2010

ADAPTIVE MANAGEMENT REPORT

CLARK COUNTY

MULTIPLE SPECIES HABITAT CONSERVATION PLAN

Final

June 15, 2010

2010 ADAPTIVE MANAGEMENT REPORT

CLARK COUNTY
MULTIPLE SPECIES HABITAT CONSERVATION PLAN

Final
June 15, 2010

Prepared for:

Clark County Department of Air Quality and Environmental Management
333 North Rancho, Suite 625
Las Vegas, Nevada 89106

Prepared by:

652 Maupas Avenue
Savannah, Georgia 31401

Table of Contents

List of Tables

Page

List of Figures

Page

Acronyms and Abbreviations

AMP	Adaptive Management Program
AMR	Adaptive Management Report
BLM	Bureau of Land Management
Cities	Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite
DCP	Desert Conservation Program
DRI	Desert Research Institute
ESA	Endangered Species Act
HCP	Habitat Conservation Plan
IMA	Intensively Managed Area
LIMA	Less Intensively Managed Area
MOA	Memorandum of Agreement
MSHCP	Multiple Species Habitat Conservation Plan
MSCP	Multiple Species Conservation Plan (San Diego)
MUMA	Multiple Use Managed Area
NDOT	Nevada Department of Transportation
NPS	National Park Service
%	percent
Permittees	Clark County, Las Vegas, North Las Vegas, Henderson, Boulder City, Mesquite, Nevada Department of Transportation
SNPLMA	Southern Nevada Public Land Management Act
TNC	The Nature Conservancy
UMA	Unmanaged Area
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1.0 Introduction

The Desert Conservation Program (DCP) is responsible for balancing protection of natural resources with the impacts of development in Clark County, Nevada. As part of the Clark County Department of Air Quality and Environmental Management, the DCP coordinates compliance with the incidental take permit issued in 2001 by the United States Fish and Wildlife Service (USFWS) in accordance with the Endangered Species Act (ESA) (16 U.S. Code 1531 *et seq.*). Compliance with the permit requires implementation of the Clark County Multiple Species Habitat Conservation Plan (MSHCP) (Clark County, 2000) and Implementing Agreement. This chapter provides the historical background on the DCP and MSHCP, and an overview of the purpose for and content of this Adaptive Management Report (AMR).

1.1 DESERT CONSERVATION PROGRAM – BACKGROUND

The DCP was formed as the result of the emergency listing of the desert tortoise (*Gopherus agassizii*) by the USFWS in 1989. The following year the USFWS made a final listing for the Mojave Desert population of the tortoise found north and west of the Colorado River as a threatened species. The DCP would provide mitigation for the species to allow development to continue on non-federal land in Clark County.

1.1.1 Incidental Take Permit

Section 9 of the ESA prohibits the ‘‘take’’ of a fish or wildlife species listed as endangered or threatened by federal regulation. The term “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed fish or wildlife species, or attempt to engage in such conduct. Section 10(a)(1)(B) of the ESA provides an exception and allows for the ‘‘incidental take’’ of listed species while carrying out an otherwise lawful activity. The USFWS may issue a permit for such incidental take provided adequate steps to minimize and mitigate impacts to listed species are documented in a habitat conservation plan (HCP).

Clark County, the cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite (Cities), and the Nevada Department of Transportation (NDOT) collectively pursued and were issued incidental take permits, with the current permit effective since 2001. This permit allows Clark County, the Cities, and NDOT as Permittees to incidentally take 78 covered species from the development of up to 145,000 acres of non-federal land in Clark County and from NDOT activities in Clark, Nye, Lincoln, Mineral, and Esmeralda counties south of the 38th parallel and below 5,000 feet in elevation. The covered species include the desert tortoise and the southwestern willow flycatcher (*Empidonax traillii extimus*), an endangered bird. Including non-listed species in an HCP reduces the chance of their listing as threatened or endangered in the future, and provides the Permittees an assurance that they will have coverage should these species be later listed under the ESA.

Clark County serves as the implementing agent on behalf of the Permittees and the DCP is the Plan Administrator for the MSHCP. This incidental take permit eliminates project-by-project permitting for actions on non-federal lands. Instead, proponents of private actions pay a $550 per acre mitigation fee to “take” habitat in Clark County without individual project consultations with the USFWS.

1.1.2 Multiple Species Habitat Conservation Plan

Within a year after the final listing of the tortoise, Clark County prepared a short-term HCP for the incidental take of the tortoise over a small area within the Las Vegas Valley. This plan was followed a few years later by a long-term HCP, referred to as the Clark County Desert Conservation Plan, which expanded the coverage for incidental take of the tortoise throughout the county. These HCPs addressed the measures necessary to minimize the incidental take of desert tortoise and mitigate habitat losses.

In 1996 the Permittees determined that proactive conservation of non-listed species and their habitats would reduce the likelihood of future federal listings. The MSHCP process was initiated as an extension to the long-term HCP to capture those species at most risk from future development. The purposes for comprehensive planning for non-listed species were to address the ecosystem needs of multiple species, provide certainty regarding future permitting and mitigation requirements, and assure that incidental take of covered species would be allowed should future listings occur. The MSHCP and an Implementing Agreement among the USFWS, Permittees, and state and federal land management agencies were completed in 2000, and the incidental take permit was issued in early 2001. Implementation of conservation activities began in July 1999 in anticipation of the acceptance of the MSHCP, Implementing Agreement, and permit issuance.

Covered Species

The MSHCP and incidental take permit cover 78 species, which include 15 reptiles and amphibians, 8 birds, 4 mammals, 8 insects, 2 crustaceans, and 41 plants (USFWS, 2001). Only the desert tortoise and the southwestern willow flycatcher are listed under the ESA as threatened and endangered, respectively. The covered species were those for which sufficient information was known and where management prescriptions could be implemented and supported by the incidental take permit. The MSHCP categorized other species to evaluate and watch because there was inadequate information available to determine if existing and future risk to those species warranted current protection.

Plan Area and Land Use Categories

The MSHCP potential "take" area encompasses non-federal lands in Clark County and NDOT activities in Clark, Nye, Lincoln, Mineral, and Esmeralda counties south of the 38th parallel and below 5,000 feet in elevation. The plan area is shown on Figure 1-1. Non-federal lands include those in private, municipal, and state ownership. The plan area also includes any federal lands within Clark County that may be designated for disposal and transferred to non-federal ownership. The current location of these disposal areas are indicated on Figure 1-2. Disposal areas may change over time via federal administrative or Congressional actions.

Lands within the MSHCP area in Clark County are categorized based on their management designations, objectives, and potential to affect species conservation. These categories are Intensively Managed Area (IMA), Less Intensively Managed Area (LIMA), Multiple Use Managed Area (MUMA), and Unmanaged Area (UMA). The conservation areas of focus for the MSHCP consist primarily of IMA and LIMA lands that generally provide adequate size and quality of habitats to support and/or augment viable species populations. These lands are mostly under federal management with some LIMAs in state ownership. The MSHCP and incidental take permit also apply to IMA or LIMA lands that may transfer from federal ownership and made available for private or municipal development. Thus, the conservation areas for the MSHCP may change over time. The MUMA lands support human activities but continue to

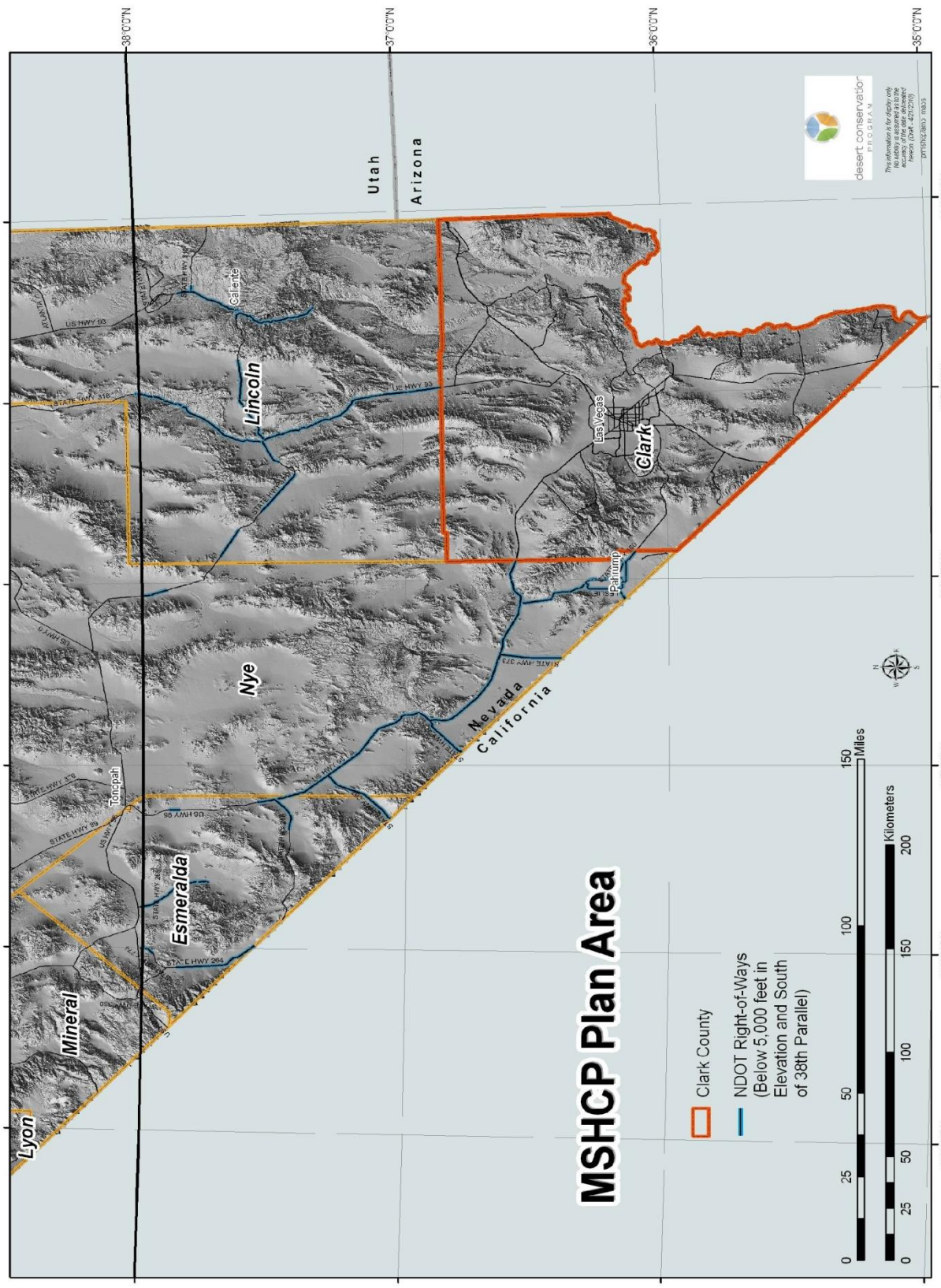

Figure 1-1. MSHCP Plan Area

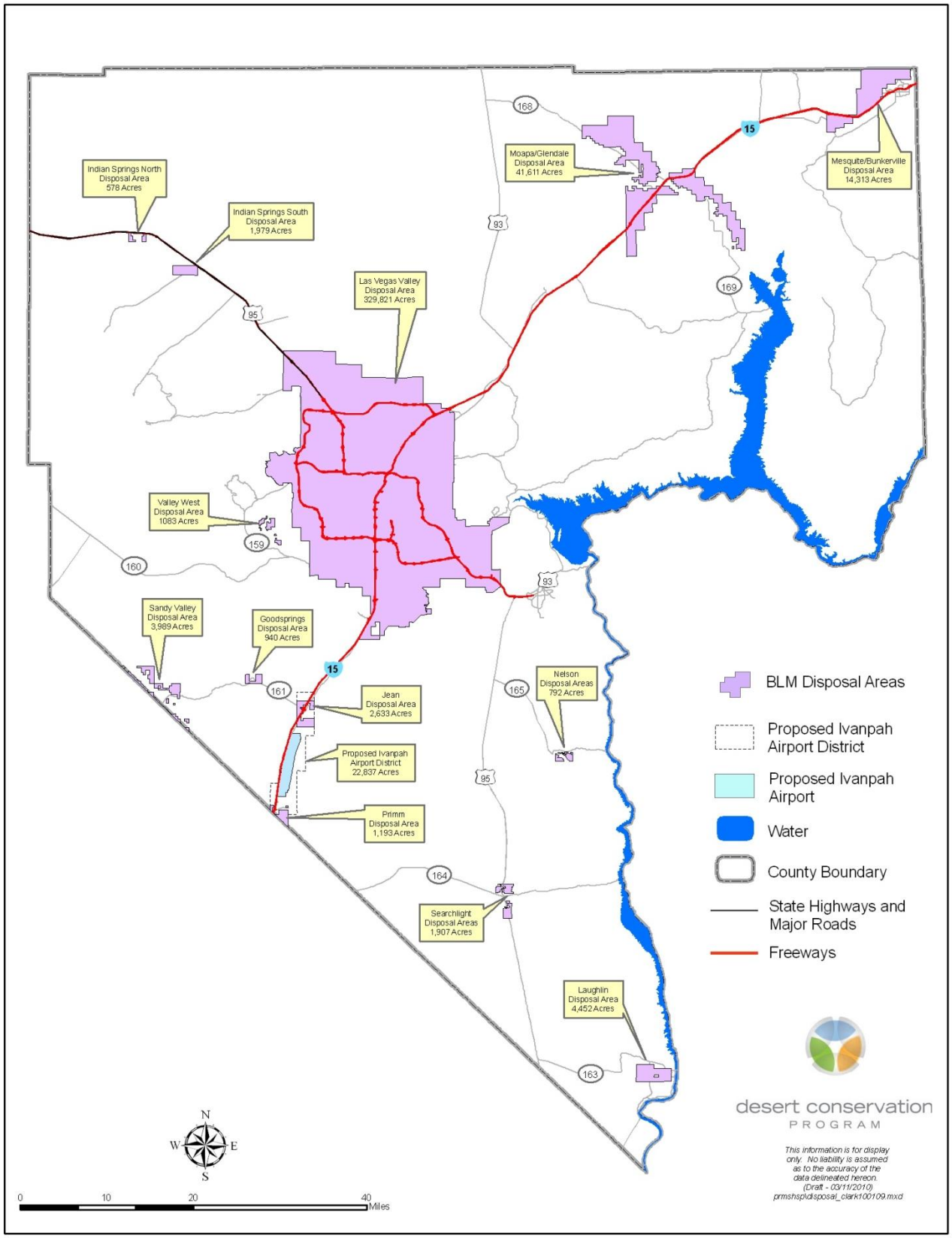

Figure 1-2. Location of Federal Disposal Areas in Clark County

support significant areas of undisturbed natural vegetation. The UMA lands are where human activities predominate but may incidentally support populations of some species.

The MSHCP area is also categorized within Clark County by ecosystem to provide a landscape-scale perspective for addressing the conservation needs of the covered species. These ecosystems include alpine, bristlecone pine, mixed conifer, pinyon-juniper, sagebrush, blackbrush, salt desert scrub, Mojave Desert scrub, mesquite/catclaw acacia, desert riparian/aquatic, and springs. These ecosystems are shown on Figure 1-3 and are described in detail in the 2008 AMR (Clark County 2008).

Goals and Objectives

The MSHCP establishes a general goal to have no net unmitigated loss or fragmentation of habitat within the IMA and LIMA land use categories, or within MUMA lands that encompass a substantial proportion of habitat occupied by a covered species. The MSHCP states numerous objectives that focus on protecting habitat and mitigating habitat loss (take) through comprehensive and coordinated efforts with land managers for long-term viability of the covered species. These objectives include evaluating the effectiveness of habitat management techniques and utilizing an adaptive management process.

Funding

Clark County collects and expends mitigation funds to implement conservation actions in accordance with terms outlined in the MSHCP and incidental take permit. The MSHCP provides funding for conservation projects to various federal, state, and local agencies, academia, nonprofit organizations, and private contractors. The primary source of funds is from mitigation fees collected by the Permittees pursuant to the incidental take permit. The MSHCP has also funded mitigation activities with funds collected by federal agencies from consultation actions on federal lands pursuant to Section 7 of the ESA and with proceeds from the disposal of federal land in Clark County authorized by the Southern Nevada Public Lands Management Act (SNPLMA).

1.2 ADAPTIVE MANAGEMENT PROGRAM AND REPORTING

A condition of the MSHCP's incidental take permit was the development of a science-based adaptive management process by which to ensure that management and conservation actions are reviewed for their effectiveness in the conservation of the covered species and their habitats (USFWS, 2001). A Memorandum of Agreement (MOA) was prepared between the federal land management agencies and Clark County as the administrator of the DCP to address adaptive management and implementation of the MSHCP. The MOA set specific goals for the Adaptive Management Program (AMP) that address status of species and habitats and effectiveness of conservation actions; monitor compliance with the incidental take permit; and provide scientific information to balance with social, economic, and political factors to formulate budget recommendations (USFWS, 2002).

The MSHCP and MOA require the AMP have an objective, science-based adaptive management contractor (i.e., Science Advisor) to provide an independent assessment of MSHCP implementation. Based on this assessment, the Science Advisor provides programmatic analysis and science advice in making recommendations for future implementation and development of the MSHCP and the AMP. The Science Advisor addresses four specific tasks set forth in the MSHCP and Biological Opinion (USFWS, 2000) in a biennial AMR. The charge is to review the most recent DCP reports and datasets and:

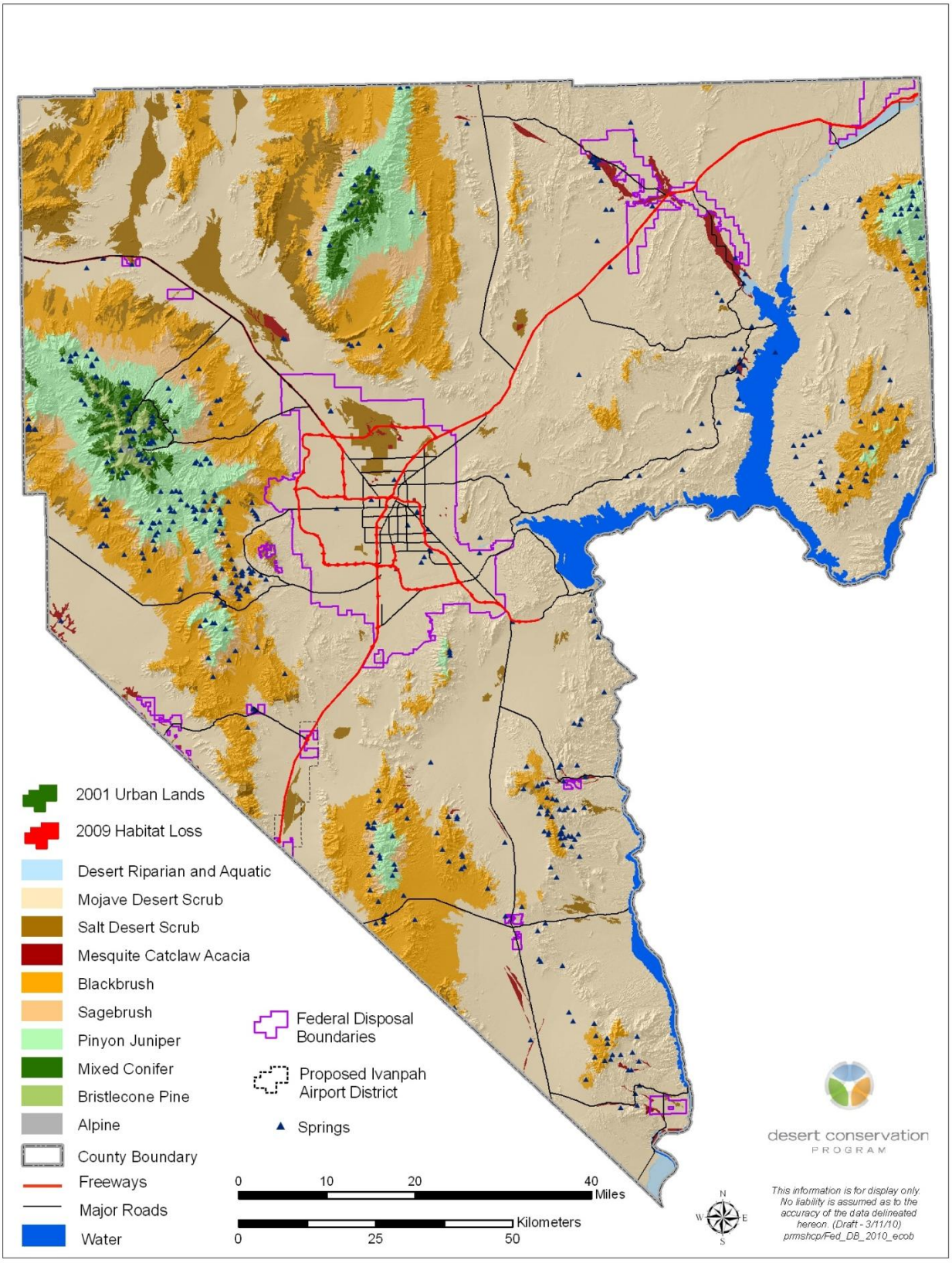

Figure 1-3. Ecosystems within the MSHCP Area in Clark County

- Provide an analysis of land-use trends in Clark County to ensure that take and habitat disturbance is balanced with conservation.
- Provide an analysis of habitat loss by ecosystem type.
- Evaluate the effectiveness of management actions at meeting MSHCP goals of conservation and recovery.
- Review species status and assess population trends.

This AMR summarizes work in each of these four areas and makes recommendations for future efforts. The AMP has implemented many of the tools and databases recommended in the 2008 AMR, and thus, this AMR also has the opportunity to use those tools and to assess if those tools and databases are meeting their intended purpose, effective and efficient in meeting their objectives, and serving the goals of the MSHCP.

To parallel the guidance of the MSHCP and HCPs in general (Federal Register, 2000), the assessment for this AMR is structured from an adaptive management perspective. The components of adaptive management provide a framework that can be used to assess the actions and products of the DCP. The overarching questions of an adaptive management framework this AMR will address include:

1. Are the program and the projects addressing the highest priority species, populations, and conservation actions within the context of the MSHCP?
2. Is the program developing focused objectives for every project based on the best available information?
3. Is the program designing or funding projects that effectively and efficiently answer program and project objectives?
4. Are the data analysis and interpretation done in a timely manner and using the best available resources?
5. Are the results from projects being communicated effectively to the appropriate decision-makers and archived for future access?
6. Is the program working with partners to use the data from projects to improve decision-making?

These questions are similar to those presented in Sutter et al. (2009) for monitoring and adaptive management projects in Clark County but expanded to a programmatic scale. More detail on the adaptive management framework is provided in the following chapters.

2.0 Land Use Trends and Habitat Losses

2.1 INTRODUCTION

The MSHCP tracks land use trends as the primary measure of balancing habitat loss with mitigation actions (Clark County, 2000). The assessment of land use trends and habitat loss is considered a surrogate for assessing impacts on the covered species.

This chapter describes the changes in land use trends and habitat loss that have occurred since 2007 and cumulatively since initiation of the MSHCP in 2001. The assessment is structured by a series of questions about land use trends and habitat loss, the total acreage and how it is distributed spatially across different disposal areas, land management categories, and ecosystems (Clark County, 2006; 2008). The specific assessment questions addressed in Section 2.4 include:

- How many acres have been permitted for habitat loss?
- How many acres of habitat loss have occurred?
- How many acres of habitat loss have occurred within the federal disposal areas?
- How many acres of habitat loss have occurred with each management area category?
- How many acres of habitat loss have occurred with each ecosystem?
- How many acres of habitat loss have occurred within ecosystems in each management area category?

Land use trends represent the change from undisturbed land to disturbed land across the different ecosystems and different land management categories. Acres of habitat loss are defined as the number of acres disturbed over a specific time period. The terms habitat loss and acres disturbed, as they have been used in previous documents, mean acres of "take".

2.2 ASSESSMENT OF TRENDS AND LOSSES

The assessment of land use trends and habitat loss is based on the assumption that any disturbed ground results in loss of habitat for covered species. The number of acres disturbed generally equates to the number of acres of habitat loss. But habitat loss may or may not impact a population of a covered species. In areas where the desert tortoise is found, the assumption is relatively valid since land disturbance reduces habitat for burrows, territories, and food sources. The assumption is not as valid for many low elevation plant species that are restricted to specific soil types and occur in limited areas. There is also an implicit assumption that all undisturbed (non-urban) lands are in good ecological condition and can provide habitat for covered species. This does not account for the impact from off-road vehicles, non-native species, or other threats to populations of the covered species. Even with these assumptions the data are a valuable component for identifying mitigation activities.

The incidental take permit issued in February 2001 established 145,000 acres as the maximum amount allowed for habitat loss during the 30-year permit. This amount includes 15,000 acres that may be used for community and local jurisdiction public purposes and are exempt from payment of the land disturbance (mitigation) fee. For the purpose of determining trends and losses, the DCP assumes these acres have been permitted for disturbance.

Data on permitted acres, land use trends, and habitat loss presented in this section are compiled and prepared by the DCP and provided to the USFWS, Permittees, and agency partners and are posted on the DCP web site (http://bit.ly/CCMSHCP_reports) for public review. Review and assessment of this data is one function of the AMR.

2.3 DATA AND DATA PROCESSING

The data on permitted acres are provided by each of the Permittees via a monthly report. The DCP assumes the data provided by the Permittees are accurate and complete. Permitted acres are those that have had the per acre mitigation fee paid for "taking" habitat for development. Because projects are required to pay their mitigation fee prior to disturbing the ground, acres of habitat loss are expected to be less than permitted acres.

Disturbed lands (i.e., habitat loss) within the county and their distribution across land management categories and ecosystems are assessed using spatial data. Spatial data for NDOT disturbances outside of Clark County were not available and therefore that portion of the plan area was excluded from this assessment. The initial disturbed lands dataset for 2001 was compiled by the DCP in late 2006 and early 2007. Disturbed lands were screen digitized using ArcGIS software from 2001 aerial and satellite imagery. Aerial imagery was predominantly used for the county because of its higher resolution (2-meter), with 2001 Landsat satellite imagery (30-meter resolution) used for rural areas where no aerial photography was available. Digitizing was done at minimum mapping units of approximately 2 acres. Urban and agricultural land was digitized as disturbed. The 2007 dataset was built on the 2001 dataset using the same approach with the newly disturbed areas added. The 2007 dataset used 2007 aerials and satellite imagery with the same resolution, minimum mapping units, and rules as the 2001 data set.

The 2009 dataset used Clark County spring 2009 aerial imagery as the background imagery (1-meter resolution). Minimum mapping unit was reduced to 0.5 acre for disturbed areas and vacant lands within the urban core. Freeways and major roads within the core urban areas were added to the dataset and were buffered to 150 feet and 80 feet, respectively. Gravel and mining operations, flood retention basins, and agriculture areas were added to the dataset.

As with any spatial assessment, there are sources of errors in estimating land use and habitat loss. While error is inherent in any spatial analysis, the DCP estimates the error is less that 5 percent (%) of any reported value, which is considered an acceptable level of error (Bice, 2010). These potential error sources include:

- Resolution of Clark County aerial imagery is much smaller than the Landsat imagery used in rural areas not covered by the County's aerial images.
- Minimum mapping units that can be digitized changed from 2 acres to 0.5 acre.
- Specific features, such as gravel pits, flood control basins, and agriculture, were included in 2009.
- GIS software analysis functions that slightly modify or recalculate the areas within each GIS dataset when re-projected to a different GIS projection and when certain GIS overlay functions are applied. This could cause slight differences in acreage totals in different analyses.
- Conversion from square meters to acres could cause slight variations in totals.
- Land management category boundaries have changed, which influences the total acreage in each category. New spatial layers of the land management categories were made available in 2008 (RECON, 2008).

In addition, non-spatial errors include:

- Some disturbance within the urban areas may take place on lands in Federal management or by Federal projects on non-federal lands that complete mitigation through Section 7 consultation of the ESA and not via the MSHCP incidental take permit. These projects would erroneously be included in the spatial analysis as habitat loss but would not be included with the tallied acres of permitted habitat loss provided by the Permittees because any Section 7 mitigation fees are not part of the MSHCP permit fees.
- As described above, NDOT disturbances permitted under the MSHCP, for which mitigation fees have been paid, were not included in this assessment.

2.4 RESULTS

The following sections present the acres permitted for habitat loss and describe the results of the spatial analysis in determining disturbed acres. As stated previously, acres of disturbance are assumed to be the acres of habitat loss that have occurred under the MSHCP.

2.4.1 Acres Permitted for Habitat Loss

Approximately 53% (77,410 acres) of the total 145,000 acres allowed for disturbance under the MSHCP have been permitted for habitat loss since the initiation of the plan in 2001, leaving 67,590 acres available for disposal and/or disturbance over the remaining time period of the incidental take permit (http://bit.ly/CCMSHCP_report). The permitted acres include acreage for which fees have been paid (62,410 acres) as of April 1, 2009 and the fee exempt acres (15,000 acres). The rate of permitted acreage was greatest during 2006 and 2007 (approximately 15,700 acres) but decreased significantly during 2008 through April 2009 (less than 2,600 acres). Permitted acres, currently, are greater than acres of habitat loss (i.e., acres of disturbance). Permitted acres will not equal the habitat loss acres until all permitted and fee exempted acres have been developed. Until that time, permitted acres are a leading indicator of habitat loss and represents what habitat loss can be expected in the near future.

2.4.2 Acres of Habitat Loss

Table 2-1 shows the results of the spatial analysis of disturbed land, which is assumed to be habitat loss. A total of 68,151 acres of habitat are assumed to have been lost in Clark County between October 2001 and April 2009. As expected, this number of acres of disturbance (68,151) is less than the number of acres permitted for loss (77,410). The reported acres in this table prior to 2007 vary slightly from what was presented in the 2008 AMR (Clark County, 2008) because of the refinement in the most recent spatial analyses described in Section 2.3.

2.4.3 Acres of Habitat Loss within Federal Disposal Areas

There are a number of federal disposal areas (see Figure 1-2) within the MSHCP area. The largest is the Las Vegas Valley Disposal Area, which surrounds the metropolitan area and includes the cities of Las Vegas, North Las Vegas, and Henderson and portions of unincorporated Clark County. It is expected that the majority of habitat loss would take place within these disposal areas. Federal lands inside and outside the federal disposal areas may be disturbed and would be addressed through consultation procedures pursuant to Section 7 of the ESA. An example would be the proposed Ivanpah Airport south of Las Vegas along Interstate 15.

Table 2-1 shows the acres of habitat loss by federal disposal area within Clark County. Between 2001 and 2009, approximately 82% of the total loss occurred within all federal disposal areas with the majority of the loss occurring in the Las Vegas Valley (78%). The amount of habitat loss has substantially slowed in the federal disposal areas since

TABLE 2-1. ACRES OF HABITAT LOSS WITHIN CLARK COUNTY

Areas	Total Acres	2001 Disturbed Acres[1]	2007 Disturbed Acres[2]	2009 Disturbed Acres[2]	2001-2007 Habitat Loss Acres[3]	% of Total Loss	2007-2009 Habitat Loss Acres[3]	% of Total Loss	2001-2009 Habitat Loss Acres[3]	% of Total Loss
All Disposal Areas	406,049	178,791	228,448	234,586	49,657	88%	6,138	52%	55,795	82%
Las Vegas Valley Only[4]	330,644	177,901	225,561	231,378	47,660	85%	5,817	49%	53,477	78%
Other than Las Vegas Valley[4]	75,405	890	2,887	3,208	1,997	4%	321	3%	2,318	4%
Outside Disposal Areas	4,650,638	25,177	31,891	37,533	6,714	12%	5,642	48%	12,356	18%
Total Acres	5,056,687	203,968	260,339	272,119	56,371		11,780		68,151	

[1] Baseline
[2] Cumulative; calculated by spatial analysis
[3] Difference of disturbed acres between time periods
[4] Subset of All Disposal Areas

TABLE 2-2. ACRES OF HABITAT LOSS BY LAND MANAGEMENT CATEGORY WITHIN CLARK COUNTY

Category	Total Acres[1]	2001 Disturbed Acres[2]	2007 Disturbed Acres[3]	2009 Disturbed Acres[3]	2001-2007 Habitat Loss Acres[4]	% of Total Loss	2007-2009 Habitat Loss Acres[4]	% of Total Loss	2001-2009 Habitat Loss Acres[4]	% of Total Loss
UMA	519,885	199,590	251,690	260,045	52,100	93%	8,355	72%	60,455	89%
MUMA	1,505,870	3,561	7,550	10,355	3,989	7%	2,805	24%	6,794	10%
LIMA	380,916	336	375	548	39	<1%	173	1%	212	<1%
IMA	2,650,021	554	633	904	79	<1%	271	2%	350	<1%
Totals	5,056,692	204,041	260,248	271,852	56,207		11,604		67,811	

[1] Totals represent most recent data source (RECON, 2008) and therefore differ from previous AMRs.
[2] Baseline
[3] Cumulative; calculated by spatial analysis
[4] Difference of disturbed acres between time periods

2007, from an average per annum loss of 8,276 acres (49,657 acres/6 years) between 2001 and 2007 to 3,069 acres (6,138 acres/2 years) between 2007 and 2009. This likely reflects the downturn in development in the Las Vegas metropolitan area. An exception to this trend is the habitat loss outside of the disposal areas. Average per annum habitat loss increased from 1,119 acres per year to 2,861 acres per year. The habitat loss during 2007-2009 outside of the disposal areas was almost the same as the per annum loss within disposal areas.

Figures 2-1 and 2-2 show where these habitat losses have occurred from 2007 to 2009 and from 2001 to 2009, respectively.

2.4.4 Acres of Habitat Loss within Land Management Categories

The MSHCP was designed such that the majority of the habitat loss was anticipated to occur in the UMA and MUMA lands. As described in Section 1.1.2, these lands support or are subject to human activities and development, and the boundaries and locations of these lands will change as land ownership and land use designations change. This assessment was conducted using the most current data available on land use designations, ownership, and management categories (RECON, 2008).

Table 2-2 shows the loss of habitat by land management category. The spatial assessment shows the majority of the habitat loss since 2001 has been in the UMA and MUMA lands, of which approximately 89% occurred in the UMA category. A total of 572 acres or less than 1% of habitat loss has occurred collectively in the LIMA and IMA lands since 2001. Land disturbance detected on the LIMA and IMA lands could be due to federal land disturbance which received ESA compliance through the Section 7 process or it may have occurred on non-federal lands located within those categories.

The GIS analysis of habitat loss in the land management categories generated a different estimate than the GIS estimate of the total area disturbed since 2001. There are 68,151 acres reported as disturbed areas across Clark County, both within and outside of federal disposal areas (see Table 2-1), whereas the analysis of land management categories for the same timeframe estimates total disturbed acres as 67,811 (see Table 2-2). This difference of 340 acres may be, in part, because the land designations on federal lands have changed since 2001, and because land disposals have taken place. Since completion of the 2008 AMR, data depicting changes in the boundaries of the management categories have become available that updates the acreage in each category (RECON, 2008).

Another reason for the difference in disturbed acres between the two analyses is that errors can arise when updating the GIS analysis in matching the land management category boundaries with the basemap. This is because some GIS software analysis functions used for this analysis slightly modifies or recalculates the areas within each GIS dataset. This could lead to differences in estimates of total area of usually less than 1%. Area calculations are recalculated in GIS datasets when they are re-projected to a different GIS projection and when certain GIS overlay analysis functions are applied. Sometimes GIS datasets contain a number of polygons that are not touching edge to edge, have overlapping areas, or have underlapping areas (thin gaps between boundaries) which can account for minor area differences. There can also be some minimal area variations due to rounding errors in the conversion from square meters to acres.

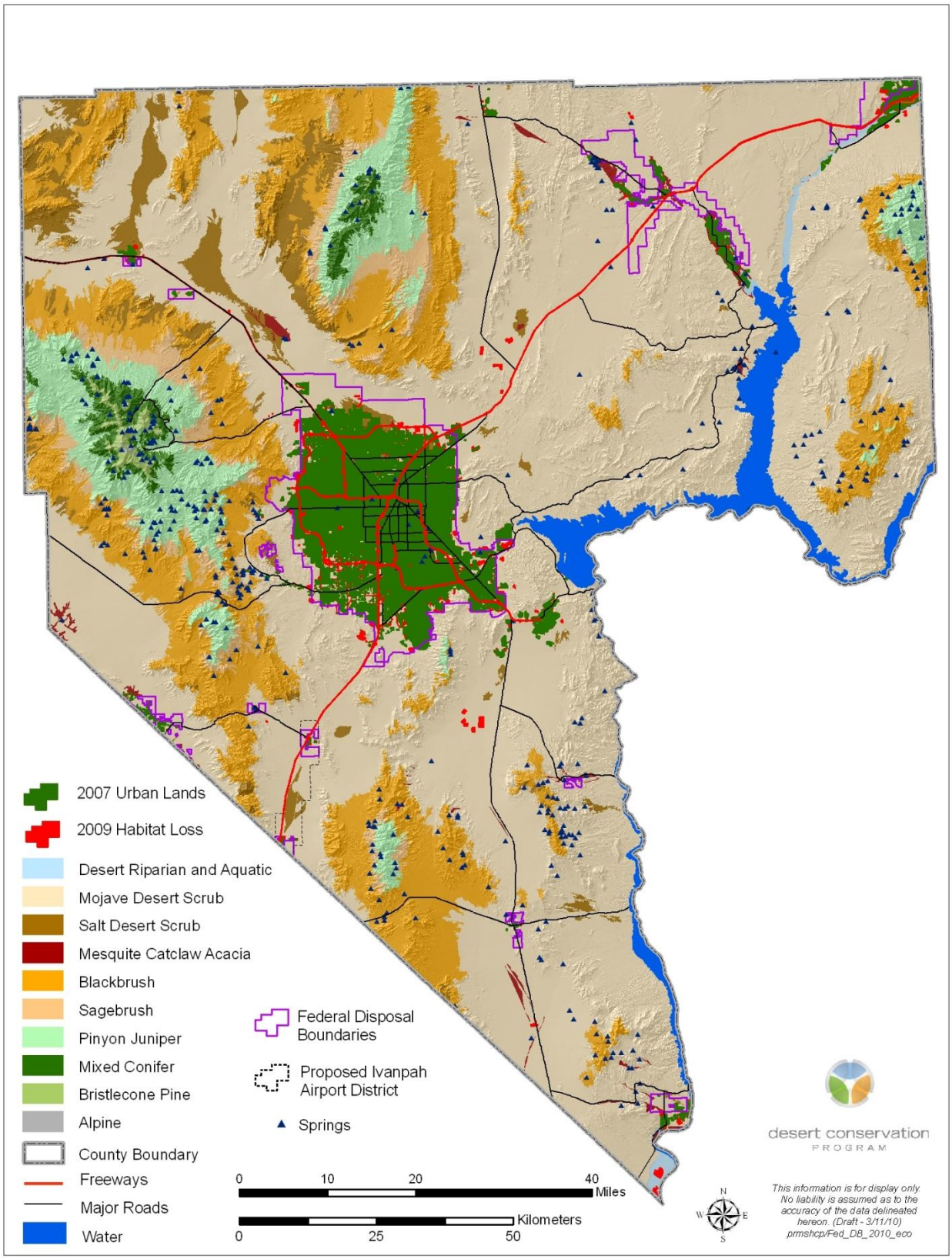

Figure 2-1. Habitat Loss by Ecosystem and Disposal Area, 2007-2009

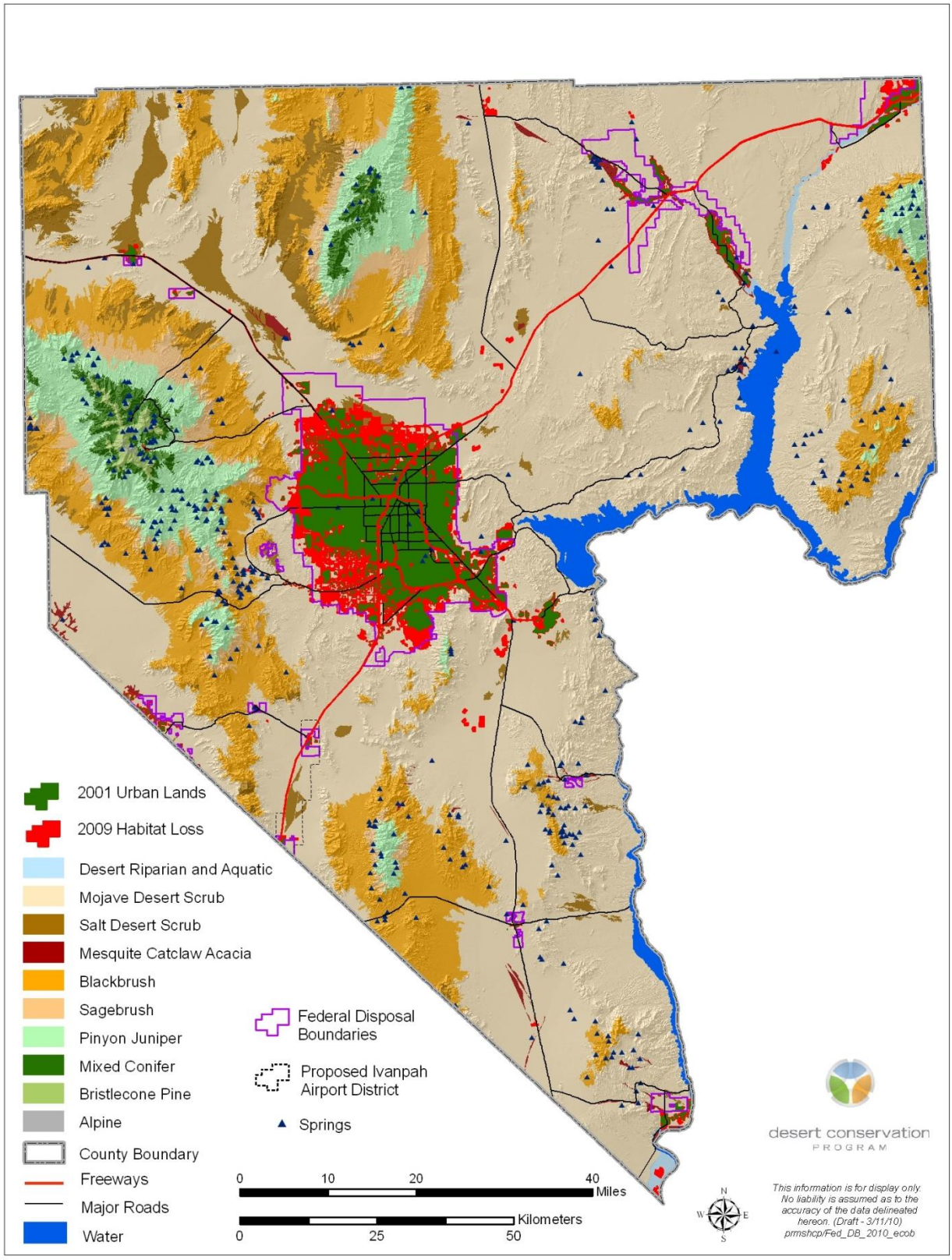

Figure 2-2. Habitat Loss by Ecosystem and Disposal Area, 2001-2009

2.4.5 Acres of Habitat Loss within Each Ecosystem

The Adaptive Management Program also tracks habitat loss by ecosystem to further assess the impacts of the MSHCP on the 78 covered species. There are 11 ecosystems described for the MSHCP area (see Section 1.1.2). A description of each ecosystem is provided in the 2008 AMR. The spatial distribution of these ecosystems is mapped on Figure 1-3.

Table 2-3 shows the acres of habitat loss by ecosystem. Approximately 23% of the total acres of mesquite/catclaw acacia and desert riparian/aquatic ecosystems have been disturbed. These are the smaller and more adversely susceptible to development of the lower elevation ecosystems. The habitat loss in mesquite/catclaw acacia and desert riparian/aquatic ecosystems since 2001 accounts for 4% and 7%, respectively, of their total acreage. The other ecosystems that have experienced the greatest percentage of acres of habitat losses since 2001 compared to their total acreage are salt desert scrub (4%) and Mojave Desert scrub (2%). The largest habitat losses in both total acres and percentages are in these lower elevation ecosystems, which is where the majority of non-federal lands and disposal areas are located and where the majority of the urban growth takes place. Most of the total habitat loss by total acres has occurred in the Mojave Desert scrub, primarily because it is the most prevalent ecosystem.

Springs are reported at the bottom of Table 2-3. Earlier survey work found 754 springs within Clark County with 16 of these springs permanently lost previous to 2001 (Clark County, 2008). No additional springs have been permanently lost since the incidental take permit was issued. Most of the permanent loss of springs (14) has occurred within the Mojave Desert scrub ecosystem, with the others occurring in the salt desert scrub and desert riparian/aquatic ecosystems.

2.4.6 Acres of Habitat Loss within Ecosystems in Each Land Management Category

Table 2-4 shows the loss of habitat by ecosystem and land management category. The majority of the habitat loss has been in the Mojave Desert scrub ecosystem – 90% of the total acres of habitat loss across all ecosystems. Of the total acres of habitat loss, the most (96%) has occurred within the UMA land management category. The Mojave Desert scrub has the most acreage loss in three of the four land management categories and the desert riparian/aquatic ecosystem has the largest acreage loss in the IMA land management category.

2.5 SUMMARY AND RECOMMENDATIONS

The purpose for tracking land use trends is to provide guidance for mitigation and minimization actions of the DCP and for assessing habitat loss against the 145,000 acres maximum amount allowed in the permit (Clark County, 2000). As stated at the beginning of this chapter, land use trends and habitat loss are considered a surrogate for impacts on the covered species. Knowledge of the trends of the acres permitted and the spatial distribution of habitat loss across disposal areas, management categories, and ecosystems assists the DCP in developing appropriate conservation actions.

TABLE 2-3. ACRES OF HABITAT LOSS BY ECOSYSTEM WITHIN CLARK COUNTY

Ecosystem	Total Acres	2001 Disturbed Acres[1]	2007 Disturbed Acres[2]	2009 Disturbed Acres[2]	% of 2009 Disturbed Acres in Ecosystem	2001-2007 Habitat Loss Acres[3]	2007-2009 Habitat Loss Acres[3]	2001-2009 Habitat Loss Acres[3]	% of Total 2001-2009 Habitat Loss	Habitat Loss as % of Total Acres
Alpine	479	0	0	0	0%	0	0	0	0%	0%
Bristlecone Pine	15,856	0	0	0	0%	0	0	0	0%	0%
Mixed Conifer	56,413	5	6	9	<1%	1	3	4	<1%	<1%
Pinyon-Juniper	281,695	52	53	53	<1%	1	0	1	<1%	<1%
Sagebrush	138,949	0	0	0	0%	0	0	0	0%	0%
Blackbrush	831,531	0	23	25	<1%	23	2	25	<1%	<1%
Salt Desert Scrub	208,565	7,472	14,171	15,032	7%	6,699	861	7,560	11%	4%
Mojave Desert Scrub	3,467,118	186,333	234,573	243,783	7%	48,240	9,210	57,450	85%	2%
Mesquite/Catclaw Acacia	34,466	6,727	7,674	7,952	23%	947	278	1,225	2%	4%
Desert Riparian/Aquatic	21,599	3,451	4,053	5,002	23%	602	949	1,551	2%	7%
Total	5,056,671	204,040	260,553	271,856		56,513	11,303	67,816	100%	
Springs[4]	754	16	16	16		0	0	0		

[1] Baseline
[2] Cumulative; calculated by spatial analysis
[3] Difference of disturbed acres between time periods
[4] Number represents individual springs, not acres

TABLE 2-4. ACRES OF HABITAT LOSS BY ECOSYSTEM AND LAND MANAGEMENT CATEGORY						
Ecosystems	**IMA**	**LIMA**	**MUMA**	**UMA**	**Total Loss**	**% of Total Loss**
Alpine	0	n/a	n/a	n/a	0	0%
Bristlecone Pine	0	0	n/a	0	0	0%
Mixed Conifer	0	2	n/a	7	9	<1%
Pinyon-Juniper	0	2	0	48	50	<1%
Sagebrush	0	0	0	0	0	0%
Blackbrush	0	1	0	24	25	<1%
Salt Desert Scrub	18	18	379	14,617	15,032	6%
Mojave Desert Scrub	302	525	9,674	233,280	243,781	90%
Mesquite/Catclaw Acacia	31	0	199	7,722	7,952	3%
Desert Riparian/Aquatic	553	0	103	4,346	5,002	2%
Total Acres (rounded)	904	548	10,355	260,044	271,851	
Percent of Total Loss	<1%	<1%	4%	96%		

.

The process of generating the data for this assessment is straight forward and the data are relatively accurate. While there are slight discrepancies in the estimation of the total acreage disturbed (see Tables 2-1, 2-2, and 2-3), the differences do not significantly impact the purpose of the assessment. The DCP believes a 5% level of precision is acceptable (Wainscott, 2010a) and this seems entirely reasonable considering the potential sources of error in GIS and the purpose of the assessment. While substantial resources should not be expended in making the estimates more accurate, the DCP should continue to reduce the discrepancies and understand known and potential sources of error.

Data on permitted acres show that 77,410 acres (53%) of the total 145,000 acres allowed for disturbance under the incidental take permit have been permitted for habitat loss in the first 9 years of the 30-year permit. The rate of permitted acres has decreased recently, as has disturbed acres. There were 849 acres permitted between April 1, 2009 and April 1, 2010. Considering the rapid growth within Clark County since 2001 and now the extensive slow down in development, it may take more than another decade to reach the incidental take permit limit for acres disturbed.

Data on habitat loss show that 68,151 acres have been disturbed or developed since 2001 (see Table 2-1). This is 47% of the total 145,000 acres allowed for disturbance under the incidental take permit. The results of the assessments are as expected for the MSHCP. The majority of acres of habitat loss are in designated federal disposal areas (with the most occurring in the Las Vegas Valley disposal area), in the UMA and MUMA land management categories, and in the lower elevation ecosystems.

Two of the assessment results, however, were unexpected. First, as discussed in Section 2.4.3, the ratio of per annum habitat loss has significantly changed between all disposal areas and outside disposal areas. Habitat loss has substantially slowed in the federal disposal areas since the last assessment in 2007 (see Table 2-1). This likely reflects the downturn in development in the Las Vegas area. However, the rate of habitat loss outside of the disposal areas has increased from an average per annum habitat loss of 1,119 acres per year to 2,861 acres per year. The habitat loss outside of disposal areas now almost equals the per annum loss within disposal areas. **The increasing**

trend in habitat loss outside of disposal areas should receive further assessment (Recommendation 2.1). Disposal areas are so designated for a number of reasons, with the quality and quantity of habitat generally of less significance within disposal areas. Land disturbance and development are assumed more likely to occur within disposal areas. While this trend may not influence how the DCP mitigates for loss, the DCP should work to understand patterns and changes in habitat loss numbers that are increasing in areas not designated for disposal.

Secondly, three of the ecosystems have lost substantial acreage since 2001 relative to their total extent within Clark County. As a percentage of total acres of habitat loss, the desert riparian/aquatic ecosystem has lost 7% of its total habitat area since 2001. This is considered significant for one of the most important habitats for MSHCP covered species (14 covered species occur in or use this ecosystem), and is greatly compounded by the landscape impacts of this loss (loss of connectivity, alteration in flows, increase in sediment), and the presence of non-native species in most of the remaining desert riparian habitat. The more extensive and rapid loss in the desert riparian/aquatic ecosystem suggests that the DCP take a more proactive and involved approach in mitigation, including acquisition, easements, and restoration, similar to the purchase of the Alamo, Henrie, and Perkins properties along the Muddy River and the funding of restoration research (Anderson & Provencher, 2010). Also significant is the loss of salt desert scrub (4%) and mesquite/catclaw acacia (4%) of the total habitat loss. While the most habitat loss has taken place in the Mojave Desert scrub, it has a smaller percentage of habitat loss (2%) because of its extensive distribution. **The DCP should further assess the habitat loss in the salt desert scrub, mesquite/catclaw acacia, and desert riparian/aquatic ecosystems to assist in determining the extent and type of mitigation needed (Recommendation 2.2).**

The DCP should explore ways to improve the correlation of habitat loss in desert riparian/aquatic, salt desert scrub, and mesquite/catclaw acacia ecosystems with potential habitat for covered species so that efforts can be more accurately directed toward the protection, management, and/or restoration of the appropriate species habitat or populations of specific species (Recommendation 2.3). This would include using the recently developed habitat models, data on species occurrences, and recent geologic datasets. Many of the covered species have very specific habitat needs and occur in only a part of the ecosystems they inhabit. An example would be the correlation between the occurrence of the Las Vegas bearpoppy (*Arctomecon californica)* and gypsum soils.

Another issue to explore is the habitat condition of the undisturbed land in these analyses. Habitat loss is only measured by the direct impacts of disturbance or development, including buildings, parking lots, gravel pits, and roads. It does not take into account the indirect impacts of development and threats from adjacency of developed areas, such as increased likelihood of invasive species introductions, and a larger human population using the natural habitats surrounding Las Vegas, such as damage caused by vehicles going off-road. If the MSHCP takes an ecosystem (habitat) approach to measuring the status of the covered species, it would be valuable to determine if remote sensing could assess habitat condition as well as habitat loss. **The DCP should explore if remote sensing could assess habitat condition as well as habitat loss (Recommendation 2.4).**

3.0 Implementation Status

3.1 INTRODUCTION

A central tenet in adaptive management is to determine if the implementation of management or conservation actions are effective at mitigating or minimizing impacts of incidental take of species and habitat. The adaptive management process of the MSHCP should provide an objective, quantitative evaluation of the effectiveness of management actions in attaining program goals (Clark County, 2000). A tool of the adaptive management process is the database upon which management decisions are made. The DCP has created tools to evaluate species, ecosystems, and landscape use and habitat loss trends. These tools are used to evaluate management actions directed at conservation of biological resources. The MSHCP established a number of conservation actions to minimize, mitigate, and monitor the impacts of incidental take of covered species. This chapter evaluates how effective the implementation of these actions has been at meeting the broad MSHCP goals of conservation and recovery.

The DCP began implementing and tracking status of projects prior to issuance of the incidental take permit. The methods and tools for tracking projects have progressively improved from self-reporting by project proponents, to specific project goal statements required for project approval, to an Access® database that consolidated information from old databases.

The status of the MSHCP is reported to the public every two years in the Biennium Progress Report. Projects completed or in progress during the biennium are detailed in these reports. The detail consists of the project description, status, agency/partner contact, funding amount, and contract term. The status of each project is also reported quarterly. These reports are available for review on the DCP web site (http://bit.ly/CCMSHCP_reports).

3.2 IMPLEMENTATION DATABASE

The previous Science Advisor developed an Implementation Database to compile data on projects implemented to address MSHCP goals. The fundamental purpose of the database is to help DCP identify, track, and account for implemented mitigation activities (Clark County, 2008).

The MSHCP Implementation Database was designed to track the tangible products and other outcomes of all implementation activities conducted for and/or funded by the DCP to implement mitigation actions for the MSHCP. The entries in the database are organized by “contract”, which may include outsourced, agency or DCP staff efforts to implement projects or programs for the MSHCP. Each contract has a unique contract number that is used in all DCP program files and records. The data entry screen from the Implementation Database is shown in Figure 3-1.

The tangible products of these contracts are varied and may include datasets, maps, conservation strategy plans, descriptions of monitoring methods, public outreach materials and events, and in many cases include project reports that summarize the land protection, public outreach, or habitat restoration actions or administrative activities conducted. These products are described in the database and they are stored in a variety of locations within the DCP’s document storage systems, annotated with the contract number.

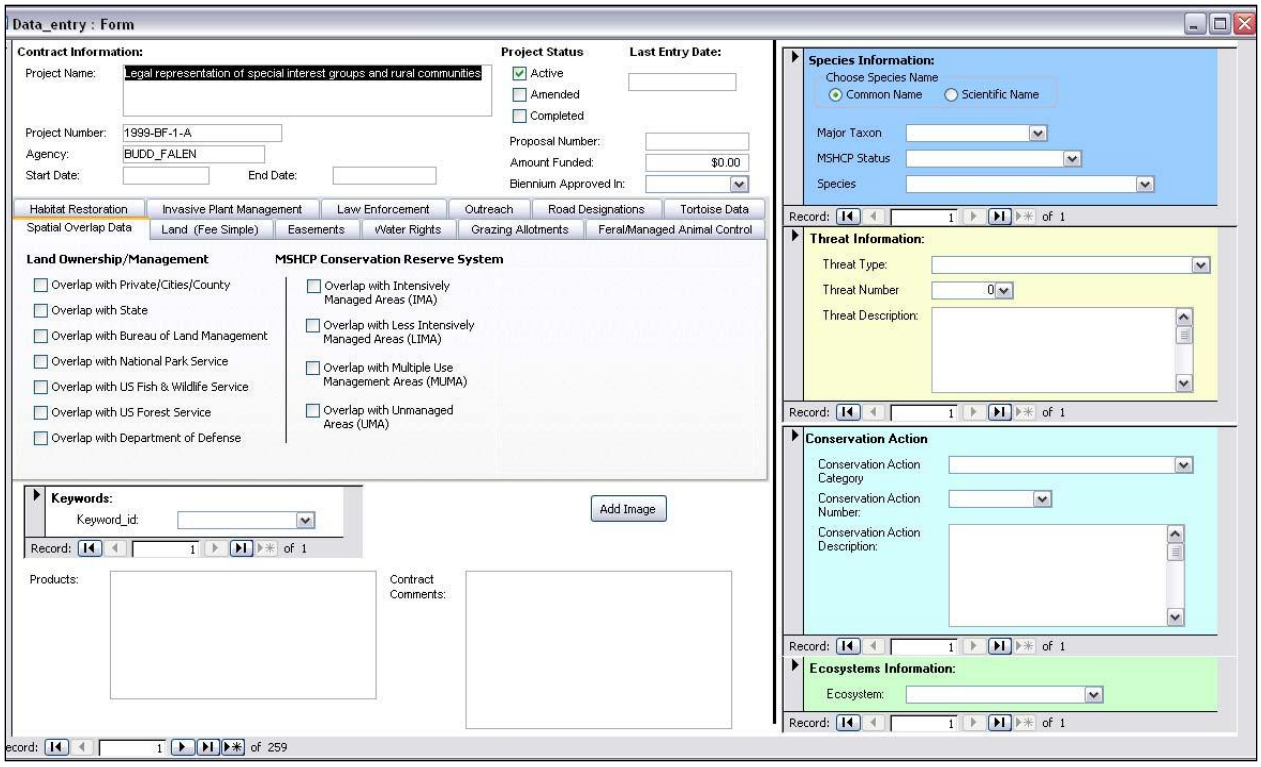

Figure 3-1. Implementation Database Entry Screen

Each entry in the database includes lists of the MSHCP "elements" that the contract was designed to address or accomplish, a low resolution map depicting the contract location(s), and summary statistics for quantifiable activities. The MSHCP elements are the species, ecosystems, threats, and conservation actions described in Chapter 2 of the MSHCP. This information enables the database user to search for all contracts that have addressed a particular element or combination of elements. Maps display for each contract that was not administrative in nature and where data exist to establish the geographic extent of the project activities. Summary statistics for activities include such things as number of miles of new desert tortoise exclusion fencing installed, dollars spent on new fence installation, number of attendees at public outreach events, number of citations issued by law enforcement, and acres of restoration conducted.

3.2.1 Database Review

The Implementation Database with the User Manual (Clark County, 2009a) was reviewed to determine its overall usefulness in tracking projects implemented to meet MSHCP requirements. The 2006 AMR noted that implementation status reports for conservation actions were based solely on the self-reported data contained in the Implementation Database existing at the time or in conservation action spreadsheets received from the agencies. Few quantitative data were available to verify implementation status. The 2006 AMR recommended a number of items that should be tracked to determine if the MSHCP goals and objectives, and quantifying effectiveness of conservation actions, were properly being advanced.

The 2008 AMR described the development of a database to assist the DCP in identifying, tracking, and accounting for implemented mitigation activities. It was decided the database should focus on projects that were funded and

implemented, with opportunities to describe how projects changed from the original proposal to actual implementation. The database would allow the DCP to assess compliance with the incidental take permit, but only when used in conjunction with other data sources (i.e., information on habitat loss). The User Manual described the process of exporting data from prior databases and the limited availability of data from completed project files to populate all fields of the Implementation Database.

Questions were formulated to facilitate the review of the Implementation Database and to generate queries for the database in attempt to answer the questions. Certain questions address the function of the database to assist the Science Advisor in understanding the content and extent of data. Other questions address the role of the database in supporting an adaptive management framework as posed by the overarching questions presented in Section 1.2.

The DCP provided a copy of the database to the Science Advisor in which to generate queries. The database was updated in December 2009 and contains 309 contracts. Because the database file was a copy and was used on a computer outside the DCP network, links and references to the network were missing and were the likely cause of run-time errors during queries. Most of these errors were related to the images connected to the database, thus when a record with a linked image was queried or viewed, a run-time error would sometimes occur.

3.2.2 Results of Database Review

The results of the database review are presented by the questions that were formulated and the responses generated from the queries.

1. **How many of the conservation actions have been implemented?** The MSHCP listed over 600 conservation actions to minimize, mitigate, and monitor the effects of potential threats to covered species and habitat, and thus, the incidental take of species. These actions were delineated by the responsible agency who committed, subject to available funding, to undertake each of the suggested conservation actions over time. Presumably all agencies responsible for implementing conservation actions are doing so. However, it is not possible to determine if actions that fall under an agency's normal operating budget (and not augmented by MSHCP funds) are being implemented. The Implementation Database is used by the DCP to track only those projects funded and contracted by DCP. If conservation actions are implemented with an agency's normal operating budget, it would be necessary for that agency to self-report that information to the DCP. Additionally, the database field "conservation action number" is a text field and therefore is not easily sorted numerically to determine which, if any, conservation actions have not been associated with and/or implemented by a project.

   Because of the limitations on sorting and self-reporting, it is very difficult and time consuming to determine how many of the conservation actions have been implemented. Because the field for "conservation action number" reports the category and not the number, the data needs to be exported to Excel™. This converts the category to the number. The sort process is complicated by the conservation action number consisting of text and numbers (e.g. BLM(101)) so the sorting process does not list the numbers sequentially (i.e., BLM(2) would come after BLM(101)). This makes a comparison of the data against the master list of conservation actions difficult. The 2006 AMR included a review of all conservation actions completed by agencies. Additional review may be necessary to determine if certain conservation actions are ongoing and require repeating.

2. **Is there a spatial/geographic designation associated with each project?** There is a general, low-resolution map showing the geographic location for less than half of the projects, but without a more thorough review of the other projects' scopes, it is not possible to determine if more projects should have a location map. Not all projects would necessarily have a map because of the type of project (e.g., public information and education, administration). The Spatial Overlay tab in the database provides check boxes to indicate land ownership/management and conservation reserve system (i.e., land management categories IMA, LIMA, MUMA, and UMA) where the project occurs. Land ownership was entered for approximately half of the projects, but should be easily determined and entered by reviewing project location(s). As with location maps, not all projects would necessarily overlap with land management agencies based on the type of project. The project number and title may give some indication where a project occurs in regards to land management, but this would not be a reliable indicator because a contract may be with one agency but the project may cross multiple jurisdictions.

   The land management category was entered for only six projects, but it should be easily obtained and entered based on a comparison of the spatial overlay of project location with the GIS boundary layer for the management categories. This information would be useful since land use trends and habitat loss are tracked by land management category. As described in the MSHCP, the long-term focus of the adaptive management process should be the evaluation of species and ecosystems within IMAs and LIMAs with respect to land use decisions potentially affecting biological resources in these areas. Although less than 1% of the total baseline acres within the IMA and LIMA categories have been disturbed (see Table 2-2), these lands are important for maintaining habitat and increasing populations, and thus achieving MSHCP goals. Tracking project implementation in these categories would assist in understanding the continued importance of this focus in achieving the MSHCP goals of conservation and recovery.

3. **What specific threats were the projects intended to address?** The data entry form has a sub form that notes this information. Most projects addressed more than one threat type and more than one specific threat within each type. The project products or outcomes (i.e., scope, objectives, goals, data, reports, etc.) would have to be reviewed to determine the effectiveness of the project in minimizing or mitigating these threats and the resultant benefit towards advancing the MSHCP goals. The number of each threat type addressed by the projects is displayed in Figure 3-2. The projects addressed threats from recreation significantly more often than others, which may be due to the greater number of potential threats described within the recreation threat type.

4. **Which species is the focus of most projects?** More than half of the projects listed at least one of the 78 covered species as being addressed by the project, with projects implemented to date listing 76 of the 78 covered species. Not all projects would necessarily list a species as a focus, such as public information and education and law enforcement projects. A review of project titles seems to suggest that certain projects should have a species listed but did not. There could be a few reasons for this such as data exportation issues from older databases, incomplete data entry, or unavailable information. However, these statistics do not indicate the effectiveness of any particular project because the project scope may have been broad with limited objectives and the project proponent may have "taken credit" for addressing a number of species to facilitate approval and funding. As would be expected, most of these projects listed the desert

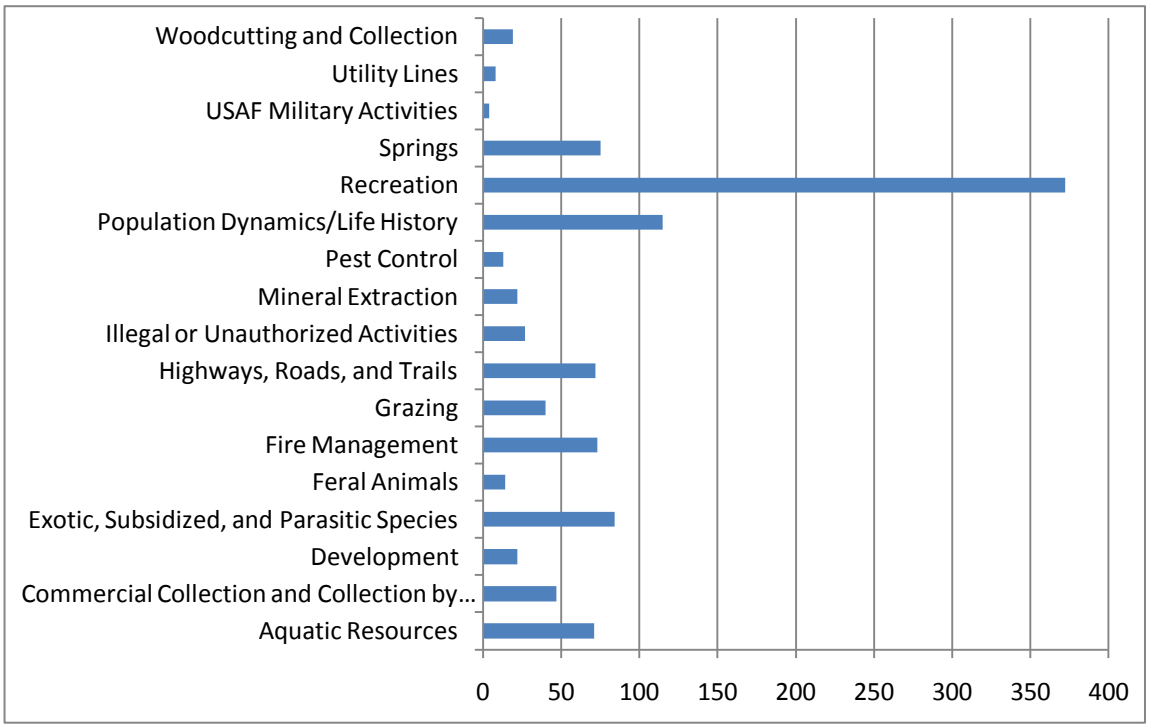

Figure 3-2. Number of Threat Types Listed

tortoise as at least one focus species. Other than inventory projects, which generally listed nearly all covered species as project focus, the species proposed for coverage under the pending permit amendment (includes covered, watch, and evaluation species) were listed on between 14 and over 50 projects. Data sorting through more than 3,400 entries and the likely over ambitious listing of potential species benefits of projects makes assessing actual numbers difficult.

5. **Which ecosystem is the focus of most projects?** The 129 projects in the database approved and funded prior to the 2003-2005 biennium do not list an ecosystem focus. This information may not have been reported and/or was not able to be extracted from older databases and files. Similar to the species focus, most projects listed more than one ecosystem and some projects since 2003 did not list any. The reasons may be incomplete data entry, unavailable information, or the type of project (e.g., public information and education, law enforcement) does not have a specific ecosystem focus. Of the projects that listed an ecosystem focus, the emphasis across the ecosystems is displayed in Figure 3-3.

   The rate and location of habitat loss are greatest in the desert riparian/aquatic, mesquite/catclaw acacia, Mojave Desert scrub, and salt desert scrub ecosystems (see Table 2-3). From a quantitative perspective, the ecosystem focus of the implemented projects since 2003 seems to address the locations where habitat loss is the greatest. The project products or outcomes (i.e., scope, objectives, goals, data, reports, etc.) would have to be reviewed to determine the effectiveness of the project in minimizing or mitigating the disturbance (i.e., habitat loss) and the resultant benefit towards advancing the MSHCP goals.

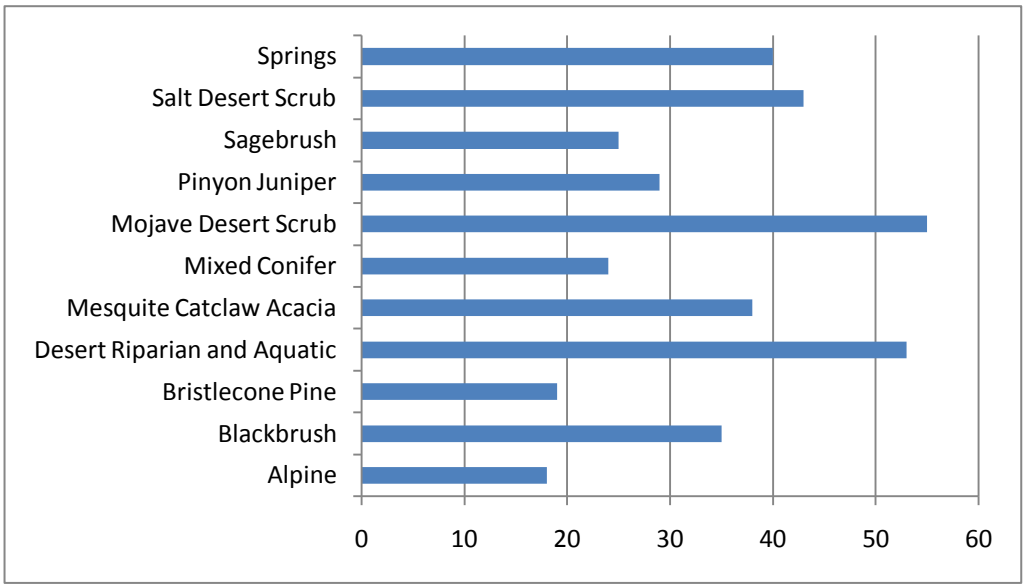

Figure 3-3. Number of Projects Listed by Ecosystem

6. **Which conservation action category is the focus of most projects?** The scopes of projects or types of activities conducted in implementing the projects are generally organized by the seven conservation action categories – inventory, monitoring, policy, protection, public information and education, research, and restoration and enhancement. The conservation actions are a subset of the categories and because many projects listed numerous conservation actions, more than one category was also listed for many projects. Research, inventory, monitoring, and public information and education projects were more likely to be single focus projects. Figure 3-4 shows the distribution of projects among the conservation action categories. Projects that focused on protection, monitoring, and restoration and enhancement have been implemented the most. From a quantitative perspective, the focus of implemented projects seems to address activities that would be expected to progress the MSHCP goals of conservation and recovery.

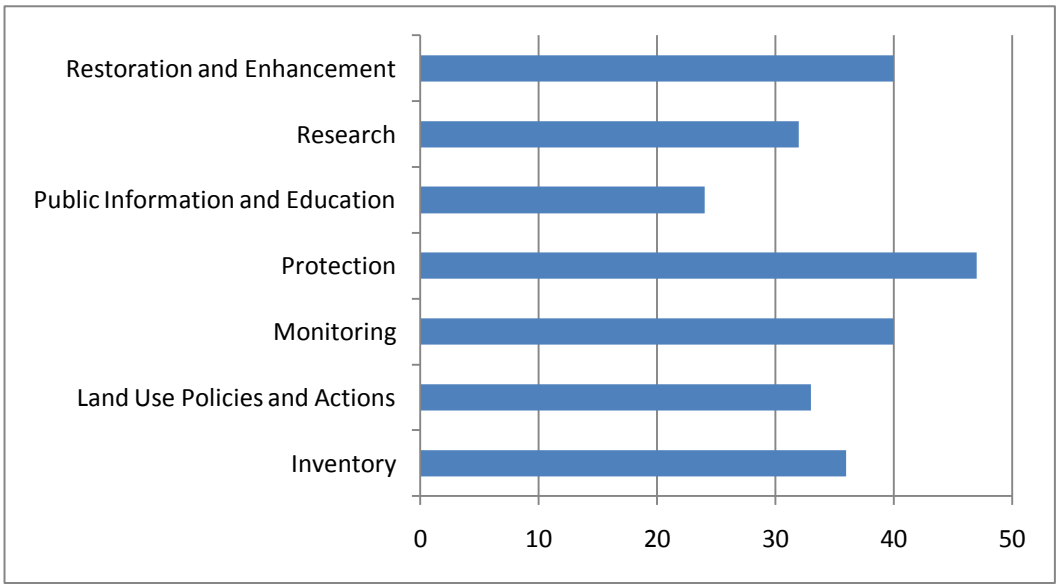

Figure 3-4. Number of Projects by Conservation Action Category

7. **How are the projects evaluated to determine effectiveness in achieving MSHCP goals?** Since the 2007-2009 Implementation Plan and Budget process, proposed projects must include at least one specific goal statement that ties the MSHCP elements (i.e., species, ecosystems, threats, and conservation actions) to the work being proposed. Projects selected from the 2005-2007 process developed goal statement(s) at contract award. The DCP uses a standardized form and list of elements to prepare goal statements. The elements from the goal statement are entered into the database upon contract award. Although this approach provides more explicit goal and objective statements than received on projects in the earlier years of the program, it assumes the relationship between MSHCP elements and project activities indicates effectiveness. Additional information may be needed for certain projects to determine if it could be effective. For example, a project for monitoring should contain a description of the elements of a useful monitoring program to support its goal statement (see Section 4.2.2). Information from the database alone is not of sufficient detail to evaluate if a project was effective in achieving its stated goal(s) or contributed to the effectiveness of the program in achieving MSHCP goals. The Final Project Report form requires the proponent detail how the results of the project achieved the stated goal(s); however, transfer of that information to the database is either incomplete or not possible. For example, projects that indicated restoration and enhancement as a conservation action category are assumed to have completed some type or amount of restoration or enhancement activity. Although 40 projects indicated restoration and enhancement as a conservation category, information for only one project has been entered into the database on the Habitat Restoration tab and no information entered on the Invasive Plant Management tab on the Contract Information screen.

3.3 SUMMARY AND RECOMMENDATIONS

The initial objective of the database was a "mitigation action status tracking system that can better inform effectiveness monitoring and other adaptive management program tasks, including an analysis of the balance between habitat loss and mitigation actions" (Clark County, 2008). However, as development of the database progressed, the initial objectives were refined and the resulting fundamental purpose was to identify, track, and account for implemented mitigation activities (Clark County, 2008).

Tracking and evaluating the effectiveness of implemented projects towards advancing MSHCP goals has been a difficult task. The 2006 AMR discussed the application of project-specific purposes and results to programmatic level conclusions, and recommendations for designing project-level and programmatic-level effectiveness monitoring came from a workshop in September 2008. Although some of the difficulty in evaluating effectiveness stems from the lack of specific objectives for the MSHCP, the DCP continues to establish procedures and guidelines to best compensate for this. **The DCP should review the Quarterly Progress Report and Final Project Report formats to determine if more information specific to evaluating effectiveness should be requested (Recommendation 3.1).** This would require the acceptance of a design for effectiveness monitoring or data collection by which to evaluate the project goals and objectives.

It is not possible to make an assessment of the effectiveness of implemented projects using the database alone, as was acknowledged by the previous Science Advisor during development of the database. However, it would be a more useful tool if certain empty data fields were populated and certain data fields were culled. The completeness of the information from the query results was likely influenced by the age of the project information and data. Since the database was recently developed, information from projects completed in the earlier years of the program may not

have tracked or maintained the same type of information. Information lacking in data fields prevents a complete picture of the status of the program and limits the ability to evaluate the effectiveness of projects. **The DCP should consider including "Not Available" as a data entry choice as this may alleviate confusion and explain the empty data fields (Recommendation 3.2)**. However, a choice of "Not Available" must be used judiciously and may be best used in conjunction with a further explanation, such as not applicable, not collected, not reported, etc. The type of data field (text or integer) would have to be considered so as not to impede the sort function of the data.

Data are lacking in many fields for older projects for the reasons just discussed, but are also lacking in recently completed and ongoing projects. **The DCP should enter the land management category (i.e., IMA, LIMA, MUMA, UMA) for the implemented projects and all future projects (Recommendation 3.3).** The MSHCP requires that mitigation funds for "take" of species and habitat be spent on management actions that will meet quantifiable biological goals for covered species. The focus should by on conservation actions on IMA and LIMA lands. There are no quantifiable biological goals for UMA lands and therefore funding conservation actions on these lands should be a lower priority. The GIS layers for these land management boundaries could be used with the spatial images for the projects to obtain the information needed to complete the Spatial Overlay tab in the database.

The spatial assessment of habitat loss indicates the ecosystems where the loss is occurring. Although the ecosystem locations where projects have been implemented appear to track with the habitat loss, the over ambitious reporting of elements associated with project proposals to attract funding may have skewed this quantitative assessment. **The projects that listed the ecosystems of most concern in regards to habitat loss should be reviewed to determine if data should be culled to realistically represent project scope and results (Recommendation 3.4).** This would better represent program implementation based on a quantitative assessment.

There is a significant difference among the numbers of threat types listed by projects (see Figure 3-2). The most repeated threat type addressed by the implemented projects is recreation. This may be due in part to the number of different recreation threats described in the MSHCP compared to other threat types. **The results of the projects listing recreation as a threat should be reviewed to determine how management decisions regarding the recreation threats are affected, and how this information is used to advance MSHCP goals and prioritize future projects (Recommendation 3.5).**

The MSHCP acknowledged that the conservation actions are somewhat generic but characterize potential actions available to land managers to avoid, minimize, or mitigate the effects of potential threats and stressors on populations and habitat. The conservation actions could change and could be implemented over time. Because certain conservation actions are implemented by agencies under their normal operating mission, it is unlikely a complete picture of the status of these actions could be attainable. **The DCP should determine, in consultation with the Permittees and USFWS, if obtaining implementation status on any or all of the agency-specific conservation actions would assist in evaluating the effectiveness of the program in advancing the MSHCP goals (Recommendation 3.6).** The signatory agencies to the Implementing Agreement have not reported the status of any self-funded projects or conservation actions that may contribute to achieving MSHCP goals and objectives since requested for the 2006 AMR. Coordination and collaboration would be necessary to obtain this information. Status information on specific conservation actions could be obtained through a forum similar to before, and to report/track their status separately from, but preferably linked to the Implementation Database.

The DCP should consider changing certain text fields in the database to integer fields to improve data sorting and reporting from the database (Recommendation 3.7). As discussed above, the field for "conservation action number" could not be queried numerically to facilitate a quick review for missing numbers.

The DCP should consider developing a standard list of key words to describe project objectives and/or effectiveness and add a text field to enter project results using these key words (Recommendation 3.8). If the intent is to use the database to evaluate effectiveness of projects in advancing the MSHCP goals, then an additional field(s) should be added. This key word text field would indicate if the project goal and objective(s) established during the proposal process were attained. However, expansions to the database may not improve reporting on the "completeness" or effectiveness of the program but would likely result in additional incomplete data fields. This is because it is probably not an efficient use of time or funds to enter new information on all older projects.

4.0 Status and Trends of Covered Species

4.1 INTRODUCTION

The general goal for MSHCP covered species is to ensure that no net unmitigated loss or fragmentation of covered species habitat occurs on the IMA and LIMA lands, and to maintain stable or increasing population numbers within Clark County (Clark County, 2000). While there are no quantitative goals for each of the covered species, a goal of the MSHCP is to develop quantitative goals through an adaptive management process (Clark County, 2000). This mirrors the requirements of HCPs in general, with a requirement to establish either habitat-based or species-based goals for every covered species (Federal Register, 2000).

One task of the AMP is to monitor population trends and ecosystem health through inventory, monitoring and research (Clark County, 2000). Over the term of the MSHCP, the DCP has funded many projects for which the proposed objective was to assess the status and/or trend of populations of covered species, and/or the effectiveness of management actions on covered species (see Chapter 3.0). There are also data on covered species collected by the state and federal land management agencies in Clark County. Some of this data was entered into the Species Status Database in 2009, but the majority of this data was just recently received by the DCP and will be assessed in the next Adaptive Management Report. Thus, this assessment is based on the limited set of data on covered species that were entered into the Species Status Database.

4.2 SPECIES STATUS DATABASE

The previous Science Advisor developed a Species Status Database to summarize data on covered species and assess population trends. The purpose of the Species Status Database is "to assess the temporal and spatial changes in abundance and distribution" of the covered species and can "be used to review, update, and analyze available data" (Clark County, 2009b). The database had the "aim of calculating quantified population metrics capable of providing statistical summaries (such as mean and standard deviation), over a period of several years, from which a measure of population trend could be generated" (Clark County, 2009b). Figure 4-1 shows the data entry screen from the Species Status Database.

The Species Status Database pilot was to be tested using data for 12 priority species; however, the DCP decided to exclude data on desert tortoise from the pilot test data entry (Wainscott, 2010b). These species were selected based on six criteria; (1) taxonomic diversity of taxa, (2) sufficient demographic and distributional knowledge to design an effective monitoring program, (3) populations and habitats that are easily sampled, (4) occupy discreet readily quantified habitat, (5) rarest, most vulnerable to extinction, and (6) state or federally listed (Clark County, 2009b). Whipple's claopodium moss (*Claopodium whippleanum*) did not have any relevant data available to be entered. The data entered into the database were obtained by the DCP between June 2007 and February 2009. The data came from 30 sources and contained records from 1884 to 2008. As expected, data from the last few decades provided more records and more quantitative data. A total of 15,917 records were entered for 11 species.

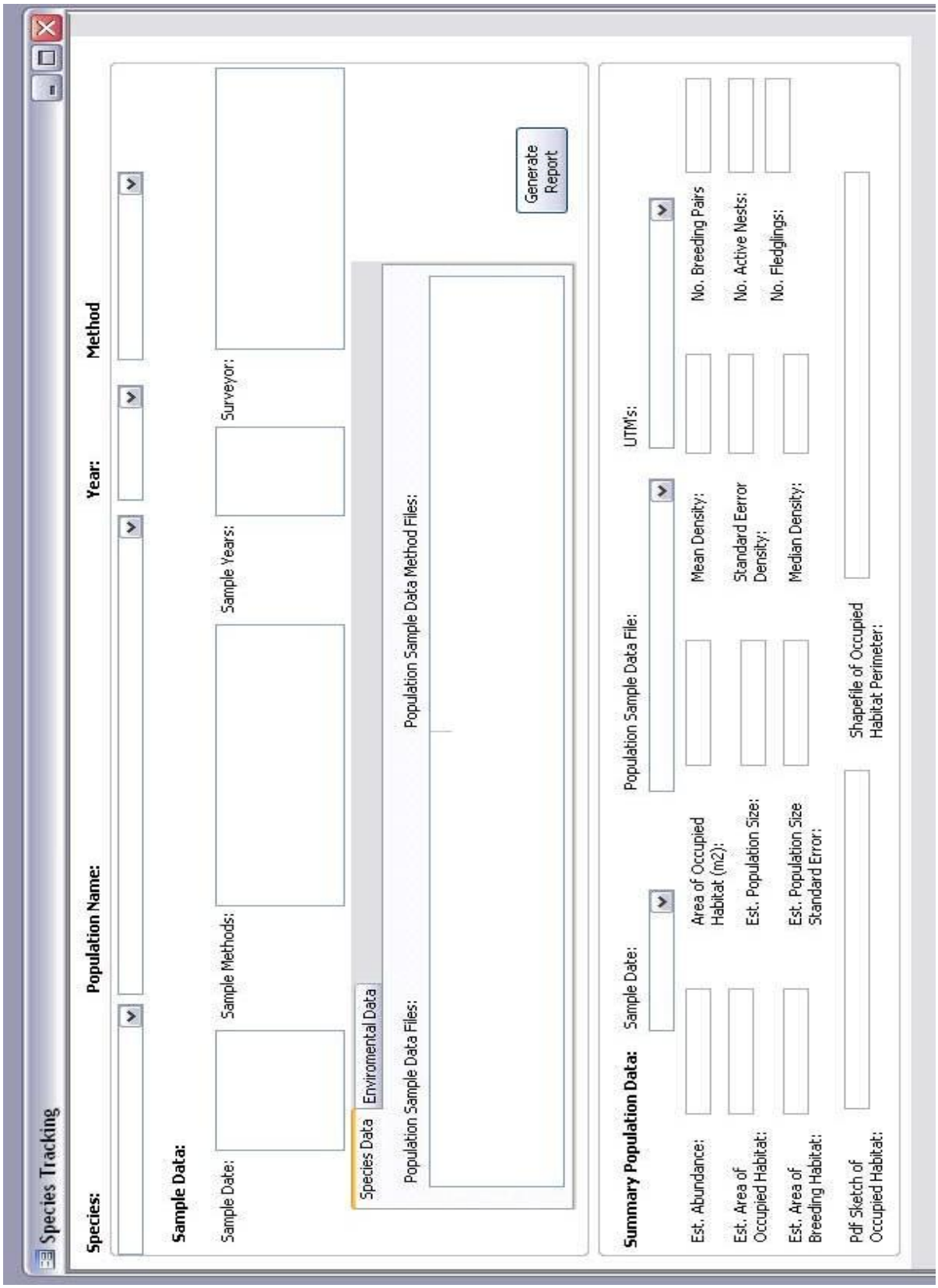

Figure 4-1. Species Status Database Entry Screen

4.2.1 Database Review

The database was assessed from the broader perspective of meeting the needs of the AMP and the MSHCP. The assessment was structured by asking the following questions.

- Is the database able to effectively catalog data on populations?
- Is the database structured to facilitate the entry of data, queries, and develop reports?
- Is the database able to assess the temporal and spatial changes in abundance and distribution of the covered species and calculate metrics to track trends of covered species?

The database is effective at cataloging population data intended to assess status and trends of covered species, and is an archive of population data. The database is easy to use, sort, query, and create reports, but the reports included with the database are very simplistic and could be designed to communicate more information. The User Guide (Clark County, 2009b) is thorough and the documentation on the database provides a complete understanding of how it was populated and reviewed.

The database does not fully meet the intended purpose of assisting the user in assessing the temporal and spatial changes in abundance and distribution of the covered species. The lack of quantitative data on population trends from monitoring projects is clearly one of the issues, but the database design could be improved to compare data and monitoring methods across sampling periods for a single population. This type of comparison needs to include whether the monitoring location, spatial area of monitoring, monitoring method, and data collection were the same in all years, in addition to the summary statistics of the data. The database does not meet its stated purpose of calculating population metrics from which a measure of population trend could be generated. The database does not calculate anything, it just reports on the calculations done in each study with a field that refers to the document that has the data. Overall, the database allows the capture of some of the data needed to assess the status and trend of covered species, but there are many ways in which it can be improved.

4.2.2 Database Recommendations

The following recommendations are made with the intent to improve the existing database in meeting its stated purpose. The recommendations include renaming fields and adding new fields but with a potential of a complete redesign. An enhanced database would not give any more insights into the current data that has been entered, but it would provide a better template to assess the data that is available and provide guidance for the type of data that would be collected in the future. An enhanced database would illustrate what data is expected from future monitoring projects to meet the MSHCP objective of monitoring population trends of covered species and incorporating an adaptive management approach in monitoring.

1. **Add a field to the database for population unit name and a written description of the population unit location (Recommendation 4.1).** Many of the covered species occur in spatially extensive populations that have multiple subpopulations or population units. The population circumscription of low elevation desert species (The Nature Conservancy, 2007) is a perfect example of this for plants, with a large area considered a population (Valley of Fire) within which there are numerous subpopulations. A wide-ranging species like the Phainopepla (*Phainopepla nitens*) exists in large populations that have specific areas for nesting. Monitoring data for species with distributions similar to the low elevation plant species and the Phainopepla is ideally collected at the subpopulation scale. Other species, such as the spring dependent

species, occur in discreet populations so the population name itself is adequate for identifying where it occurs.

It is essential to know that the population information is from the same location. To use the Species Status Database to assess data from the same population unit over time requires the consistent use of population unit names. Population and population unit names are notoriously inconsistent, as was experienced in the assessment of monitoring data for the San Diego Multiple Species Conservation Plan (MSCP) (McEachern & Sutter, in prep). This is why a field for a written description is recommended to provide additional information to correctly identify the population unit. **The DCP should establish a standardized set of population and subpopulation names and develop a crosswalk of all population and population unit names (Recommendation 4.2).**

2. **Add a field to record the monitoring objective or objectives for each project (Recommendation 4.3).** Monitoring objectives have several important roles in developing monitoring projects, including; (1) focus and sharpen thinking about the objective of the monitoring project, (2) allow communication to others about the project, a basis of understanding and collaboration, (3) determine how the monitoring will be designed, and (4) identify resource needs for the monitoring. These objectives are also essential in determining whether the monitoring project has been successful (e.g., has met its monitoring objective).

3. **Change the word "sample" to "monitoring" for the appropriate fields in the database (Recommendation 4.4).** Many of the fields in the database use the word "*sample*". Sample is defined as selecting part of something with the intent of assessing the nature of the whole. One samples a population with the intent to estimate the total population size or condition of the population. Sampling requires a sound sampling design and a statistical analysis to provide the estimates of the total population size. The sampling design needs to define the statistical population and determine the appropriate size and shape of the sample unit, how to allocate sample units, the frequency of sampling, and the number of sample units in a sample.

   Many monitoring methods, however, do not include sampling the population. This includes monitoring methods such as presence/absence, qualitative estimates of population abundance, measuring the spatial extent of the population, complete counts, and index plots. With the limited resources available to any HCP, many monitoring methods will be used.

4. **Record the monitoring method using a standardized list and develop a crosswalk table for translation of reported methods with the standardized list (Recommendation 4.5).** McEachern and Sutter (in prep) recognized seven monitoring methods for plant populations that had been implemented for the San Diego MSCP, including; (1) presence/absence of the population, (2) qualitative estimates of population abundance, (3) spatial extent of the population, (4) complete count of the population, (5) index sample used to extrapolate condition of the total population, (6) statistical estimate of the population size through sampling, and (7) demographic monitoring the following of individuals over time and space. Table 4-1 contains a detailed description of each monitoring method. Each of these monitoring methods provides different data to assess population status and trend. These monitoring methods can be combined (for

TABLE 4-1. MONITORING METHODS	
Method	**Description**
Presence/Absence	One-dimensional measure of the population, providing information on whether the population is or is not present. This method does not allow any assessment of trend, nor does it provide any information on changes in spatial distribution or the demographic condition of the population. It has no anticipatory value; a population is either present or gone. Presence/absence is appropriate for situations where the emphasis is monitoring the habitat for the species and when threats are minimal.
Qualitative Estimate	Population size provides information on the numbers of individuals, but not spatial distribution or demographic condition. It is fraught with non-sampling error, the influence of the individual surveyors to estimate numbers, survey the same areas in a population and the detectability of the individual organisms.
Complete Count	Can be done when the population is relatively small. If the counting is accurate the resulting recorded population size is accurate and absolute changes in population size can be assessed. Many rare plant populations are small and can be completely counted. This type of monitoring has been traditionally called a census in the HCP, but the term census has multiple meanings including the collection of demographic data. We will use the term complete census in this document.
Spatial Extent	Provides precise quantitative information on the spatial extent of the population, best done with a sub-meter GPS. In some cases the boundaries of populations are difficult to determine when numbers dwindle to very low densities or are patchy across the landscape. This method is appropriate for species that vary in numbers from year to year within a specific habitat, such as vernal pools, rock outcrops or shallow soils areas.
Statistical Estimate of Population Size	Obtained when one samples the population. One samples a population with the intent to estimate the total population size or condition of the population. Sampling requires a sound sampling design and a statistical analysis to provide the estimates. The sampling design needs to define the statistical population and determine the appropriate size and shape of the sample unit, how to allocate sample units, the frequency of sampling and the number of sample units in a sample. All of these factors of sample design, along with the variability in the numbers of plants detected in samples, will determine the level of statistical confidence obtained for the estimate.
Index Sample	Use of a nonrandom sample to assess population condition, but cannot be used to infer or estimate to the numbers of individuals present in the whole population. Rather, the data from the index sample is used to extrapolate conditions of the whole population. Its reflection of the whole population is depends on the representativeness of the sample, a condition that is unknown.
Demographic Monitoring	Follows fates of individuals over time and space. The data include estimates of survivorship, mortality and reproduction for specific age or size classes of individuals. This is usually the most resource intensive monitoring method, with the marking and following of individuals and the frequency of sampling. The data can identify components of the life history that affect population growth over time.
Source: McEachern & Sutter, in prep	

example, spatial extent and a statistical estimate of the population) to increase data to assess status and trends. How each of these monitoring methods is implemented determines their precision and repeatability. The database does have a population monitoring method field, but it only captures the method as described in the project. It does not provide an option to categorize the method into a few types that can be

consistently interpreted or assessed. Currently the database has 22 population monitoring methods in that field that are diverse and overlapping that makes it meaningless to sort.

5. **Add a field to the database to record demographic condition (Recommendation 4.6).** Demographic condition is a measure of demographic features of a population; for example, the presence or absence of recruitment (seedlings, fledglings, young), juvenile age or size classes, and reproductive adults. The appropriate demographic measure depends on the life history of the species; for example, spatial distribution of annual species or different stage classes for a perennial plant. Some measures of demographic condition can be easily collected while monitoring, for example, assessing stage classes in a plant population, while other measures (especially of animals, such as juveniles) are very difficult and expensive to collect. The emphasis of this recommendation is the collection of demographic measures that are easily obtained. Some measure of demographic condition can be added to all of the above monitoring methods. This information would provide another way to assess the status and trend of a population.

6. **Add fields to allow the reporting of the standard deviation and the confidence interval and level to add precision to all estimates of population size (Recommendation 4.7).** The current database recognizes the importance of the precision of population estimates with a field for the standard error of the population size. This should be expanded to report standard deviation, a standardized and comparable metric of precision, and a confidence interval and level, such as an estimate of precision that is dependent on the size of the mean. Data reported without a level of precision cannot be compared.

7. **Add several fields to the database to link habitat data to population monitoring (Recommendation 4.8).** The MSHCP has habitat-based goals that are measured by the amount and/or condition of the habitat. This is certainly more appropriate for large area HCPs where habitat is not extremely threatened or degraded and where monitoring habitat is substantially easier than measuring species population size and condition. The USFWS, however, requires that even habitat-based goals must account for every covered species (Federal Register, 2000). The database should be expanded so that habitat data, such as a qualitative assessment of structure, composition, soil conditions, and ecological processes (fire, hydrology), can be recorded and used as part of the assessment of status and trend for a population. These data can be used as co-variates when assessing the data and can provide valuable information about threats and management. All that exists in the current database is a way to link environmental data in another report to the species record.

4.3 SPECIES STATUS AND TREND DATA

The previous Science Advisor also assessed the data for the species entered into the Species Status Database to determine if any trends could be detected (Desert Research Institute, 2009). Their review of the data found that only six populations of three species could be tentatively assessed for trends. There were a number of reasons provided for why the majority of the data could not be used to assess trends, including:

- No date associated with the data on a population.
- Uncertain that the same location was monitored.
- Survey or monitoring method not described.
- Monitoring methods changed over time.

- Qualitative estimates of population size using descriptive terms (e.g., scarce, common, or abundant) that cannot be used for trends.
- Incomparable monitoring methods.

The review concluded that while there had been sufficient sampling, the changing collection methods and different data formats made most of the data incomparable over time.

4.3.1 Data Review

Developing monitoring programs to detect trends has been difficult for HCPs (Sutter et al, 2009; McEachern et al., 2007; Wilhere, 2002; Kareiva et al, 1999). A similar situation was found in 11 years of monitoring data collected for the San Diego MSCP (McEachern & Sutter, in prep). Of the 123 monitoring projects that had data that could be analyzed, only 69 (56%) were monitored with a method (complete count, quantitative sampling) that allowed a trend in population size to be detected. The majority of these (44) were complete counts of a population of which only 16 (36%) were able to detect a trend (see the first bullet below for the reason). Of the 25 populations that were sampled to estimate a total population size, only 1 (4%) had the power to detect a trend, as the paper defined as being able to detect a change of 50% over time. In total, 17 (14%) of the monitoring projects were able to meet the objective of detecting a trend in population numbers.

There were several reasons that the majority of complete count and quantitative sampling projects could not detect trends:

- Lack of repeatability in the counting methods – even complete counts of populations could not be used to assess trends because different spatial areas were counted each year or the spatial area was never defined.
- Inconsistent sampling over sample periods – either the monitoring method or the number of sample units changed over the period of monitoring.
- Sample design issues – not allocating the sample units randomly within the population.
- Lack of precision and power – even the few quantitative sampling projects that had a good sampling design, only one of 25 had enough precision and power to detect a trend. Precision is the closeness of observations within a sample, thus similar observations result in less data variability, smaller standard errors and standard deviations (these are measures of precision), and a narrower confidence interval width. Higher precision gives one more confidence in the statistical estimate of the population size. Power is the statistical ability to detect change between samples, usually from different years; it depends on the precision of the data in any sample period, but also the ability to detect change across the variability of the data in all sample periods.
- Not continuing the monitoring long enough to detect trends.

None of the data in the Species Status database can detect population trends and we disagree with the Desert Research Institute report (2009) that concludes that trends can be detected for six populations of three species. Most of the monitoring methods do not allow one to assess trends over time, such as presence/absence and qualitative assessments of abundance (e.g., Southern Nevada springsnail [*Pyrgulopsis turbatrix*]). There are difficulties interpreting the data with changing data collection methods (e.g., phainopepla) and spatial areas assessed

for a complete count (e.g., threecorner milkvetch [*Astragalus geyeri* var. *nilesii*]). At most, the data show that the populations were still present in the year of monitoring or collection.

It is also uncertain if these data are a true representation of all the data that have been collected. That will be determined in the next AMR when additional data are available for analysis.

4.3.2 Data Recommendations

The DCP has to provide more than a good database to successfully track the status and trend of the MSHCP covered species. Additional effort in improving the monitoring of covered species will be necessary for the DCP to meet the MSHCP goals. The DCP should take a more proactive role to ensure that monitoring data is collected in a way that most effectively assesses status and trend. Although DCP has addressed and supported this in the past (e.g., 2005 workshop on statistically valid sampling designs; 2007 workshop on improving the precision of monitoring; development of model protocols in 2009), the focus on monitoring should be expanded to include the following recommendations.

1. **The DCP should clearly and explicitly state what constitutes "good" (or acceptable or meaningful) monitoring data for assessing status and trend (Recommendation 4.9).** While "good" monitoring data has been discussed widely in the literature (McEachern & Sutter, in prep; Atkinson et al., 2004; Elzinga et al., 2001), it appears DCP does not explicitly communicate their expectation for monitoring data supporting the MSHCP. "Good" monitoring data should be defined as:

    - Being relevant to the priority monitoring objectives for the covered species or the habitat that contains the covered species. The monitoring objectives need to be developed within the context of the MSHCP.
    - Being repeatable across investigators and over sample periods. This includes being able to locate the population being sampled, the sample units used to sample the population, and collect the same data.
    - If sampling of a population to estimate a total population size is the monitoring method, having an appropriate level of precision and power that will allow DCP to track meaningful change in the population or habitat. Since not reporting precision or power is a common problem in monitoring projects that include sampling, the DCP should require that all monitoring data based on quantitative sampling of a population report precision and power.
    - Data that are efficiently collected and provide the appropriate return on resources in the context of the objective and species priority, and that it match the funding that is available now and into the foreseeable future.

2. **The DCP should develop criteria to assist with prioritizing the method and level of monitoring for each covered species population (Recommendation 4.10).** For populations that are being managed or have a specific threat, a method that more accurately tracks status and/or trend is appropriate. These methods usually spatially track the abundance of the population over time, sometimes including demographic measures, and are more resource intensive. For populations that are relatively secure with no site-specific management or threat, then a monitoring method may be selected that is easy and less expensive to implement and may include measures of the habitat in lieu of more extensive measures of the population.

The DCP should not consider estimating the quantitative abundance of a population as the default monitoring method but think creatively about the range of methods that could be used to assess status and trend. Obtaining precise estimates of population sizes may be logistically difficult to impossible, and/or the resources costs too extensive. The desert tortoise is an excellent example of the difficulty of estimating a total population size, as are annual species in San Diego County, California (McEachern & Sutter, in prep) and many annual and perennial species in the Mojave Desert.

3. **The DCP should take a more proactive role ensuring that meaningful monitoring data is being collected on priority species and populations (Recommendation 4.11).** This proactive role could be realized through one or several approaches:

   - Provide specific guidelines for monitoring in contracts and require frequent interaction with contractors to make sure the monitoring approach and design meets the "good" monitoring criteria.
   - Continue peer review of monitoring proposals and monitoring reports for both contracted and internal monitoring projects. Use peer reviewers who understand the context and objectives of the MSHCP.
   - Be the lead for monitoring projects on high priority species and populations, either completing the project with staff or contractors.
   - Provide monitoring advice and workshops in monitoring and adaptive management to agencies, partners and contractors.
   - Develop standardized survey and monitoring protocols for specific species and/or populations that require a population level assessment.
   - Work with agencies and partners in the design of their monitoring projects for covered species, even when the monitoring is not funded by the MSHCP.
   - Establish an entity similar to the Southern Nevada Agency Partnership (SNAP) or the San Diego MSCP web site for agencies to discuss monitoring and status/trends of covered species.

   As listed above, one standardized monitoring protocol would not be appropriate for every population or site, but there may be a standardized core monitoring protocol that every monitoring project should complete. Developing a standardized core monitoring protocol would be essential in getting precise and repeatable data that can be used to assess status and trend. This was suggested previously in the 2006 AMR and was the conclusion from work for the San Diego MSCP (McEachern & Sutter, in prep). The core monitoring protocol for that project standardized the information gathered on the habitat, threats, and the spatial extent of the population. Whether to collect additional data on the population size, density, and condition was determined for each population by the managing entity. While much of the monitoring literature and workshops have focused on the precision of monitoring data, the repeatability in basic components of a monitoring protocol such as relocating the population, relocating sample units, and repeating the same monitoring methodology need to have equal attention. A standardized monitoring protocol would be extremely valuable in ensuring the repeatability of these components of a monitoring plan.

   Without a more proactive approach in monitoring, the DCP will be at the mercy of whatever data is collected by contactors and agencies. As has been experienced in Clark County, San Diego, and numerous other projects, the data that are collected will rarely be able to meet the needs of the MSHCP to assess the status and trends of covered species. The DCP is the only entity whose focus is the status and trend of the

covered species over their range in Clark County and is in the position to influence the quality and purpose of monitoring data collection for covered species within the MSHCP area.

4. **The DCP should develop a strategic plan to obtain internal and external expertise that is commensurate with the monitoring and adaptive management responsibilities of the DCP (Recommendation 4.12).** For any of these approaches DCP needs to have adequate expertise on staff; staff that are knowledgeable and experienced in monitoring, can communicate well with contractors and agency staff, and are respected by agency and partner staff. This does not fully exist with the present staff. This can be obtained through hiring new staff that have this experience or developing internal training to improve existing staff. This can also be obtained through the use of consultants, but they need to be fully informed on the objectives of the MSHCP and DCP and develop a close working relationship with staff.

5. **The DCP should take a more proactive role in promoting and insuring that monitoring projects are done within an adaptive management context, both internally and working with agencies and partners (Recommendation 4.13).** Adaptive management starts with the right priorities, focused objectives that address key uncertainties, a monitoring design that meets the objectives, and the collection of meaningful data. But it is not adaptive until the information is interpreted, disseminated, and integrated in future management, restoration, and mitigation actions. The DCP should become a spokesperson for developing an adaptive management approach for covered species and making sure that what is learned from past management and research is incorporated into current management actions and research.

4.4 SUMMARY AND RECOMMENDATIONS

The Species Status Database is a significant start on a way to track the status and trend of the MSHCP covered species. The recommendations (detailed above) are to improve the database and to populate it with additional data on covered species. Additionally, the review of available data on 11 species provides valuable insights in what problems exist in the collection of monitoring data. The fact that no populations could be assessed for trends is important information for the DCP.

The DCP should now put more emphasis on obtaining good data so that the status and trends of covered species can be assessed. This is an important shift for the DCP from just being a repository for whatever data is available to a program dedicated to the collection and use of meaningful monitoring data, and the design of focused and efficient monitoring projects, within an adaptive management context. This is essential if the DCP wants to assess whether populations of covered species are stable or increasing.

5.0 Summary and Recommendations

5.1 INTRODUCTION

Past AMRs have provided information for program direction and summarized progress on specific tools and databases that have been developed to meet the needs of the DCP and the MSHCP, including:

- Species Status Database to assess the temporal and spatial changes in abundance and distribution of covered species.
- Implementation Status Database designed to track the tangible products and other outcomes of implementation activities conducted for and/or funded by the DCP to implement mitigation actions for the MSHCP.
- Initial conceptual models for the 11 MSHCP ecosystems to understand the ecological processes that maintain these ecosystems and the covered species that occur within them.
- Decision-support system to make project-level prioritized recommendations for future plans and budgets.
- Conceptual model of the MSHCP, illustrating the interactions among species, habitats, land use trends, and funded actions and how they further the conservation goals of the plan.
- Recommendations on how to implement conservation measures and adaptive management within the context of the MSHCP.

Many of these tools and databases have been implemented. With their implementation, this AMR has the opportunity to assess if they are meeting their intended purpose, effective and efficient in meeting their objectives, and serving the goals of the MSHCP. This AMR addresses several of these tools and databases and provides an assessment. This chapter of the document takes a broader look using the adaptive management framework questions introduced in Chapter 1 to assess both projects and the program as a whole.

Previous AMRs have discussed adaptive management in great length (Clark County, 2006; 2008) such that it does not need repeating here. What is different with this AMR is the framework presents a broader interpretation of adaptive management than is generally presented in the previous AMRs and in the scientific literature. This AMR addresses a wider range of actions, including setting priorities, establishing objectives, monitoring design, data management, getting information to decision-makers, and institutional support (Sutter et al., 2009; Table 3).

This Science Advisor defines adaptive management as a structured and sequential learning process that, by producing understanding and reducing uncertainty, iteratively leads to more effective programmatic, management, and conservation decisions. As a learning process, adaptive management uses the best available information to understand how a system works (preferably by using conceptual models as a tool), develops hypotheses, and assesses the outcomes from monitoring and review. As an action tool, adaptive management allows the implementation of actions in the context of uncertainty. As a results tool, adaptive management leads to more effective and enduring programmatic, management and conservation actions. For more detail on an adaptive management framework for monitoring and management projects see Sutter et al. (2009).

This broader definition is similar to that used by the USFWS and the Department of the Interior (Williams et al. 2009). These agencies use adaptive management as a learning process leading to better management, and as a method for examining alternative strategies for meeting measureable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what has been learned (Federal Register, 2000). These broader definitions of adaptive management put this concept in reach of HCPs. They explore alternative ways to meet programmatic or management objectives through either sequential or experimental designs. The former process is often the only option for management agencies with few resources and/or limited spatial areas to test different management actions, and is certainly the only option for many programmatic actions. This definition is different than the recommendation in the 2006 AMR in that it does not ask the DCP to "embrace the principles and techniques of active adaptive management".

While this interpretation is broader, it does not mean that an adaptive management approach is appropriate for every programmatic and management situation (Federal Register, 2000). Adaptive management is best used when (SNAP, 2009):

- Consequential decisions are necessary for the future of natural resources.
- Opportunity to apply learning and new information.
- Management objectives are clear.
- Scientific uncertainty is significant and the value of reducing it is high.
- Monitoring can be established, supported, and will provide data to reduce uncertainty.

This AMR and the review of the program for implementing the MSHCP followed the adaptive management framework structured by the six questions introduced in Chapter 1. The remainder of this chapter summarizes the results of the Science Advisor's assessment of the DCP against the following questions:

1. Are the program and the projects addressing the highest priority species, populations, and conservation actions within the context of the MSHCP?
2. Is the program developing focused objectives for every project based on the best available information?
3. Is the program designing or funding projects that effectively and efficiently answer program and project objectives?
4. Are data analysis and interpretation done in a timely manner and using the best available resources?
5. Are the results from projects being communicated effectively to the appropriate decision-makers and archived for future access?
6. Is the program working with partners to use the data from projects to improve decision-making?

5.2 RECOMMENDATIONS FOR THE MSHCP

This section presents the adaptive management framework questions with discussions and recommendations of the Science Advisor based on their assessment of the MSHCP and the AMP. The discussion and recommendations for Questions 3 and 4 and for Questions 5 and 6 are similar and therefore are presented together.

Question 1: Are the program and the projects addressing the highest priority species, populations, and conservation actions within the context of the MSHCP?

Although the MSHCP and supporting guidance documents provide broad sets of guidance and expectations about implementing the plan, there are no explicit statements about the relative importance of the species or the actions for implementation. There are no priorities specified among the broad categories or lists of conservation actions and where specific species or areas are mentioned the guidance is generally broad. The implication is that priorities among all expectations are equivalent and that all actions are equally important to implementation and success of the plan. Although not stated, the plan implies that priorities within these broad categories would be established as implementation progresses.

General ecosystem priorities are provided by the assessment of habitat loss (i.e., disturbed acres). The assessment differentiates between ecosystems that have no or very little habitat loss and can differentiate between habitats with significant loss versus those with minimal loss. For most ecosystems, however, the assessment does not lead to a prioritization of species, populations, or locations for the implementation of mitigation or conservation actions. There is no data that addresses the scale of a population or species. However, linked with other information, the data on habitat loss in specific ecosystems help prioritize those efforts. An example if this is the riparian restoration efforts on the Muddy River (Anderson & Provencher, 2010; Provencher et al., 2005; Provencher & Andress, 2004),

The fundamental purpose of the Implementation Database is to identify, track, and account for implemented mitigation and conservation activities. It can be used to quantitatively compare the number of implemented projects against ecosystems, threats, species, and conservation actions. A quantitative assessment could assume that the greater number of projects that address a particular ecosystem, for example, could indicate that ecosystem is of higher priority for mitigation than others. However, similar to what is stated in the paragraph above, this assessment does not lead to a prioritization of actions to address species or locations within the ecosystem. This quantitative assessment could be used in conjunction with species data and a more thorough assessment of threats to determine if mitigation actions are appropriately addressing the threats and contributing to habitat conservation and population increases.

There are no priorities established in the Species Status Database, nor is there a way to record species priorities within the database. Species and population priorities are important in determining the appropriate monitoring method. While the DCP is tasked with assessing the status and trend of all the covered species, the monitoring method for this data will vary by species and population. This is in part a function of the available resources for monitoring; a population level assessment of size and density is not possible for all the populations of all the covered species. The program needs to prioritize the level of monitoring that is appropriate for each population based on a level of confidence in the monitoring data that is acceptable. For species that are extremely rare and have significant threats, population level monitoring is appropriate. For species that have widely distributed populations with few immediate threats, monitoring the habitat would be more appropriate, with a minimal level of population monitoring (e.g., presence/absence, qualitative estimates of size). Habitat monitoring could range from on the ground assessments to remote sensing. In contrast to many HCPs and other regional conservation efforts, many of the covered species in Clark County occur in relatively intact and minimally threatened habitat.

Establishing priorities for species, populations, and conservation actions offer many benefits and values to the DCP. Explicit priorities would provide consistent guidance for DCP actions and funding of projects, a proactive and measurable approach for program work, and a comprehensive and effective approach to meeting the goals and objectives of the MSHCP. Explicit priorities for conservation actions would also provide clarity on the role of the DCP

and likely improve communication among partner agencies and Permittees during the biennial budget process. While establishing priorities may be a difficult task, it would have immediate and long-term benefits for managing the program.

Define "priority species" as the list proposed for coverage under the pending MSHCP amendment (Recommendation 5.1). This proposed list would help focus the priorities for selecting projects to implement to advance and MSHCP goals while being cognizant of pending changes. If differentiation among these species is needed, first priority would be to species that are either listed or candidates for listing as threatened or endangered by the USFWS, or are similarly listed by the State of Nevada.

Establish criteria and a process for assessing the priority of populations, projects, and mitigation and conservation actions (Recommendation 5.2). The ultimate objective is to focus the allocation of time, money and staff on populations, projects, and actions that do the most to further the biological goals and objectives of the MSHCP. Once priorities are established, they become the basis of making decisions about resources and actions and allow others to understand why and where resources are spent. Clear priorities allow the DCP to confidently allocate resources for conservation actions that do the most to achieve the goals and objectives of the MSHCP (Elzinga et al., 2001; SNAP, 2009).

The criteria should be meaningful, consistent and transparent. Potential criteria categories include conservation value (i.e., how valuable the outcomes will be toward meeting the biological goals and objectives), urgency (i.e., how important is it do obtain these outcomes now versus later), and opportunity (i.e., are there funding sources, partnerships, expertise, and planning windows that make doing this project now more valuable than later). Many of the past efforts have used some of these criteria but have failed at a process that is transparent and repeatable.

Question 2: Is the program developing focused objectives for every project based on the best available information?

Focused objectives have explicit outcomes and a clear approach (i.e., appropriate study method and measurement indicators) to obtain the outcome. The best available information comes internally from the assessments of habitat loss by ecosystem and from a wide range of external sources (i.e., publications, expert advice). Objective-based program management focuses and sharpens thinking about any programmatic or mitigation/conservation action by asking what the desired outcomes are, what steps are needed to obtain that outcome, and what timeframe is needed to reach the outcome. Objectives will assist in determining what resources are needed. A good objective will provide the basis for measuring progress toward the outcomes. And lastly, a well described objective will facilitate communication and transparency for program actions.

The DCP has general objectives for the topics reviewed in this document. The land use trends and habitat loss component is driven by six specific questions. The technical approach is sound and the outcomes provide a valuable first level assessment of mitigation actions, as well as the total acreage allowed under the incidental take permit.

Setting objectives for specific projects has evolved over time. Currently, all proposed projects must include at least one specific objective statement that ties the proposed work to the MSHCP elements (i.e., species, ecosystems, threats, and conservation actions). This standardized approach helps focus and set objectives for the project; however, further review upon project completion would not only determine if the project attained its objective, but how

those results affect other projects and management decisions. This would assist in determining effectiveness of the projects rather than assuming the relationship of MSHCP elements with the project activities is effective.

The objectives for the Species Status Database, however, do not match the performance of the database, and the data on covered species does not allow the DCP to track species status or trend. Several recommendations on the database and the data are presented in Chapter 4. Additionally, species level goals and objectives are also lacking, against which all mitigation and conservation actions can be assessed and measured. A goal of the MSHCP and all HCPs (Federal Register, 2000) is to develop quantitative goals through an adaptive management process (Clark County, 2000).

The USFWS 5-Point Policy (Federal Register, 2000) states that the biological goals and objectives for a species may be either habitat-based or species-based. Habitat-based goals and objectives are expressed in terms of amount and/or quality of habitat, while species-based goals and objectives are expressed in terms of individuals in populations and number of populations. Habitat-based goals and objectives must still be linked to each covered species in the habitat. Larger, multi-species HCPs often have both habitat-based and species-based goals. **Develop either habitat-based goals or species-based goals and objectives for each covered species (Recommendation 5.3)**. As stated in the 5 Point Policy, "determination of the biological goals and objectives is integral to the development of the operating conservation program." Having explicit and clear goals and objectives would allow the program to set priorities for mitigation and conservation actions and develop focused objectives for each project.

The information on the key ecological attributes that maintain populations and their threats is essential for developing species and population objectives and the development of management and monitoring plans. The Nature Conservancy's report on nine low elevation rare plants (2007) is an excellent example of a process to obtain this data. **Obtain information on key ecological attributes, current conditions, and threats for all covered species that require management (Recommendation 5.4).**

The 2008 AMR initiated a process of developing conceptual ecological models for all eleven ecosystems. The value of conceptual ecological models in conservation planning is gaining recognition. Conceptual ecological models are an effective tool to understand what ecological processes and conditions are key to the viability of a species. This information becomes essential for developing management, restoration, or recovery plans and guides the selection of indicators for measuring the effectiveness of these actions. They are also valuable visual tools for communicating the information used to make management decisions and illustrating what is known and hypothesized about how an ecosystem works. **The DCP should determine which conceptual ecological models are most valuable to complete and at what scale they need to be developed (Recommendation 5.5).** The priority models should be those for ecosystems that are disproportionally impacted by habitat loss or being managed for one of the covered species, where the understanding of ecological processes and condition is essential. Some ecosystems should be modeled at the scale that they are recognized, such as desert riparian and aquatic, because management is similar across the ecosystem. Other ecosystems may have enough internal variability that models will need to be developed at a scale more appropriate for management, for example, the Mojave desert scrub and its range of soil types.

Questions 3 and 4: Is the program designing or funding projects to effectively and efficiently answer program and project objectives? Are data analysis and interpretation done in a timely manner and using the best available resources?

An effective and efficient designed project has an appropriate study and sample design that will meet the project objective at an appropriate level of accuracy, precision, and/or power.

The tabular data on permitted acres and the spatial analysis of land use does effectively and efficiently answer the six questions of the analysis of disturbed acres and habitat loss. Interpretation of the analysis is the responsibility of the biennial AMR that is completed in even numbered years. This appears to be an appropriate timeframe for these analyses.

There has been an improved effort since the 2005-2007 planning and budgeting process to fund and implement projects that have expressed goals. The goals are based on a relationship of project activities with MSHCP elements (i.e., species, ecosystems, threats, and conservation actions); however, there may be a tendency to over state the numbers and types of elements the project may actually address to potentially make the project more "saleable". There is no mechanism to rank or weigh the extent a project's activities would address the elements by reviewing the Implementation Database.

The Species Status Database does not fully meet the intended purpose of assessing the temporal and spatial changes in abundance and distribution of the covered species. It does not assess spatial changes, does not calculate and assess trends, and does not include all the information needed for an appropriate assessment of status and trend.

Even with these projects not being able to meet their objectives, the DCP has attempted to develop appropriate designs for the projects, used best available information and, with this AMR, actively sought an assessment of the products and outcomes.

Questions 5 and 6: Are the results from projects being communicated effectively to the appropriate decision-makers and archived for future access? Is the program working with partners to use the data from projects to improve decision-making?

The completion of the adaptive management cycle is improved decision-making within the context of the plan's goals. In the case of the MSHCP, the decision-makers that need to be reached are the USFWS, all land managing agencies in Clark County, Permittees, and the Board of County Commissioners. Not only do these decision-makers require information to make appropriate decisions, but they would benefit from a learning culture that integrates knowledge and adapts program actions.

The land use trend and habitat loss data are reported in the Quarterly Plan Administrator Update, Biennium Progress Report, and biennial AMR. These reports are sent to all interested parties and placed on the DCP web site (http://bit.ly/CCMSHCP_reports). Information on the status of implementing projects and programmatic actions are communicated through the same reports and the Quarterly Progress Report completed by each project proponent. In addition, an annual Symposium is held for projects to report their results. The status of covered species is communicated only through the biennial AMR. While all these data are widely distributed, it does not appear to be

actively communicated to all appropriate decision-makers, especially the land managing agencies. The web site is an excellent location to archive these reports, as well as other archiving done in the Department of Air Quality and Environmental Management.

The DCP should more actively communicate program and project information to land managing agencies (Recommendation 5.6). Types of communication include direct and regular information flow (i.e., status emails), requesting information on agency projects that further the goals of the MSHCP, and promote feedback on DCP programs and projects. In addition to the Symposium, the DCP should become active in SNAP or organize a similar workgroup with the land managing agencies with the intent of sharing information on mitigation and conservation actions to advance adaptive management.

5.3 SUMMARY

Implementing an adaptive management program for an HCP is especially challenging (Sutter et. al., 2009; Atkinson et al., 2004). Many HCPs cover geographic areas that include multiple jurisdictions and ownerships, each with different levels of support and resources. There is commonly a lack of coordination in developing an adaptive management approach, including monitoring protocols, sharing data, and lessons learned (McEachern et al., 2007). In addition, it is difficult for the multiple jurisdictions to have a perspective of conservation at the scale of the whole HCP.

The success of a multi-jurisdictional project, such as an HCP, depends on both the working relationship among partners and focused and explicit objectives of the lead program. Both are especially important and challenging. Several of the keys to success for multi-jurisdictional projects include engaging local and regional leadership in guiding the learning process, maintaining and valuing cooperation among management and research partners, and developing long-term funding strategies for all partners (Haynes et al., 2006; SNAP, 2009).

The assessment questions introduced in Chapter 1 and summarized above primarily focus on program operations and provide a basis for improving and maintaining relationships among partners. The recommendations resulting from the Science Advisor's assessment of the program are detailed in the previous chapters and are summarized in Table 5-1.

The DCP is in a transitional period between the funding of projects, compilation of information, development of tools and databases, and a more active implementation and refinement phase. During this period DCP has the opportunity to take a leadership role in making the MSHCP objective-driven, improving monitoring, and promoting adaptive management. Uncertainty is a central concept in adaptive management. It could be stated that the role of the DCP is to reduce uncertainties, increase knowledge, and improve decision-making for all agency partners and Permittees. The DCP is the only entity whose focus is the mitigation and conservation of covered species over the range of the MSCHP. The recommendations in this report reflect some of the ways that the DCP can be a leader for the MSHCP, continuing the current desire, commitment, and focus to succeed.

TABLE 5-1. SUMMARY OF RECOMMENDATIONS			
Assessment	**Number[1]**	**Recommendation**	**Discussion**
Land Use Trends and Habitat Loss	2.1	The increasing trend in habitat loss outside of disposal areas should receive further assessment	Section 2.5, page 18
	2.2	The DCP should further assess the habitat loss in the salt desert scrub, mesquite/catclaw acacia, and desert riparian/aquatic ecosystems to assist in determining the extent and type of mitigation needed	Section 2.5, page 18
	2.3	The DCP should explore ways to improve the correlation of habitat loss in desert riparian/aquatic, salt desert scrub, and mesquite/catclaw acacia ecosystems with potential habitat for covered species so that efforts can be more accurately directed toward the protection, management, and/or restoration of the appropriate species habitat or populations of specific species	Section 2.5, page 18
	2.4	The DCP should explore if remote sensing could assess habitat condition as well as habitat loss	Section 2.5, page 18
Implementation Status	3.1	The DCP should review the Quarterly Progress Report and Final Project Report formats to determine if more information specific to evaluating effectiveness should be requested.	Section 3.3, page 25
	3.2	The DCP should consider including "Not Available" as a data entry choice as this may alleviate confusion and explain the empty data fields.	Section 3.3, page 26
	3.3	The DCP should enter the land management category (i.e., IMA, LIMA, MUMA, UMA) for the implemented projects and all future projects.	Section 3.3, page 26
	3.4	The projects that listed the ecosystems of most concern in regards to habitat loss should be reviewed to determine if data should be culled to realistically represent project scope and results	Section 3.3, page 26
	3.5	The results of the projects listing recreation as a threat should be reviewed to determine how management decisions regarding the recreation threats are affected, and how this information is used to advance MSHCP goals and prioritize future projects.	Section 3.3, page 26
	3.6	The DCP should determine, in consultation with the Permittees and USFWS, if obtaining implementation status on any or all of the agency-specific conservation actions would assist in evaluating the effectiveness of the program in advancing the MSHCP goals.	Section 3.3, page 26
	3.7	The DCP should consider changing certain text fields in the database to integer fields to improve data sorting and reporting from the database.	Section 3.3, page 27
	3.8	The DCP should consider developing a standard list of key words to describe project objectives and/or effectiveness and add a text field to enter project results using these key words.	Section 3.3, page 27
Status and Trends of Covered Species	4.1	Add a field to the database for population unit name and a written description of the population unit location.	Section 4.2.2, page 30
	4.2	The DCP should establish a standardized set of population and subpopulation names and develop a crosswalk of all population and population unit names.	Section 4.2.2, page 31

	4.3	Add a field to record the monitoring objective or objectives for each project	Section 4.2.2, page 31
	4.4	Change the word "sample" to "monitoring" for the appropriate fields in the database	Section 4.2.2, page 31
	4.5	Record the monitoring method using a standardized list and develop a crosswalk table for translation of reported methods with the standardized list	Section 4.2.2, page 31
	4.6	Add a field to the database to record demographic condition	Section 4.2.2, page 33
	4.7	Add fields to allow the reporting of the standard deviation and the confidence interval and level to add precision to all estimates of population size	Section 4.2.2, page 33
	4.8	Add several fields to the database to link habitat data to population monitoring	Section 4.2.2, page 33
	4.9	The DCP should clearly and explicitly state what constitutes "good" (or acceptable or meaningful) monitoring data for assessing status and trend.	Section 4.3.2, page 35
	4.10	The DCP should develop criteria to assist with prioritizing the method and level of monitoring for each covered species population.	Section 4.3.2, page 35
	4.11	The DCP should take a more proactive role ensuring that meaningful monitoring data is being collected on priority species and populations.	Section 4.3.2, page 36
	4.12	The DCP should develop a strategic plan to obtain internal and external expertise that is commensurate with the monitoring and adaptive management responsibilities of the DCP.	Section 4.3.2, page 37
	4.13	The DCP should take a more proactive role in promoting and insuring that monitoring projects are done within an adaptive management context, both internally and working with agencies and partners.	Section 4.3.2, page 37
Programmatic	5.1	Define "priority species" as the list proposed for coverage under the pending MSHCP amendment.	Section 5.2, page 41
	5.2	Establish criteria and a process for assessing the priority of populations, projects, and mitigation and conservation actions.	Section 5.2, page 41
	5.3	Develop either habitat-based goals or species-based goals and objectives for each covered species.	Section 5.2, page 42
	5.4	Obtain information on key ecological attributes, current conditions, and threats for all covered species that require management.	Section 5.2, page 42
	5.5	The DCP should determine which conceptual ecological models are most valuable to complete and at what scale they need to be developed.	Section 5.2, page 42
	5.6	The DCP should more actively communicate program and project information to land managing agencies.	Section 5.2, page 44

[1] Recommendations are numbered consecutively within the specific chapter of the AMR.

6.0 References

Anderson, T. and Provencher, L. 2010. Effectiveness Monitoring for Saltcedar and Knapweed Control on the Upper Muddy River Floodplain. Report to the Clark County Desert Conservation Program. Contract 2005-TNC-572-P.

Atkinson, A.J., Trenham, P.C, Fisher, F.N., Hathaway, S.A., Johnson, B.S., Torres, S.G. & Moore, Y.C. 2004. Design Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans. U.S. Geological Survey Technical Report. USGS Western Ecological Research Center, Sacramento, CA. 69 pp.

Bice, Lee. 2010. Senior GIS Analyst, Clark County Desert Conservation Program. Personal communications with Rob Sutter, Enduring Conservation Outcomes, regarding GIS spatial analysis. February-March 2010.

Clark County. 2000. Final Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clarke County, Nevada. September 2000.

_____. 2006. Adaptive Management Report for the Clark County, Nevada Multiple Species Habitat Conservation Plan. Department of Air Quality and Environmental Management. May 1, 2006.

_____. 2008. Adaptive Management Report for the Clark County, Nevada Multiple Species Habitat Conservation Plan. Department of Air Quality and Environmental Management. October 22, 2008

_____. 2009a. MSHCP Implementation Database User Manual. Created by Shawn MacCabe, Desert Research Institute for Clark County. March 2009, Updated January 26, 2010.

_____. 2009b. MSHCP Species Status Database User Guide, Version 1.1. Created by Shawn MacCabe, Desert Research Institute for Clark County. May 2009.

Desert Research Institute (DRI). 2009. WAF574A0003: Covered Species Population Trends. Unpublished Report from Desert Research Institute to Clark County Desert Conservation Program. June 30, 2009.

Elzinga, C.L., Salzer, D.W., Willoughby, J.W. Gibbs, J.P. 2001. Monitoring Plant and Animal Populations, Oxford, England. Blackwell Science.

Federal Register. 2000. Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process. U.S. Fish and Wildlife and National Oceanic and Atmospheric Administration. June 1, 2000. Pages 35242-35257.

Haynes, R.W., Bormann, B.T., Lee, D.C., & Martin J.R. (tech. eds.). 2006. Northwest Forest Plan – The First 10 Years (1994-2003): Synthesis of Monitoring and Research Results. Gen. Tech. Rep. PNW-GTR-651. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Kareiva, P. et al. 1999. Using Science in Habitat Conservation Plans. American Institute of Biological Sciences, Washington D.C.

McEachern, K & Sutter, R. in prep. Analyzing Ten Years of Monitoring Data from the San Diego Multiple Species Conservation Plan.

McEachern, K., Pavlik, J.M., Rebman, J., and Sutter, R. 2007. San Diego Multiple Species Conservation Program (MSCP) Rare Plant Monitoring Review and Revision. U.S. Geological Survey, Scientific Investigations Report 2007-5016, Reston, Virginia. 68 pages.

Provencher, L., Wainscott, S., & Andress, R. 2005. Integrated Science Assessment for the Upper Muddy River, Clark County, Nevada. Final Report to the Clark County Multiple Species Habitat Conservation Plan. The Nature Conservancy, Reno, Nevada.

Provencher, L. & Andress, R. 2004. Integrated Science Assessment for the Upper Muddy River, Clark County, Nevada. Annual Report to the Clark County Multiple Species Habitat Conservation Plan. The Nature Conservancy, Reno, Nevada.

RECON. 2008. Management Change Analysis for the Clark County Multiple Species Habitat Conservation Plan. Clark County. 32 pages.

Southern Nevada Agency Partnership (SNAP). 2009. Science and Research Strategy.

Sutter, R.D., Kokos, S., & Bangle, D. 2009. Improving the Implementation of Ecological Monitoring and Adaptive Management in the Clark County Multiple Species Habitat Conservation Plan. Clark County Desert Conservation Program Contract 2005-TNC-574F-P.

The Nature Conservancy. 2007. A Conservation Management Strategy for Nine Low Elevation Rare Plants in Clark County, Nevada by The Nature Conservancy, Nevada Field Office, Reno, Nevada.

U.S. Fish and Wildlife Service (USFWS). 2000. Intra-Service Biological Opinion and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada for a Multiple Species Habitat Conservation Plan. File No. 1-5-00-FW-575. November 19, 2000.

_____. 2001. Federal Fish and Wildlife Permit Number TE034927-0. Clark County MSHCP Permittees. Effective January 9, 2001.

_____. 2002. Memorandum of Agreement among United States Bureau of Land Management, National Park Service, Unites States Department of Agriculture-Forest Service, United States Fish and Wildlife Service (Refuges), United States Fish and Wildlife Service (Ecological Services) and Clark County, Nevada in its Capacity as Administrator of the Desert Conservation Program Regarding Adaptive Management of the Clark County Multiple Species Habitat Conservation Plan. December 12, 2002.

Wainscott, Sue. 2010a. Adaptive Management Coordinator, Clark County Desert Conservation Program. Personal communications with Rob Sutter, Enduring Conservation Outcomes, regarding spatial analysis precision. February 2010.

Wainscott, Sue. 2010b. Adaptive Management Coordinator, Clark County Desert Conservation Program. Personal communication with Rob Sutter, Enduring Conservation Outcomes, regarding Species Status Database and desert tortoise data. May 12, 2010.

Wilhere, G.F. 2002. Adaptive Management in Habitat Conservation Plans. Conservation Biology 16:20-29.

Williams, B. K., Szaro, R.C., & Shapiro, C.D. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

7.0 Preparers

This Adaptive Management Report has been prepared for the Clark County Desert Conservation Program with contractual assistance from Enduring Conservation Outcomes, LLC as the Science Advisor to the program. The following people were involved in the preparation and review of this report:

Robert D. Sutter
Conservation Ecologist
Enduring Conservation Outcomes, LLC

Mary B. Peters
Environmental Planner/Biologist
MBP Consulting, LLC

Barry Mulder
Conservation Ecologist

Sue Wainscott
Adaptive Management Coordinator
Desert Conservation Program

Lee Bice
Senior GIS Analyst
Desert Conservation Program