsheets completed by the Implementing Agreement agencies should be used to inform these models.

Several reviewers of this document mentioned the need to strengthen the emphasis the AMP places on closing the Adaptive Management loop (Barry Mulder, Bruce Marcot, . Closing this loop involves both determining thresholds for the data values that trigger notification of decision-makers and providing effectiveness monitoring results and other data to decision-makers.

Law Enforcement: During the 2003-2005 biennium, UNR-BRRC as Science Advisor contractor developed a prototype digital data collection and reporting system to improve the efficiency of law enforcements efforts augmented by MSHCP-administered funding, and to allow for better data collection to improve implementation and effectiveness monitoring for these conservation actions. UNR-BRRC provided a description of this effort on 20 December 2005, authored by Dr. Kenneth Nussear. This description can be found in appendix L.

Public Information and Education: During the 2001-2003 biennium, the DCP contracted with Strategic Solutions to conduct an effectiveness evaluation of Public Information and Education (PIE) projects to determine whether PIE was successful in achieving the three program-specific objectives described in the MSHCP. The final report for this evaluation was included in appendix 11 of the 2004 Adaptive Management Report (UNR-BRRC). The conclusion of the evaluation was that PIE was successful in achieving its program-specific goals. Thus, the PIE program as currently implemented has been found to be effective. Recommendations regarding future efforts to evaluate the effectiveness of PIE are described in chapter 7.

# CHAPTER 7 RECOMMENDATIONS

*Author Sue Wainscott with contributions from* ***Drs. Jill Heaton, Karin Hoff, Ron Marlow, Ken Nussear and Dick Tracy***

***We are drowning in information, but starved for knowledge.***
***-- James Naisbitt***

- **The Adaptive Management Program is tasked with making recommendations for further implementation of the MSHCP, including future development of the Adaptive Management Program.**
- **A total of 96 recommendations are provided.**

The Adaptive Management Program is directed to make recommendations for further implementation of the MSHCP, including development of the Adaptive Management Plan. These recommendations are to be based on the best available science, and should provide alternative approaches for consideration where possible. The following 96 recommendations are provided, and are summarized in table 8.

## MSHCP IMPLEMENTATION RECOMMENDATIONS

General Recommendations for All Projects

The following general recommendations are made for all projects:

- Data will be collected and transferred to the DCP in accordance with the Data Management Plan Development and Implementation Guidelines.
- Contracts that address permit conditions, monitoring or production of programmatic analyses for the AMP should include a deliverable schedule that accommodates subject-matter review of draft products,
- Monitoring project RFPs should require bidders to include the qualifications of each statistical or biometrician subject-matter expert that will be involved in the design of monitoring protocols.

In addition, for all projects the Science Advisor recommends the following considerations regarding reporting and data quality:

Reporting: The DCP goals and objectives, quantifying effectiveness of conservation actions, documenting species' status and trend, have not been advanced by the current system of self-reporting. Despite many project proposals asserting that proposed actions would benefit species by addressing species or ecosystem threats or would

inform species' status reporting there is little quantitative evidence to support these assertions and it is difficult to defend the current system as effective for reporting MSHCP and permit compliance. The program should conduct a review of critical priorities prior to the next funding cycle to identify and define next actions and these should constitute the scopes of work for a directed call for proposal. It seems apparent that circumstances for many species have become more threatening and management options are less clear. The next funding cycles should emphasize information gathering projects for species, or threats, that appear most critical. It also seems clear that continuing implementation actions for which not effectiveness assessment has been initiated puts the program at risk. Implementation actions without objective, independent effectiveness monitoring should be avoided.

Considerations of Data Quality: In preparing contracts for MSHCP implementation and information gather projects the following information on previous MSHCP projects should be considered:

- Data delivered as Access databases or Excel spread sheets are not immediately GIS friendly and will require considerable time to make them so
- More recent data from the Federal land managers (weed data, restoration actions, law enforcement patrol routes) appear to be very well documented.
- Knowledge of quality control procedures is required to make an assessment of usefulness of data. From the example of Desert Tortoise monitoring we know that quality control is expensive and time consuming.
- Knowledge of the purpose and design of data collection is required to determine usefulness of the data. For example, data collection intended to support a narrow research question are not necessarily appropriate for determining species distribution.
- Cleaning up data from multiple sources, and collected for multiple reasons without prior metadata specification will be a long, involved and expensive process. Possibly not worthwhile in some cases. Making the decision whether to invest in that clean-up, or to better define the project and redo it with proper data and metadata specifications will take some discussion among Clark County, the PIs who produced the data, the USFWS and any necessary experts.

General Recommendations for All Implementation Projects

The following general recommendation is made for all implementation projects:

- As recommended in the draft Weeds Strategic Plan (NDOA 2005), implementation project methods should include best management practices to reduce the spread of invasive weed species during project activities.

Specific Recommendations for Implementation Projects

The data available for production of this Adaptive Management Report were not sufficient to support or refute the current direction of implementation of the MSHCP. However, as the conservation actions listed in the MSHCP were extracted from approved agency management plans and other agency guidance documents and reviewed for inclusion in the MSHCP by USFWS and others, it is reasonable to assume that expert opinion and available data at the time supported some probability that implementation of these actions would in some manner benefit to some degree or at the least not preclude the recovery of the species covered by the MSHCP. This uncertainty and lack of new data to inform more specific recommendations for implementation of the MSHCP was discussed during the January 2006 meeting of the Adaptive Management Science Team. The AMST made the following recommendation:

> The AMST recommends that the program continue on the current trajectory for implementation projects within programmatic categories used during the development of the 2005-2007 Implementation Plan and Budget.

This can be accomplished by using descriptions of the funded projects from 2005-2007 to guide creation of RFPs for similar implementation projects. The funding for implementation projects should be divided among project types in proportions equal to the 2005-2007 CFP categories (table 7). This approach to implementation is reasonable only if it is combined with a strong commitment by the DCP to undertake a substantial effort to design and begin effectiveness monitoring to inform the AMP. The AMST recommended approach to effectiveness monitoring for implementation projects of the DCP is described in the following section.

**Table 7. Expenditures in 2005-2007 in Call for Proposal Categories.**

| Proportion of 2005-2007 IPB | $ | Number of Projects | Program Category: | Project Category: |
|---|---|---|---|---|
| .07 | $2,372,000 | 3 | Implementation | DESERT TORTOISE FENCING |
| .05 | $1,806,649 | 4 | Implementation | LAW ENFORCEMENT |
| .01 | $243,333 | 2 | Implementation | ON THE GROUND MITIGATION PROJECTS FOR COVERED SPECIES |
| .03 | $930,000 | 4 | Implementation | PUBLIC INFORMATION AND EDUCATION |
| .02 | $595,620 | 2 | Implementation | RIVERINE HABITAT RESTORATION AND ENHANCEMENT |
| .01 | $471,411 | 3 | Implementation | UPLAND HABITAT RESTORATION AND ENHANCEMENT |
| .18 | $6,419,013 | 18 | Subtotal Implementation | |
| .06 | $2,177,649 | 5 | Information gathering and analysis | EFFECTIVENESS MONITORING-IMPLEMENTATION PROJECTS THAT ARE NOT DOCUMENTED TO BE EFFECTIVE |
| .01 | $500,000 | 1 | Information gathering and analysis | EFFECTIVENESS MONITORING-LAW ENFORCEMENT (NATURAL RESOURCE PROTECTION) |
| .28 | $9,594,311 | 18 | Information gathering and analysis | INVENTORY, RESEARCH AND MONITORING-COVERED SPECIES |
| .03 | $1,155,696 | 6 | Information gathering and analysis | INVENTORY, RESEARCH AND MONITORING-EVALUATION, WATCH LIST OR OTHER SPECIES |
| .19 | $6,680,737 | 12 | Information gathering and analysis | THREATS RESEARCH AND MONITORING-COVERED SPECIES |
| .58 | $20,048,393 | 42 | Subtotal Information gathering and analysis | |

**Table 7. (Continued)**

| Proportion of 2005-2007 IPB | $ | Number of projects | Program Category: | Project Category: |
|---|---|---|---|---|
| .004 | $135,430 | 1 | Operations | FORESTER II |
| .09 | $2,950,335 | 1 | Operations | ADAPTIVE MANAGEMENT PROGRAM |
| .01 | $500,000 | 1 | Operations | DESERT TORTOISE CONSERVATION CENTER AND DESERT TORTOISE TRANSFER AND HOLDING FACILITY |
| .03 | $1,131,781 | 5 | Operations | GEOGRAPHIC INFORMATION SYSTEMS AND MANAGEMENT |
| .01 | $260,660 | 1 | Operations | LAND AND RESOURCE ACQUISITION AND MANAGEMENT SERVICES |
| .07 | $2,324,600 | 1 | Operations | PROGRAM ADMINISTRATION |
| .21 | $7,302,806 | 10 | Subtotal Operations | |
| .0009 | $30,000 | 1 | Planning | BOULDER CITY CONSERVATION EASEMENT MANAGEMENT PLAN |
| .02 | $650,000 | 1 | Planning | CONSERVATION MANAGEMENT STRATEGY DEVELOPMENT |
| .01 | $256,623 | 1 | Planning | VIRGIN RIVER PLANNING PARTICIPATION |
| .03 | $936,623 | 3 | Subtotal Planning | |

## AMP RECOMMENDATIONS

General Recommendations for All AMP Projects

Regular Reporting on Adaptive Management Tasks

The 2006 Adaptive Management Report (this document) is weakened by the lack of a timely contribution from the Science Advisor contractor, which resulted in submittal of this draft report to the FWS on March 15, 2006. While the DCP has solicited reviewers for this draft and intends to submit a final report to the USFWS by 1 May 2006 that includes materials submitted by the Science Advisor contractor and is responsive to reviewer comments, the delay is disruptive. A remedy is recommended below.

Future Science Advisor and AMP contracts should include a specific schedule for submittal of draft designs of the AMP analyses recommended above. These designs should be received by the DCP and reviewed by the AMST using clear acceptance criteria before they are considered acceptable deliverables. Similar review and acceptance criteria should be incorporated for the results of all major AMP analyses completed by the Science Advisor and other contractors. In addition, the delivery of AMP analyses results and compilation of those results into the 2008 Adaptive Management Report by the Science Advisor contractor should be scheduled far enough in advance of the 15 March 2008 deadline to provide for response by the contractor to peer review of a final draft by the AMST. The response to this review and final Adaptive Management Report should be received by the DCP in advance of the 15 March 2008 deadline to allow for acceptance of the deliverable and transmittal by the DCP to the USFWS.

Active Adaptive Management Recommendation

While the DCP and Implementing Agreement agencies have been learning by doing for some time, this is a passive form of adaptive management. The DCP must increase its efforts to fully embrace the principles and techniques of active adaptive management. This will require adequate funding for the design, review and implementation of effectiveness monitoring and management decision oriented species and threats monitoring. As was described in the 2004 Adaptive Management Report (UNR-BRRC), the DCP should prepare a detailed monitoring manual that provides contractors and agencies with suggested steps for designing and documenting monitoring plans. This manual should supplement, not replace, the existing monitoring manuals available to land managers, many of which were recommended by both the Science Advisor (UNR-BRRC 2004) and the reviewers of this document. These monitoring manuals are listed in appendix W.

Some issues that should be described and addressed in the MSHCP monitoring manual include: the time lag between the decision to monitor and the analysis of the data; the utility of previously collected data; the utility of indicators and surrogates; the role of research in active adaptive management; newer monitoring designs and frameworks, such as multiple hypotheses approaches and Bayesian statistics;

Monitoring Time Lags: As depicted in the MSHCP Actions sector of the MSHCP model (figures 12 and 13) there is a time lag inherent between the gathering of monitoring data and the use of those data to inform implementation decisions. The solution is to not delay species or effectiveness monitoring, and bring necessary resources to bear for design and technical review of the designs to ensure that monitoring data collection can begin quickly as possible.

Utility of Previously Collected Data: As described earlier in this report, the availability of so many previously unavailable data poses both opportunities and challenges for the AMP. These data were collected for very specific purposes, and

they may not be compatible for programmatic analyses. However, they should be used to inform conceptual models and hypotheses regarding the status of species, ecosystem health, trends in threats and land use, and effectiveness of previously implemented actions.

Utility of Species Status Indicators: The science of adaptive management has progressed since the MSHCP was written. The AMP should seek to enhance the scientific and technical resources available to inform the DCP. For instance, there is little supporting evidence for the use of indicators as a more efficient means of monitoring species' status both in the literature (USGS 2004) and in the program's products (Clark County 2005b). Independent experts should critically review the value to the DCP of continuing to seek indicators of species' status.

Role of Research in Active Adaptive Management: The MSHCP describes the role of research in adaptive management (RECON 2000 p 2.185.) The rigorous scientific methodology used in research and scientific experimentation is appropriate and desired in all monitoring projects funded by the DCP. However, research and development of new technologies for their own sake are not a priority for the program. Research and development of new technology projects must be responsive to uncertainties that impact land and natural resource management decisions and should be subjected to review by independent experts with subject matter and adaptive management expertise. In addition, all such projects should contain an explicit description of how the data and results of the project will be used by managers to confirm or alter implementation of the MSHCP.

Monitoring and research/development projects funded by the MSHCP must be informative to adaptive management of the DCP. In other words, monitoring should be designed to address key uncertainties about the species or effectiveness of actions in achieving goals and objectives of the MSHCP. In addition, the monitoring should be rigorous enough to refute or support hypotheses to provide guidance for land and resource managers. Figure 19 below depicts the relationship between the type of monitoring/research and the strength of inference or ability to make inferences from the results of monitoring efforts. Note that formal experimentation is defined in this figure as experiments that are not bounded by the decision space faced by land and resource managers. Adaptive management is by definition bounded by such a decision space. In the case of the DCP, we are bounded by the direction in the MSHCP, and the 604 conservation actions currently approved for implementation of the MSHCP. Research that does not inform the AMP is of little utility to the DCP.

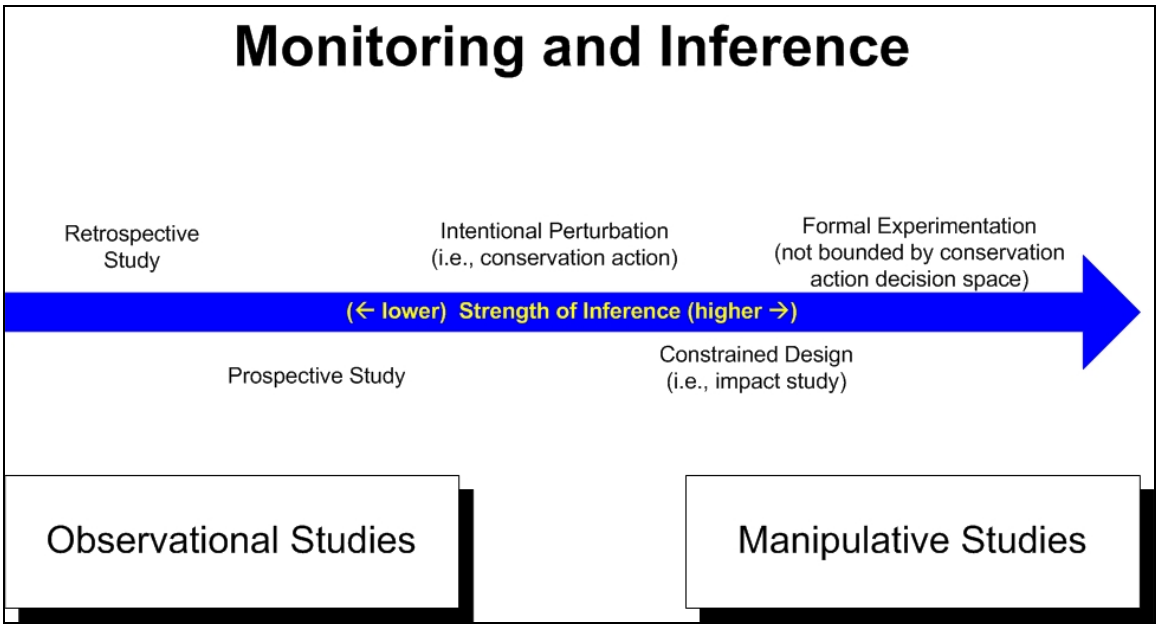


**Figure 19. Relationship Between Monitoring Techniques and the Strength of Inference. Adapted with permission from Clinton Moore. As presented at U.S. Fish and Wildlife Service National Conservation Training Center 30 January - 3 February, 2006.**

Newer Approaches to Monitoring Design: Shenk and Franklin (2001) describe an approach to adaptive management that was also described in a USFWS Adaptive Management and Monitoring for Endangered Species Conservation course at the National Conservation Training Center (30 January - 3 February 2006). This approach is described in great detail in chapter 10 of Shenk and Franklin's book (Kendall in Shenk and Franklin 2001). The approach addresses the need to choose between/among different models of a system. Differences between or among models amount to multiple hypotheses that can be tested using a multiple-hypothesis approach (Nichols in Shenk and Franklin 2001). A multiple-model, multiple-hypothesis approach is a-priori, based on available data and is consistent with guidance provided in previous Adaptive Management Reports (UNR-BRRC 2002, 2004), and the effectiveness monitoring and rare species monitoring workshops UNR-BRRC as Science Advisor contractor provided to the DCP in April 2004 and March 2005.

In a multiple-hypothesis approach, available data, including expert opinion, is used to assign goodness-of-fit probabilities to each hypothesis. Experimental treatments and/or data collection are designed to provide data that will assess these goodness-of-fit hypothesis probabilities, and adjust the probabilities up or down as confidence in each hypothesis is affected by the accumulation of data. A model considered should not be discarded, even if the level of confidence in that model hypothesis reaches a low value (personal communication to Sue Wainscott by Clinton Moore, 2 February

2006). Those models with low levels of confidence still have value to an adaptive management program not only as a legacy of the learning that has taken place, but because the hypotheses in the model may prove to be of value when exploring outlying data points or changes in the system being studied (personal communication to Sue Wainscott by Clinton Moore, February 2, 2006).

For example, the completion of the Southwest Regional GAP effort provides an opportunity for the DCP to consider a multiple model hypothesis testing technique described in Shenk and Franklin (2001). The MSHCP contained potential habitat models based on very coarse surrogates for habitat – eleven ecosystems within Clark County (appendix C). The Southwest Regional GAP effort developed more detailed predictive habitat models for several vertebrate species across the five states of Nevada, Arizona, Utah, Colorado and New Mexico, including several MSHCP covered species. In addition, several products of the DCP will be available during the 2005-2007 biennium that propose alternatives to or refinements of the coarse predictive habitat models presented in the MSHCP (RECON 2000). The MSHCP coarse predictive habitat models (ecosystem associations of each covered species) represents one hypothesis for each species' habitat, and the Southwest Regional GAP predictive habitat models represent another. Rather than view these competing hypotheses as an intractable uncertainty, the DCP might embrace the multiple hypotheses and fund monitoring programs that reduce the uncertainty, and improve our understanding of species' distributions and status. Similarly, if there is uncertainty regarding the outcomes of implementing a conservation action, the multiple potential outcomes can be stated as hypotheses, the relative confidence in each outcome (hypothesis) quantified, and an effectiveness monitoring experiment designed to discriminate among the hypotheses.

Nichols (in Shenk and Franklin 2001 p 21) also makes the following statements:

> *With a multiple-hypothesis approach, design criteria based on the rejection of a single hypothesis are no longer relevant. Instead of maximizing test power, we want to maximize discrimination ability. We seek a design that will produce data with the greatest ability to discriminate among the competing hypothesis.*

In other words, design criteria typically used to optimize the power (probability of correctly rejecting the null hypothesis when it is false) are no longer the sole standard by which the design of an experiment or monitoring program should be judged. As this approach to experimental and monitoring design is relatively new, the AMP should identify and make available to the program subject-matter and statistical experts who are familiar with application of the multiple-hypothesis approach and the appropriate statistical techniques. Experts who also have experience implementing this approach within a regulatory, adaptive management framework should be strongly considered.

<u>Specific Recommendations for AMP Projects</u>

Specific recommendations for AMP projects and tasks are described below.

Land Use Trends

As described in chapter 2, the direction for this AMP task is currently vague, and clarification should continue to be sought from the Fish and Wildlife Service. Once the direction is better understood, a design for implementing this AMP task should be included in the scope of work for the Science Advisor contract. The design and results of this and all AMP analyses should be reviewed by the AMST and subject-matter experts as necessary.

Habitat Loss by Ecosystem

The AMP is to track land disturbance (habitat loss) under the section 10 take permit by ecosystem in order to better recommend implementation and information gathering projects that will mitigate for the land disturbance or minimize the direct and indirect impacts of the land disturbance, as discussed in chapter 3. The intent of this AMP task is to ensure that land disturbance under the section 10 take permit is balanced with implementation of conservation actions (RECON 2000 p 2.179). This AMP task might be sufficiently accomplished by an estimate of potential disturbance under the section 10 take permit for the MSHCP using the boundaries of the disposal areas and private lands outside of those areas, as was done for the preliminary risk assessment conducted by UNR-BRRC as Science Advisor contractor during the 2003-2005 biennium. The areas for which NDOT has coverage for take under the MSHCP should also be included. An analysis to quantify the relative amounts of disturbance that might be permitted in each of the eleven ecosystems (appendix C) is being completed by the BLM as part of their analysis of the impacts of PL 107-282, described in chapter 2. The results of this analysis will allow the DCP to prioritize conservation actions by the potential percentage of each ecosystem that might be disturbed under the section 10 take permit for the MSHCP.

As described in chapter 3, more detailed spatial tracking of land disturbance under the section 10 take permit might be necessary if it is determined that the areas within disposal boundaries contain a majority of the habitat for a covered species. This would require a strategy to convert the data from disturbance permit reports from all permittees to a GIS compatible data layer, and may take considerable effort. This information might also be inferred using new remote sensing technologies if an appropriate baseline dataset is available. The priority for more detailed spatial tracking of this AMP task should be considered against the other priorities of the AMP program.

In addition, the definitions of the eleven ecosystems used as surrogates for species habitat in the MSHCP may warrant refinement in light of currently available data, including the Southwest Regional GAP data currently available in provisional form. The Southwest Regional GAP effort is a regional effort to describe land cover, management and species distribution and potential habitat information across a five state area (Nevada, Arizona, Utah, Colorado, New Mexico). The need to cross-walk vegetation and management designation categories across jurisdictional boundaries

has created some inconsistencies with the ecosystem classifications used by the MSHCP from the Nevada GAP data. However, the refinement of the land use and management data layers, the use of a national vegetation classification system, the incorporation of potential habitat models for terrestrial vertebrates (birds, reptiles, amphibians, mammals) and the date of the remote sensing data layers used (1998) to produce the land cover dataset are all strong arguments in favor of using this dataset to refine our models and hypotheses regarding the use of ecosystems as surrogates of potential species distribution within Clark County. Further evaluation of this approach should occur early in the 2005-2007 biennium.

In addition, it must be noted that any differences between the Nevada GAP data used by RECON in development of the MSHCP's eleven ecosystems and the land cover data in Southwest Regional GAP are not likely to be the result of actual changes in land cover (ie conversion between ecosystems or habitat type), but are the result of refinements in the resolution of the Southwest Regional GAP data, as well as of differences in the land cover classifications used by the two efforts.

Species Status and Ecosystem Health

During the 2007-2009 the DCP should produce species' status reports for the third most at risk covered species as described in chapter 4 and in the 6 January 2006 letter to the USFWS (appendix F).

The Science Advisor makes the following recommendation regarding species' status reports:
Species Status Monitoring: The monitoring of population status and trend for all "Covered" MSHCP species and other species of concern, assessment of the amount, quality and occupancy of habitat, the extent of habitat fragmentation and the actions to mitigate or minimize decrements need to be regularly reported in Species Status Reports. The species' status report for each species must at a minimum:

- summarize the known distribution
- review current taxonomic status
- create an habitat model that predicts the possible distribution in order to guide inventory efforts
- summarize known natural history and autecology of the species
- analyze all available inventory, monitoring and other data to describe population status and trend
- summarize the known threats to the species
- identify gaps in our knowledge of this species and propose projects to fill those gaps
- summarize the conservation and other actions taken to benefit this species
- identify needed actions to address threats
- list and archive all information resources (published, peer-reviewed papers, reports, locality information, implementation project description, etc.)

The AMP should strengthen ties to the USFWS Desert Tortoise Recovery Office to ensure that data and recommendations from this office are clearly incorporated into the AMP. This will ensure that the DCP continues to actively implement projects that address the recovery of the desert tortoise.

In response to the finding of the AMST proposal review for the 2005-2007 IPB (UNR-BRRC 2005), UNR-BRRC as Science Advisor contractor hosted a rare species monitoring design workshop 14-15 March 2005 to bring additional expertise to the DCP. As described in chapter 5, several invited scientists and statisticians participated in this workshop to provide proposal specific advise to several proponents whose proposals had been recommended for 2005-2007 funding. The invited experts worked with proponents to better understand the criteria for development of conceptual or predictive habitat models, explicit hypotheses and considerations for monitoring design to encourage more rigorous, statistically valid sampling designs. Many of these proponents have incorporated early deliverables in their project proposals to address these concerns, but few have explicitly identified the credentials of the experts they will enlist to produce these deliverables. The AMP should set aside funding to provide appropriate subject-matter experts, such as those who participated in the 2005 workshop, to assist in the design and review of those monitoring projects to ensure that learning for adaptive management is maximized during the 2005-2007 biennium, in preparation for development of species' status reports in 2007-2009.

In addition, the DCP would benefit from a better mechanism for the AMP to learn from data generated outside the program. The species information database and species' status reports are designed to glean information from the peer reviewed and grey literature, but other scientists, land and resource management experts and amateur naturalists may have unpublished and unreported data that are of value to the AMP, but there is not currently a clear mechanism for receipt of these data. In the past, these issues were brought to the attention of DCP and AMP contractors through informal communications, but were seldom substantiated by data that can be incorporated into species' status reports or the species information database described above. An effort to design a more efficient means of receiving more formal notice of these data is recommended for the 2005-2007 biennium.

The Science Advisor makes the following recommendations regarding species knowledge gaps: Our increasing knowledge of at least anecdotal information of population losses or declines and previously unknown threats and the paucity of the information necessary to produce adequate and informative Species Status Reports on the Covered Species is a serious deficiency in the DCP. We repeat our 2004 BAMR proposal:

The Science Advisor should identify and insure the participation of appropriate scientific and other experts into a working committee for a Species Status Report Initiative that would use existing Knowledge Gap analysis, the Preliminary Risk Assessment and input from species and other experts to prioritize and create timelines

for filling the knowledge gaps for Covered Species and other species of concern. Further we believe this action should occur in the next three months and the resulting priorities be incorporated into a directed actions request for proposal to fill critical knowledge gaps and emergency management actions where the failure to act may result in serious population impacts.

The Science Advisor also makes the following specific recommendations regarding species' status information needs:

*Desert Tortoise*

- Continue to develop technologies to improve estimates in trends in population density from transect data. Consider using data only in "good years", and develop models of animal availability to be seen during monitoring as a means to provide more accurate estimates of density.
- Continue to develop technologies to assess trends in habitat occupancy by live and dead tortoises. Consider using data only in "good years", and develop models of animal availability to be seen during monitoring as a means to provide more accurate estimates of density.
- Develop means to assess stress in tortoises as a means to monitor at the individual scale.
- Correlate stress and immune competence in tortoise as a means to give meaning to individual-scale monitoring.
- Develop a spatially explicit model of areas in which tortoises are stressed to the point of being vulnerable to disease and assess temporal trends in vulnerability to disease.
- Monitor trends in known threats to tortoise populations.
- Monitor trends in quality of habitat for tortoise populations.

*Adaphic Specialist Plants*

- Consider abandoning attempts to assess population densities of populations based solely upon numbers of plants insofar as this metric does not include all life stages of the species (e.g., it does not include dormant seeds).
- Develop technologies to assess spatially-explicit trends in habitat occupancy by populations of adult plants and of seeds.
- Begin program of monitoring seed banks of each species of plants.
- Begin program of monitoring frequency of reproduction in populations of sensitive species, and correlate reproductive competence with habitat fragment size and proximity to threats to the species.
- Monitor trends in known threats to populations including habitat fragmentation.
- Monitor trends in quality of habitat (including threats to pollinators) for each species.
- Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations.

*Rare Butterflies*

- Reconsider attempts to assess population densities of populations based solely upon simple observations of adult insects as this metric has not been calibrated to consistent measures of density that would permit estimates of population trends.
- Develop means to assess spatially-explicit trends in habitat occupancy by populations of adult insects.
- Monitor trends in known threats to populations including habitat fragmentation.
- Monitor trends in quality of habitat (including threats to nectar sources and host plants) for each species.
- Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations

*Rare Migratory Birds*

- Continue to monitor population sizes in Clark County for each species.
- Develop models of habitat suitability as a means to identify suitable, but unoccupied, habitat.
- Monitor trends in quality of habitat.
- Develop means to assess population sizes of species in wintering grounds.
- Monitor trends in known threats to populations including habitat fragmentation.
- Monitor trends in quality of habitat.
- Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations

Effectiveness Monitoring

In the 2005-2007 IPB (table 7), 18 implementation projects were recommended to receive 18% of the IPB, while 6 projects that included a component of effectiveness monitoring were recommended to receive 7% of the IPB. Of this 7%, $500,000 was set aside for effectiveness monitoring of LE actions. Of the remaining $2,177,649 recommended for funding of effectiveness monitoring, the amount to be spent solely on effectiveness monitoring is less due to the inclusion of some restoration action funding within the effectiveness monitoring proposals.

Both the 2005-2007 Ecosystem Indicators and Desert Tortoise Monitoring proposals have been claimed to collect data on several indicators of disturbance in desert tortoise conservation areas to inform effectiveness monitoring of conservation actions implemented in the areas where the two proposals will collect data. Before the designs of these data collection projects are finalized, it is recommended that a technical advisory group be convened to review the available implementation data and the programmatic and project-specific hypotheses to be tested by these monitoring projects.

One source of information that can inform development of effectiveness monitoring strategy are the self-reported entries in the implementation database (appendices P, Q R and Y). In the 2001-2003, 2003-2005 and 2005-2007 biennia, project proponents were able to enter self-reported lists of the conservation actions, threats and species to be addressed to some degree by the project. In addition, in the 2005-2007 biennium, project proponents were also able to enter location data to describe in general where the project would be implemented. As described in chapter 5, the standards used to select these data were not standardized among proposals. Thus, it is cautioned that these data be used to formulate conceptual models and hypotheses to be tested rather than used to draw conclusions regarding actual extent of implementation of the MSHCP.

As described earlier in the general recommendations for implementation projects, the AMP currently has no data to inform project-specific recommendations. This is due to the lack of effectiveness monitoring data gathered to date. In January 2006, the AMST recommended that future IPBs include funding to initiate effectiveness monitoring for major categories of implementation actions. The AMST recommended that a matching fund for effectiveness monitoring be included in the 2007-2009 IPB for each category of implementation project to ensure that the program begins to design and implement monitoring for the effectiveness of implementation projects as soon as possible. The ratio of match was discussed, but no data or expertise within the AMST were available to inform a recommended ratio of funding for effectiveness monitoring.

*General Effectiveness Monitoring Project Recommendations*

For each programmatic category of implementation action, the 2007-2009 IPB should allocate funding for development and execution of effectiveness monitoring for that implementation project category. The RFP for contractors to perform this work should be based upon the following schedule of tasks:

**Year 1**

1. Compile existing data and with local resource and land management agency staff and subject-matter experts refine draft management objectives for the programmatic category and the implemented conservation actions.
2. If applicable design analyses for retrospective study of the implementation.
3. Execute retrospective study if applicable.
4. Design effectiveness monitoring study, including an explicit plan for those data to be gathered by the implementing parties.

**Year 2**

1. Provide results of the retrospective study of the implementation, if applicable.
2. Implement effectiveness monitoring study to address management objectives.
3. Provide results of first year of effectiveness monitoring study, including recommendations for any changes in the effectiveness monitoring approach.

In the past, the AMP has made recommendations for effectiveness monitoring (UNR-BRRC 2002, 2004), provided a workshop (14 and 15 April 2005) and consulted with project proponents during the 2005-2007 IPB development process. However, the AMP must be more specific if the AMP recommendations are to inform development of RFPs for specific effectiveness monitoring projects. The USGS monitoring and adaptive management manual (USGS 2004) provides a more detailed approach to designing monitoring for adaptive management, and could be referenced in the RFPs for effectiveness monitoring projects.

*Specific Recommendation for Continuation of Projects that Inform Programmatic Effectiveness Monitoring*

The Science Advisor provides the following recommendation for continuation of several 2005-2007 projects. The current projects that are preliminary steps toward programmatic effectiveness monitoring; those that provide indirect measures of effectiveness should be continued. They are:

- Desert tortoise density monitoring
- Reptile and amphibian distribution
- Ecosystem Indicators
- Effectiveness of Muddy River salt cedar and knapweed removal and native vegetation restoration
- Virgin River restoration effectiveness research

*Specific Recommendation for Public Information and Education Effectiveness Monitoring*

As described in chapter 6 by the editor, the DCP has completed an effectiveness monitoring assessment of PIE. The results of this assessment were that PIE is effective in meeting its measurable goals, defined in the MSHCP. This author recommends no additional monitoring of PIE unless the methods used to implement PIE or the objectives for PIE are changed.

Alternatively, the Science Advisor contractor provides the following recommendation:

The assessment has so far provided substantial guidance to improving the reach of PIE projects, but the assessment is not intended as effectiveness monitoring for species benefits. The Science Advisor recommends development of species' specific objectives for PIE and design of an effectiveness monitoring program to evaluate the conservation effectiveness of PIE activities.

*Specific Recommendation for Law Enforcement Effectiveness Monitoring*

Design and implementation of a law enforcement effectiveness monitoring program was recommended in the 2004 Adaptive Management Report (UNR-BRRC). While

the development of more efficient data collection and reporting as described in chapters 5 and 6 is important, even more important is the design of effectiveness monitoring programs to utilize these data. Step one must be the development of MSHCP-specific, measurable management objectives and hypotheses to be tested within the bounds of management guidance, state and federal laws and regulations. This effort will require expertise beyond that of the biological scientists and statisticians already engaged in the MSHCP, and the DCP and AMP should solicit adequate expertise from the law enforcement community. Both this author and the Science Advisor recommend continued development of a data collection devise (described in chapter 6) for law enforcement officers funded by the DCP.

*Specific Recommendation for Road/Vehicle Impact Restoration Effectiveness Monitoring*

The Science Advisor recommends explicit studies of road/vehicle impact restoration projects and a road vehicle traffic impacts study as a means of working toward programmatic monitoring.

*Specific Recommendation for Recreational Impacts Monitoring*

The Science Advisor recommends explicit studies of recreation (hiking, OHV, skiing) impacts study (these should include study of informal recreation activities as well as planned expansion of facilities to expand recreational opportunities) as a means of working toward programmatic monitoring of related implementation projects.

## SUMMARY

The DCP has made progress in implementation of conservation actions and development of the AMP. However, there is much improvement to be made in the development of explicit monitoring to inform active adaptive management. Many of the above recommendations represent a general recommendation for a renewed focus on monitoring and research that addresses key land and resource management uncertainties in a statistically defensible active adaptive management framework. All of the recommendations made in this report are summarized in table 8.

Table 8. Summary of Recommendations

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 1** | **General Recommendations for All Projects** | | |
| **AMR(2006) 1.1** | 93 | Data will be collected and transferred to the DCP in accordance with the Data Management Plan Development and Implementation Guidelines. | Chapter 5<br>Appendix O |
| **AMR(2006) 1.2** | 93 | Contracts that address permit conditions, monitoring or production of programmatic analyses for the AMP should include a deliverable schedule that accommodates subject-matter review of draft products. | |
| **AMR(2006) 1.3** | 93 | Monitoring project RFPs should require bidders to include the qualifications of each statistical or biometrician subject-matter expert that will be involved in the design of monitoring protocols. | |
| **AMR(2006) 1.4** | 94 | The program should conduct a review of critical priorities prior to the next funding cycle to identify and define next actions and these should constitute the scopes of work for a directed call for proposal. | |
| **AMR(2006) 1.5** | 94 | The next funding cycles should emphasize information gathering projects for species, or threats, that appear most critical. | |
| **AMR(2006) 1.6** | 94 | Implementation actions without objective, independent effectiveness monitoring should be avoided. | |
| **AMR(2006) 1.7** | 94 | Data delivered as Access databases or Excel spread sheets are not immediately GIS friendly and will require considerable time to make them so | |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 1.8** | 94 | More recent data from the Federal land managers (weed data, restoration actions, law enforcement patrol routes) appear to be very well documented. | |
| **AMR(2006) 1.9** | 94 | Knowledge of quality control procedures is required to make an assessment of usefulness of data. | |
| **AMR(2006) 1.10** | 94 | Knowledge of the purpose and design of data collection is required to determine usefulness of the data. | |
| **AMR(2006) 1.11** | 94 | Cleaning up data from multiple sources, and collected for multiple reasons without prior metadata specification will be a long, involved and expensive process. | |
| **AMR(2006) 2** | **General Recommendation for All Implementation Projects** | | |
| **AMR(2006) 2.1** | 94 | As recommended in the draft Weeds Strategic Plan (NDOA 2005), implementation project methods should include best management practices to reduce the spread of invasive weed species during project activities. | Chapter 6 |
| **AMR(2006) 3** | **Specific Recommendations for Implementation Projects** | | |
| **AMR(2006) 3.1** | 95 | The AMST recommends that the program continue on the current trajectory for implementation projects within programmatic categories used during the development of the 2005-2007 Implementation Plan and Budget. | Chapter 5<br>Appendices E, J & K |
| **AMR(2006) 3.2** | 95 | This can be accomplished by using descriptions of the funded projects from 2005-2007 to guide creation of RFPs for similar implementation projects. | Chapter 5<br>Appendices E, J & K |
| **AMR(2006) 3.3** | 95 | The funding for implementation projects should be divided among project types in proportions equal to the 2005-2007 CFP categories (table 7). | Chapter 5<br>Appendices E, J & K |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 3.4** | 95 | This approach to implementation is reasonable only if it is combined with a strong commitment by the DCP to undertake a substantial effort to design and begin effectiveness monitoring to inform the AMP. | Chapter 5 & 6<br>Appendices E, J & K |
| **AMR(2006) 4** | **General Recommendations for All AMP Projects** | | |
| **AMR(2006) 4.1** | *Regular Reporting on Adaptive Management Tasks* | | |
| **AMR(2006) 4.1.1** | 98 | Future Science Advisor contracts should include a specific schedule for submittal of draft designs of the AMP analyses recommended above. | Chapter 5 |
| **AMR(2006) 4.1.2** | 98 | These designs should be received by the DCP and reviewed by the AMST using clear acceptance criteria before they are considered acceptable deliverables. | Chapter 5 |
| **AMR(2006) 4.1.3** | 98 | Similar review and acceptance criteria should be incorporated for the results of all major AMP analyses completed by the Science Advisor and other contractors. | Chapter 5 |
| **AMR(2006) 4.1.4** | 98 | In addition, the delivery of AMP analyses results and compilation of those results into the 2008 Adaptive Management Report by the Science Advisor contractor should be scheduled far enough in advance of the 15 March 2008 deadline to provide for response by the contractor to peer review of a final draft by the AMST. | Chapter 5 |
| **AMR(2006) 4.1.5** | 98 | The response to this review and final Adaptive Management Report should be received by the DCP in advance of the 15 March 2008 deadline to allow for acceptance of the deliverable and transmittal by the DCP to the USFWS. | Chapter 5 |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 4.2** | *Active Adaptive Management Recommendation* | | |
| **AMR(2006) 4.2.1** | 98 | The DCP must increase its efforts to fully embrace the principles and techniques of active adaptive management. | Appendices S, T & V |
| **AMR(2006) 4.2.2** | 98 | As was described in the 2004 Adaptive Management Report (UNR-BRRC), the DCP should prepare a detailed monitoring manual that provides contractors and agencies with suggested steps for designing and documenting monitoring plans. | Chapters 4 and 6 |
| **AMR(2006) 4.2.3** | 98 | The solution is to not delay species or effectiveness monitoring, ---------- ($2^{nd\ part\ of\ recommendation}$) and bring necessary resources to bear for design and technical review of the designs to ensure that monitoring data collection can begin quickly as possible. | Appendices S, T & V |
| **AMR(2006) 4.2.4** | 99 | However, they [other data] should be used to inform conceptual models and hypotheses regarding the status of species, ecosystem health, trends in threats and land use, and effectiveness of previously implemented actions. | Chapter 1<br>Appendices S, T & V |
| **AMR(2006) 4.2.5** | 99 | The AMP should seek to enhance the scientific and technical resources available to inform the DCP. | Appendix S, T, V & W |
| **AMR(2006) 4.2.6** | 99 | Independent experts should critically review the value to the DCP of continuing to seek indicators of species' status. | |
| **AMR(2006) 4.2.7** | 99 | Research and development of new technology projects must be responsive to uncertainties that impact land and natural resource management decisions ---------- ($2^{nd\ part\ or\ recommendation}$) and should be subjected to review by independent experts with subject matter and adaptive management expertise. | |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 4.2.8** | 99 | Research and development of new technology projects must be responsive to uncertainties that impact land and natural resource management decisions<br>---------- (2nd part or recommendation)<br>and should be subjected to review by independent experts with subject matter and adaptive management expertise. | |
| **AMR(2006) 4.2.9** | 99 | In addition, all such projects should contain an explicit description of how the data and results of the project will be used by managers to confirm or alter implementation of the MSHCP. | Chapters 4 & 6 |
| **AMR(2006) 4.2.10** | 99 | Monitoring and research/development projects funded by the MSHCP must be informative to adaptive management of the DCP. | Appendix S, T, V & W |
| **AMR(2006) 4.2.11** | 99 | In other words, monitoring should be designed to address key uncertainties about the species or effectiveness of actions in achieving goals and objectives of the MSHCP. | Appendix S, T, V & W |
| **AMR(2006) 4.2.12** | 99 | In addition, the monitoring should be rigorous enough to refute or support hypotheses to provide guidance for land and resource managers. | Appendix S, T, V & W |
| **AMR(2006) 4.2.13** | 101 | For example, the completion of the Southwest Regional GAP effort provides an opportunity for the DCP to consider a multiple model hypothesis testing technique described in Shenk and Franklin (2001). | |
| **AMR(2006) 4.2.14** | 101 | As this approach to experimental and monitoring design is relatively new, the AMP should identify and make available to the program subject-matter and statistical experts who are familiar with application of the multiple-hypothesis approach and the appropriate statistical techniques. | |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 4.2.15** | 101 | Experts who also have experience implementing this approach within a regulatory, adaptive management framework should be strongly considered. | |
| **AMR(2006) 4.2.16** | 101 | These approaches to monitoring design and testing of multiple models or hypotheses can be applied to all AMP tasks and monitoring funded by the DCP. | |
| **AMR(2006) 5** | **Specific Recommendations for AMP Projects** | | |
| **AMR(2006) 5.1** | *Land Use Trends* | | |
| **AMR(2006) 5.1.1** | 101 | As described in Chapter 2, the direction for this AMP task is currently vague, and clarification should continue to be sought from the Fish and Wildlife Service. | Chapter 2 |
| **AMR(2006) 5.1.2** | 101 | Once the direction is better understood, a design for implementing this AMP task should be included in the scope of work for the Science Advisor contract. | Chapter 2 |
| **AMR(2006) 5.1.3** | 102 | The design and results of this and all AMP analyses should be reviewed by the AMST and subject-matter experts as necessary. | Chapter 2 |
| **AMR(2006) 5.2** | *Habitat Loss by Ecosystem* | | |
| **AMR(2006) 5.2.1** | 102 | This AMP task might be sufficiently accomplished by an estimate of potential disturbance under the section 10 take permit for the MSHCP using the boundaries of the disposal areas and private lands outside of those areas, as was done for the preliminary risk assessment conducted by UNR-BRRC as Science Advisor contractor during the 2003-2005 biennium. | Chapter 3<br>Appendix D |
| **AMR(2006) 5.2.2** | 102 | The areas for which NDOT has coverage for take under the MSHCP should also be included. | Chapter 3<br>Appendix D |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 5.2.3** | 102 | The results of this [BLM] analysis will allow the DCP to prioritize conservation actions by the potential percentage of each ecosystem that might be disturbed under the section 10 take permit for the MSHCP. | Chapter 3<br>Appendix D |
| **AMR(2006) 5.2.4** | 102 | As described in chapter 3, more detailed spatial tracking of land disturbance under the section 10 take permit might be necessary if it is determined that the areas within disposal boundaries contain a majority of the habitat for a covered species. | Chapter 3<br>Appendix D |
| **AMR(2006) 5.2.5** | 102 | This would require a strategy to convert the data from disturbance permit reports from all permittees to a GIS compatible data layer, and may take considerable effort. | Chapter 3<br>Appendix D |
| **AMR(2006) 5.2.6** | 102 | This information might also be inferred using new remote sensing technologies if an appropriate baseline dataset is available. | Chapter 3 |
| **AMR(2006) 5.2.7** | 102 | The priority for more detailed spatial tracking of this AMP task should be considered against the other priorities of the AMP program. | Chapter 3 |
| **AMR(2006) 5.2.8** | 102 | In addition, the definitions of the eleven ecosystems used as surrogates for species habitat in the MSHCP may warrant refinement in light of currently available data, including the Southwest Regional GAP data currently available in provisional form. | Chapter 3 |

| Code | Page (Chapter 7) | Recommendation | Further Information |
|---|---|---|---|
| **AMR(2006) 5.2.9** | 102 | However, the refinement of the land use and management data layers, the use of a national vegetation classification system, the incorporation of potential habitat models for terrestrial vertebrates (birds, reptiles, amphibians, mammals) and the date of the remote sensing data layers used (1998) to produce the land cover dataset are all strong arguments in favor of using this dataset to refine our models and hypotheses regarding the use of ecosystems as surrogates of potential species distribution within Clark County. | Chapter 3 |
| **AMR(2006) 5.2.10** | 103 | Further evaluation of this approach should occur early in the 2005-2007 biennium. | Chapter 3 |
| **AMR(2006) 5.3** | *Species Status and Ecosystem Health* | | |
| **AMR(2006) 5.3.1** | 103 | During the 2007-2009 the DCP should produce species' status reports for the third most at risk covered species as described in the 6 January 2006 letter to the USFWS. | Chapter 4, Appendix F |
| **AMR(2006) 5.3.2** | 103 | The monitoring of population status and trend for all "Covered" MSHCP species and other species of concern, assessment of the amount, quality and occupancy of habitat, the extent of habitat fragmentation and the actions to mitigate or minimize decrements need to be regularly reported in Species Status Reports. | Chapter 4 |

| Code | Page (Chapter 7) | Recommendation | Further Information |
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| **AMR(2006) 5.3.3** | 103 | The species' status report for each species must at a minimum:<br>• summarize the known distribution<br>• review current taxonomic status<br>• create an habitat model that predicts the possible distribution in order to guide inventory efforts<br>• summarize known natural history and autecology of the species<br>• analyze all available inventory, monitoring and other data to describe population status and trend<br>• summarize the known threats to the species<br>• identify gaps in our knowledge of this species and propose projects to fill those gaps<br>• summarize the conservation and other actions taken to benefit this species<br>• identify needed actions to address threats<br>list and archive all information resources (published, peer-reviewed papers, reports, locality information, implementation project description, etc.) | Chapter 4 |
| **AMR(2006) 5.3.4** | 103 | The AMP should strengthen ties to the USFWS Desert Tortoise Recovery Office to ensure that data and recommendations from this office are clearly incorporated into the AMP. | Chapter 4 |
| **AMR(2006) 5.3.5** | 104 | The AMP should set aside funding to provide appropriate subject matter experts, such as those who articipated in the 2005 workshop, to assist in the design and review of those monitoring projects to ensure that learning for adaptive management is maximized during the 2005-2007 biennium, in preparation for development of species' status reports in 2007-2009. | Chapter 4 |

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| **AMR(2006) 5.3.6** | 104 | In addition, the DCP would benefit from a better mechanism for the AMP to learn from data generated outside the program. | Chapter 4 |
| **AMR(2006) 5.3.7** | 104 | An effort to design a more efficient means of receiving more formal notice of these data is recommended for the 2005-2007 biennium. | Chapter 4 |
| **AMR(2006) 5.3.8** | 104 | The Science Advisor should identify and insure the participation of appropriate scientific and other experts into a working committee for a Species Status Report Initiative that would use existing Knowledge Gap analysis, the Preliminary Risk Assessment and input from species and other experts to prioritize and create timelines for filling the knowledge gaps for Covered Species and other species of concern. | Chapter 4 |
| **AMR(2006) 5.3.9** | 104 | Further we believe this action <AMR(2006) 5.3.8> should occur in the next three months and the resulting priorities be incorporated into a directed actions request for proposal to fill critical knowledge gaps and emergency management actions where the failure to act may result in serious population impacts. | Chapter 4 |
| **AMR(2006) 5.3.10** | 105 | Desert Tortoise: Continue to develop technologies to improve estimates in trends in population density from transect data. Consider using data only in “good years”, and develop models of animal availability to be seen during monitoring as a means to provide more accurate estimates of density. | Chapter 4 |
| **AMR(2006) 5.3.11** | 105 | Desert Tortoise: Continue to develop technologies to assess trends in habitat occupancy by live and dead tortoises. Consider using data only in “good years”, and develop models of animal availability to be seen during monitoring as a means to provide more accurate estimates of density. | Chapter 4 |

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| **AMR(2006) 5.3.12** | 105 | Desert Tortoise: Develop means to assess stress in tortoises as a means to monitor at the individual scale. | Chapter 4 |
| **AMR(2006) 5.3.13** | 105 | Desert Tortoise: Correlate stress and immune competence in tortoise as a means to give meaning to individual-scale monitoring. | Chapter 4 |
| **AMR(2006) 5.3.14** | 105 | Desert Tortoise: Develop a spatially explicit model of areas in which tortoises are stressed to the point of being vulnerable to disease and assess temporal trends in vulnerability to disease. | Chapter 4 |
| **AMR(2006) 5.3.15** | 105 | Desert Tortoise: Monitor trends in known threats to tortoise populations. | Chapter 4 |
| **AMR(2006) 5.3.16** | 105 | Desert Tortoise: Monitor trends in quality of habitat for tortoise populations. | Chapter 4 |
| **AMR(2006) 5.3.17** | 105 | Adaphic Specialist Plants: Consider abandoning attempts to assess population densities of populations based solely upon numbers of plants insofar as this metric does not include all life stages of the species (e.g., it does not include dormant seeds). | Chapter 4 |
| **AMR(2006) 5.3.18** | 105 | Adaphic Specialist Plants: Develop technologies to assess spatially-explicit trends in habitat occupancy by populations of adult plants and of seeds. | Chapter 4 |
| **AMR(2006) 5.3.19** | 105 | Adaphic Specialist Plants: Begin program of monitoring seed banks of each species of plants. | Chapter 4 |
| **AMR(2006) 5.3.20** | 105 | Adaphic Specialist Plants: Begin program of monitoring frequency of reproduction in populations of sensitive species, and correlate reproductive competence with habitat fragment size and proximity to threats to the species. | Chapter 4 |
| **AMR(2006) 5.3.21** | 105 | Adaphic Specialist Plants: Monitor trends in known threats to populations including habitat fragmentation. | Chapter 4 |

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| **AMR(2006) 5.3.22** | 105 | Adaphic Specialist Plants: Monitor trends in quality of habitat (including threats to pollinators) for each species. | Chapter 4 |
| **AMR(2006) 5.3.23** | 105 | Adaphic Specialist Plants: Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations. | Chapter 4 |
| **AMR(2006) 5.3.24** | 105 | Rare Butterflies: Reconsider attempts to assess population densities of populations based solely upon simple observations of adult insects as this metric has not been calibrated to consistent measures of density that would permit estimates of population trends. | Chapter 4 |
| **AMR(2006) 5.3.25** | 106 | Rare Butterflies: Develop means to assess spatially-explicit trends in habitat occupancy by populations of adult insects. | Chapter 4 |
| **AMR(2006) 5.3.26** | 106 | Rare Butterflies: Monitor trends in known threats to populations including habitat fragmentation. | Chapter 4 |
| **AMR(2006) 5.3.27** | 106 | Rare Butterflies: Monitor trends in quality of habitat (including threats to nectar sources and host plants) for each species. | Chapter 4 |
| **AMR(2006) 5.3.28** | 106 | Rare Butterflies: Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations | Chapter 4 |
| **AMR(2006) 5.3.29** | 106 | Rare Migratory Birds: Continue to monitor population sizes in Clark County for each species. | Chapter 4 |
| **AMR(2006) 5.3.30** | 106 | Rare Migratory Birds: Develop models of habitat suitability as a means to identify suitable, but unoccupied, habitat. | Chapter 4 |
| **AMR(2006) 5.3.31** | 106 | Rare Migratory Birds: Monitor trends in quality of habitat. | Chapter 4 |
| **AMR(2006) 5.3.32** | 106 | Rare Migratory Birds: Develop means to assess population sizes of species in wintering grounds. | Chapter 4 |
| **AMR(2006) 5.3.33** | 106 | Rare Migratory Birds: Monitor trends in known threats to populations including habitat fragmentation. | Chapter 4 |

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| **AMR(2006) 5.3.34** | 106 | Rare Migratory Birds: Monitor trends in quality of habitat. | Chapter 4 |
| **AMR(2006) 5.3.35** | 106 | Rare Migratory Birds: Do analysis to determine the smallest length of time required to achieve an estimate of trend in populations | Chapter 4 |
| **AMR(2006) 5.4** | *Effectiveness Monitoring* | | |
| **AMR(2006) 5.4.1** | 106 | Before the designs of these data collection projects are finalized, it is recommended that a technical advisory group be convened to review the available implementation data and the programmatic and project-specific hypotheses to be tested by these monitoring projects. | Chapter 6 |
| **AMR(2006) 5.4.2** | 107 | Thus, it is cautioned that these data be used to formulate conceptual models and hypotheses to be tested rather than used to draw conclusions. | Chapter 6 |
| **AMR(2006) 5.4.3** | 107 | In January 2006, the AMST recommended that future IPBs include funding to initiate effectiveness monitoring for major categories of implementation actions. | Chapter 6 |
| **AMR(2006) 5.4.4** | 107 | The AMST recommended that a matching fund for effectiveness monitoring be included in the 2007-2009 IPB for each category of implementation project to ensure that the program begins to design and implement monitoring for the effectiveness of implementation projects as soon as possible. | Chapter 6 |

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| **AMR(2006) 5.5** | *General Effectiveness Monitoring Project Recommendations* | | |
| **AMR(2006) 5.5.1** | 107 | For each programmatic category of implementation action, the 2007-2009 IPB should allocate funding for development and execution of effectiveness monitoring for that implementation project category. | Chapter 6 |
| **AMR(2006) 5.5.2** | 107 | The RFP for contractors to perform this work should be based upon the following schedule of tasks:<br>Year 1<br>1. Compile existing data and with local resource and land management agency staff and subject-matter experts refine draft management objectives for the programmatic category and the implemented conservation actions.<br>2. If applicable design analyses for retrospective study of the implementation.<br>3. Execute retrospective study if applicable.<br>4. Design effectiveness monitoring study, including an explicit plan for those data to be gathered by the implementing parties.<br>Year 2<br>1. Provide results of the retrospective study of the implementation, if applicable.<br>2. Implement effectiveness monitoring study to address management objectives.<br>3. Provide results of first year of effectiveness monitoring study, including recommendations for any changes in the effectiveness monitoring approach. | Chapter 6 |
| **AMR(2006) 5.5.3** | 107 | However, the AMP must be more specific if the AMP recommendations are to inform development of RFPs for specific effectiveness monitoring projects. | Chapter 6 |

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| **AMR(2006) 5.5.4** | 107 | The USGS monitoring and adaptive management manual (USGS 2004) provides a more detailed approach to designing monitoring for adaptive management, and could be referenced in the RFPs for effectiveness monitoring projects. | Chapter 6 |
| **AMR(2006) 5.5.5** | 108 | The current projects that are preliminary steps toward programmatic effectiveness monitoring; those that provide indirect measures of effectiveness should be continued. They are:<br>• Desert tortoise density monitoring<br>• Reptile and amphibian distribution<br>• Ecosystem Indicators<br>• Effectiveness of Muddy River salt cedar and knapweed removal and native vegetation restoration<br>Virgin River restoration effectiveness research | Chapter 6 |
| **AMR(2006) 5.6** | *Specific Recommendation for Public Information and Education Effectiveness Monitoring* | | |
| **AMR(2006) 5.6.1** | 108 | No additional monitoring of PIE is recommended unless the methods used to implement PIE are changed. | Chapter 6 |
| **AMR(2006) 5.6.2** | 108 | The Science Advisor recommends development of species' specific objectives for PIE and design of an effectiveness monitoring program to evaluate the conservation effectiveness of PIE activities. | Chapter 6 |

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| **AMR(2006) 5.7** | *Specific Recommendation for Law Enforcement Effectiveness Monitoring* | | |
| **AMR(2006) 5.7.1** | 108 | While the development of more efficient data collection and reporting as described in chapters 5 and 6 is important, even more important is the design of effectiveness monitoring programs to utilize these data. | Chapter 6 |
| **AMR(2006) 5.7.2** | 108 | Step one must be the development of MSHCP-specific, measurable management objectives and hypotheses to be tested within the bounds of management guidance, state and federal laws and regulations. | Chapter 6 |
| **AMR(2006) 5.7.3** | 109 | This effort will require expertise beyond that of the biological scientists and statisticians already engaged in the MSHCP, and the DCP and AMP should solicit adequate expertise from the LE community. | Chapter 6 |
| **AMR(2006) 5.7.4** | 109 | Both this author and the Science Advisor recommend continued development of a data collection devise (described in chapter 6) for law enforcement officers funded by the DCP. | Chapter 6<br>Appendix L |
| **AMR(2006) 5.7.5** | 109 | The Science Advisor recommends explicit studies of road/vehicle impact restoration projects and a road vehicle traffic impacts study as a means of working toward programmatic monitoring. | Chapter 6 |
| **AMR(2006) 5.7.6** | 109 | The Science Advisor recommends explicit studies of recreation (hiking, OHV, skiing) impacts study (these should include study of informal recreation activities as well as planned expansion of facilities to expand recreational opportunities) as a means of working toward programmatic monitoring of related implementation projects. | Chapter 6 |

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