2016
ADAPTIVE MANAGEMENT REPORT

CLARK COUNTY
MULTIPLE SPECIES HABITAT CONSERVATION PLAN

June 2016

desert conservation
PROGRAM

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Prepared for:

desert conservation
PROGRAM

Prepared by:

Enduring Conservation Outcomes

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ACRONYMS AND ABBREVIATIONS

AMP	Adaptive Management Program
AMR	Adaptive Management Report
BCCE	Boulder City Conservation Easement
BLM	Bureau of Land Management
DCP	Desert Conservation Program
ESA	Endangered Species Act
GIS	Geographic Information System
GISMO	Clark County Geographic Information Systems Management Office
GPS	Global Positioning System
HCP	Habitat Conservation Plan
MSHCP	Multiple Species Habitat Conservation Plan
NAIP	National Agriculture Imagery Program
Permit	Incidental Take Permit TE34927-0
Permittees	Clark County, cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquites, and Nevada Department of Transportation
USFWS	U.S. Fish and Wildlife Service

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1.0 INTRODUCTION TO THE ADAPTIVE MANAGEMENT REPORT

1.1 Introduction

The Clark County Desert Conservation Program (DCP) coordinates compliance with the Incidental Take Permit (Permit) issued by the United States Fish and Wildlife Service (USFWS) to Clark County; the cities of Boulder City, Henderson, Las Vegas, Mesquite, and North Las Vegas; and the Nevada Department of Transportation (collectively referred to as the Permittees) in accordance with Section 10(a)(1)(B) of the Endangered Species Act (ESA). Compliance with the permit requires implementation of the Clark County Multiple Species Habitat Conservation Plan (MSHCP) and Implementing Agreement (Clark County 2000, USFWS et al. 2000). Clark County serves as the Plan Administrator for the MSHCP on behalf of the other Permittees, with the DCP representing Clark County in this role.

The MSHCP and Permit required the development of an adaptive management process to review and report on the effectiveness of conservation and management actions in the conservation of MSHCP covered species and their habitats. This Adaptive Management Report (AMR) summarizes the status and effectiveness of the Adaptive Management Program from fall of 2009 through spring of 2015. The purpose for the AMR is to provide an assessment of land use and ecosystem disturbance, species status and populations, and the effectiveness of management actions in achieving conservation goals and objectives.

This section describes the history, function, and proposed future amendment of the MSHCP and Permit, and provides an overview of the purpose for and content of this AMR.

1.2 Multiple Species Habitat Conservation Plan and Incidental Take Permit

1.2.1 Background

The Mojave Desert population of the desert tortoise (*Gopherus agassizii*) was listed by the USFWS under the ESA as a threatened species in April 1990 (USFWS 1990), after an emergency listing of the tortoise as endangered in 1989. The federal listing of the tortoise stalled development on non-federal lands in Clark County pending the completion of a habitat conservation plan (HCP) and receipt of an incidental take permit issued by the USFWS.

Section 10(a)(1)(B) of the ESA allows for the incidental "take'' of threatened or endangered wildlife species while carrying out an otherwise lawful activity on non-federal land. An HCP must accompany an application for a permit, and USFWS may issue a permit for incidental take provided adequate steps to monitor, minimize, and mitigate impacts to listed species and habitat are documented in the HCP.

Clark County led the preparation of a short-term HCP for the incidental take of the tortoise over a small area within the Las Vegas Valley. The short-term plan and permit issued in 1991 was followed by a long-term HCP (referred to as the Clark County Desert Conservation Plan) and permit issued in 1995, which expanded the coverage for incidental take of the tortoise throughout the county. Information on these HCPs and permits is available at http://www.clarkcountynv.gov/Depts/dcp/Pages/About.aspx.

In 1996 the Permittees determined that proactive conservation of non-listed species and their habitats would reduce the likelihood of future federal listings under the ESA. The MSHCP process was initiated as an extension to the long-term HCP (Desert Conservation Plan) 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 Permit TE34927-0 was issued in early 2001.

1.2.2 Covered Species

The MSHCP and Permit addressed 78 species categorized as "covered" species, and included 15 reptiles and amphibians, 8 birds, 4 mammals, 8 insects, 2 crustaceans, and 41 plants (USFWS 2001). 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. Additional species were categorized as "evaluate" or "watch" because there was inadequate information available to determine if existing and future risk to those species warranted current protection. Including non-listed species in an HCP reduces the chance of their federal 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

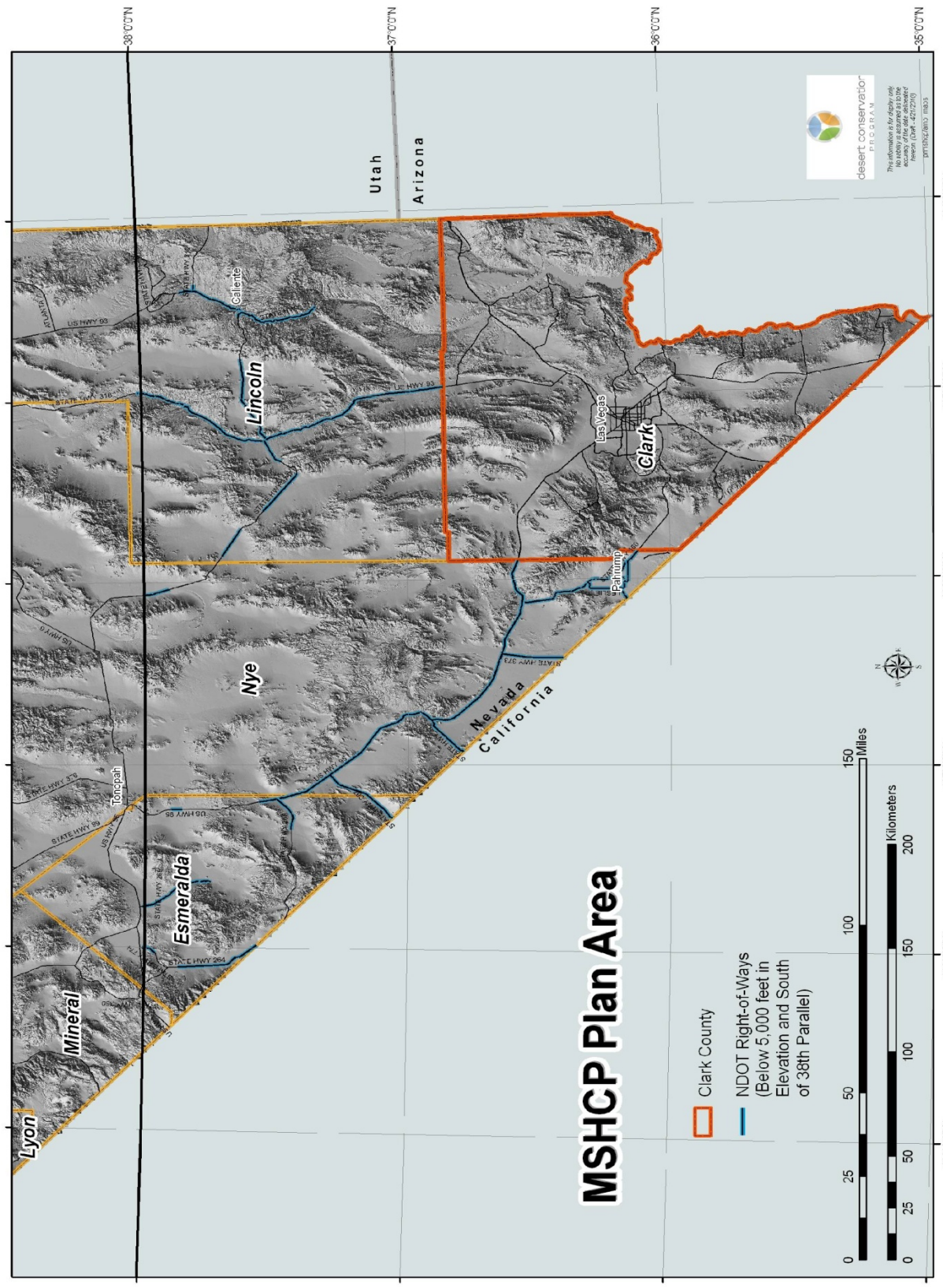
At the time the MSHCP was prepared in 2000, only the desert tortoise and the southwestern willow flycatcher (*Empidonax traillii extimus*) were listed under the ESA as threatened and endangered, respectively. The Mount Charleston blue butterfly (*Icaricia shasta charlestonensis*) and the western population of the yellow-billed cuckoo (*Coccyzus americanus*), both covered species, have since been listed as endangered (2013) and threatened (2014), respectively.

1.2.3 MSHCP Area

The MSHCP area where incidental take would be allowed encompasses non-federal lands in Clark County below 5,000 feet in elevation, and areas in Nye, Lincoln, Mineral, and Esmeralda counties south of the 38th parallel where Nevada Department of Transportation activities could occur. Non-federal lands include those in private, municipal (city and county), and state ownership. The plan area is shown in Figure 1-1.

The plan area also includes any federal lands within Clark County that may be designated by the federal agency, primarily Bureau of Land Management (BLM), for disposal and eventual transfer to non-federal ownership. The locations of these disposal areas are shown in Figure 2-1 in Section 2.2. The largest of the disposal areas is the Las Vegas Valley Disposal Boundary that encompasses BLM-managed federal land within the metropolitan area of Las Vegas, North Las Vegas, Henderson, and Clark County. Disposal areas may change over time via federal administrative or Congressional actions. The Las Vegas Valley

Figure 1-1. MSHCP Area



Disposal Boundary was modified in December 2014 by the legislation[1] that created the Tule Springs Fossil Beds National Monument. The pending 2016 revision to the BLM Resource Management Plan for the Las Vegas and Pahrump Field Offices could eliminate, add, or change the size of existing federal disposal areas throughout the county.

1.2.4 Goals and Objectives

The MSHCP established broad goals that focused on preventing loss and fragmentation of habitat on lands that are managed for resource protection, such as designated critical habitat or areas with significant undisturbed natural vegetation, for the benefit of stabilizing or increasing species population numbers. The broad objectives included maintenance of habitat values of ecosystems in Clark County for the recovery and conservation of covered species. These broad goals and objectives are being met by implementing management and conservation actions that address the key purposes of the MSHCP, as listed on the DCP website (http://www.clarkcountynv.gov/Depts/dcp/Pages/About.aspx):

- Achieve a balance between long-term conservation and recovery of the diversity of natural habitats and native species of plants and animals that make up an important part of the natural heritage of Clark County;
- Maintain an orderly and beneficial use of land in order to promote the economy, health, well-being, and custom and culture of the growing population of Clark County;
- Provide substantial recovery and conservation benefits to species and ecosystems in Clark County;
- Maximize flexibility and available options in developing mitigation and conservation programs;
- Reduce the economic and logistical burden of these programs on individual landowners and state and Federal land managers by distributing their impacts in a fair and effective manner;
- Reduce uncoordinated decision making, which can result in incremental habitat loss and inefficient project review;
- Provide the community with long-term planning assurances and increase the number of species for which assurances can be given; and
- Bring a broad range of activities under the permit's legal protection.

1.2.5 Budgets and Funds

The DCP is responsible for developing a biennial Implementation Plan and Budget that is responsive to key provisions outlined in the MSHCP. The general steps of the budget development process are to determine available funding and to identify and recommend management and conservation actions that further the purpose of the MSHCP. Actions that are stipulated by the Permit are required expenditures to maintain compliance and are therefore nondiscretionary. These non-discretionary actions include administering and managing the MSCHP implementation, supporting the Adaptive Management Program, managing the Boulder City Conservation Easement (BCCE), managing acquired riparian

[1] Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015, Public Law 113-219, December 2014.

properties and water rights, maintaining the tortoise fencing program along major roads, wild tortoise pick-up services, and the public information and education program. Other actions that further the goals and objectives of the MSHCP but are not directly specified in the Permit are considered discretionary.

The DCP collects and expends mitigation funds to implement management and conservation actions approved in each biennial Implementation Plan and Budget. The primary source of funds is the mitigation fees of $550 per acre (referred to as Section 10 funds) collected by the Permittees in conjunction with the review and approval of grading and building permits on non-federal land. Through the end of March 2015, approximately $41.6 million dollars in mitigation fees had been collected (Clark County 2015a).

Conservation actions are also funded with proceeds from the disposal of BLM-managed federal land in Clark County authorized by the Southern Nevada Public Lands Management Act. Mitigation funds collected by federal agencies (primarily BLM) from consultation actions on federal lands pursuant to Section 7 of the ESA had been used through the 2009 biennium to fund some conservation actions; however, the DCP no longer accepts Section 7 funds from federal agencies.

The DCP provides funding for conservation projects to various federal, state, and local agencies, academia, nonprofit organizations, and private contractors, in addition to projects implemented by DCP staff. Approximately $123 million has been expended or budgeted to manage and implement the MSHCP since the Permit was issued in 2001 through budget year 2017 (Clark County 2015b). Approximately $18.5 million was approved for the biennial budgets of 2011-2013 and 2013-2015 (Clark County 2015a) that closely cover the time frame addressed in this 2015 AMR.

1.2.6 Incidental Take Permit

An incidental take permit provides a streamlined process for complying with the ESA by eliminating project-by-project consultation and permitting for actions and development that occur on non-federal lands. The USFWS issued Permit TE34927-0 to the Permittees for a period of 30 years from January 2001 to January 2031. The Permit allows for the incidental take of 78 species from the development of up to 145,000 acres of non-federal land in the MSHCP area. The number of acres of permitted for take since January 2001 is described in Chapter 2.

The legislation that established the Tule Springs Fossil Beds National Monument provided a credit for the land conserved for the Monument toward the development of an additional 22,650 acres of non-federal land within the county through an amendment to the MSHCP. Based on the DCP's interpretation of the legislation, the Permit would now allow take of up to 167,650 acres of non-federal land.

1.2.7 Proposed Permit Amendment

Development in Clark County was occurring at a rapid pace during the early- to mid-2000s with incidental take (habitat disturbance) outpacing projections of the Permit. By 2007 more than 45 percent of the 145,000 acres of take authorized by the 30-year permit had been expended in less than 7 years.

Through March 2015, this amount had increased to approximately 90,800 acres or approximately 62 percent of the total permitted (Clark County 2015a).

Additional take authorization is needed to reduce the gap between what is currently permitted and the amount of land that is available for development in Clark County. The amount of federal land identified and proposed for disposal is greater than the total acres permitted for development by the MSHCP and Permit. These federal disposal lands together with non-federal lands available for development result in a gap of approximately 170,000 to 215,000 acres more than what is currently permitted.

The Permittees have determined that the MSHCP and Permit must be amended to address the acreage gap, to continue to guide orderly development within the County and secure long-term assurances that would provide for continued economic growth and opportunity. The primary goals for pursuing an amendment to the MSHCP and Permit include:

- Obtain coverage for acres that are not currently permitted for take.
- Reduce the number of species covered by the MSHCP to focus on those most at risk from and impacted by development.
- Revise the conservation strategy to improve mitigation effectiveness and accountability.
- Restructure the MSHCP to improve efficiency and reduce bureaucracy.
- Increase the permit term from 30 years to 50 years.

Further information on the permit amendment process is available on the DCP website at http://www.clarkcountynv.gov/depts/dcp/Pages/PermitAmendment.aspx.

1.3 Adaptive Management Program and Reporting

The MSHCP and Permit required the development of a science-based adaptive management process to ensure that management and conservation actions are reviewed for their effectiveness in the conservation of the 78 species and their habitats. A Memorandum of Agreement (MOA) was prepared between the federal land management agencies and Clark County (as the Plan Administrator) to address adaptive management and implementation of the MSHCP. The MOA set specific goals for the Adaptive Management Program that address status of species and habitats and effectiveness of conservation actions; monitor compliance with the Permit; and provide scientific information to balance with social, economic, and political factors to formulate budget recommendations (USFWS 2002).

The MSHCP and MOA required the Adaptive Management Program have an objective, science-based adaptive management contractor (i.e., Science Advisor) to provide an independent assessment of MSHCP implementation. 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 management and conservation projects, reports, and datasets and:

- Provide an analysis of land-use trends in Clark County to ensure that take and habitat disturbance is balanced with conservation (see Chapter 2).
- Provide an analysis of habitat loss by ecosystem type (see Chapter 2).

- Evaluate the effectiveness of management actions at meeting MSHCP goals of conservation and recovery (see Chapter 3 and Chapter 5).
- Review species status and assess population trends (see Chapter 4).

Although the MSHCP and Biological Opinion required biennial reporting in even-numbered years, it was mutually agreed between the DCP and USFWS via electronic mail and telephone conversations in 2012 to be flexible with this requirement (personal communication with Sue Wainscott, DCP Adaptive Management Coordinator, 2012). Because the pace of development and number of permitted acres had slowed significantly between 2009 and 2014, the DCP decided to delay reporting on the Adaptive Management Program until 2015.

2.0 LAND USE TRENDS: PERMITTED ACRES AND HABITAT LOSS

2.1 Introduction

The MSHCP uses permitted acres and habitat loss as the primary measures of "take" for covered species (Clark County 2000). Permitted acres have had the per-acre mitigation fee paid for "taking" habitat for development, and also included the 15,000 acres that were disturbed for community and local jurisdiction public purposes that were exempt from payment of the mitigation fee. Permitted acres are used to track the acres that have been developed and the remaining acres available for development under the MSHCP.

Habitat loss is determined from an assessment of disturbed acres and is used as a surrogate of assessing impacts on covered species, with the assumption that any disturbed ground results in the loss of habitat for covered species. Habitat loss is measured at the scale of the non-federal lands, federal disposal areas, ecosystems, and the county. Non-federal lands include lands in private, municipal (city and county), and state ownership.

This chapter summarizes the number of acres permitted and habitat loss that have occurred since the last assessment from fall of 2009 (Clark County 2010) and cumulatively since the initiation of the MSHCP in 2001. The assessment is structured by a series of questions about permitted acres and habitat loss (Clark County 2006, 2008, 2010). These assessment questions are:

- How many acres have been permitted for habitat loss?
- How many total acres of habitat loss have occurred?
- How many acres of habitat loss have occurred within non-federal lands and federal disposal areas?
- How many acres of habitat loss have occurred within each ecosystem?

The two questions that addressed habitat loss by management area categories in the 2010 AMR are not included in this assessment because the DCP no longer tracks or uses these designations.

2.2 Assessment of Permitted Acres

The data on permitted acres are provided monthly by each of the Permittees and are summarized in the Quarterly Administrator Update reports. This assessment used the data from the January through March 2015 update (Clark County 2015a). It is assumed that the data from the Permittees are accurate, complete, and up-to-date. Because project proponents are required to pay their mitigation fee prior to disturbing the ground, acres of habitat loss are expected to be less than permitted acres. Permitted acres are used to track the remaining acres available for development under the MSHCP.

Through the end of March 2015, there have been 90,768.94 acres permitted for development since 2001 (Clark County 2015a), which represents approximately 62 percent of the 145,000 acres allowed under the MSHCP. There are 54,231.06 acres remaining for development or disturbance through expiration of the Permit in January 2031. As discussed in Section 1.2.6, the establishment of the Tule Springs Fossil Beds National Monument provided for an additional 22,650 acres for non-federal land

development as an amendment to the MSHCP. The summary of permits from the Quarterly Administrator Update, January through March 2015 was matched against the same time frame of aerial imagery to compare results and assess habitat loss.

2.3 Assessment of Habitat Loss

2.3.1 Spatial Assessment Process

Disturbed acres resulting in habitat loss are assessed using spatial data. The initial 2001 disturbed lands dataset was compiled by DCP in early 2007. Disturbed lands were screen digitized using ArcGIS software from 2001 Clark County aerial imagery and 2000 and 2001 Landsat satellite imagery. Aerial imagery was used where available because of its higher resolution (1-foot). Aerial imagery is flown for urban and developing areas and covers approximately 20 percent of the county. Landsat satellite imagery (30-meter resolution) was used for areas not covered by aerial imagery and includes the rural areas of the county. Minimum mapping units were 2 acres for aerial imagery and 5 acres for Landsat imagery. Developed and vacant lands in the urban core and all agricultural lands were digitized as disturbed.

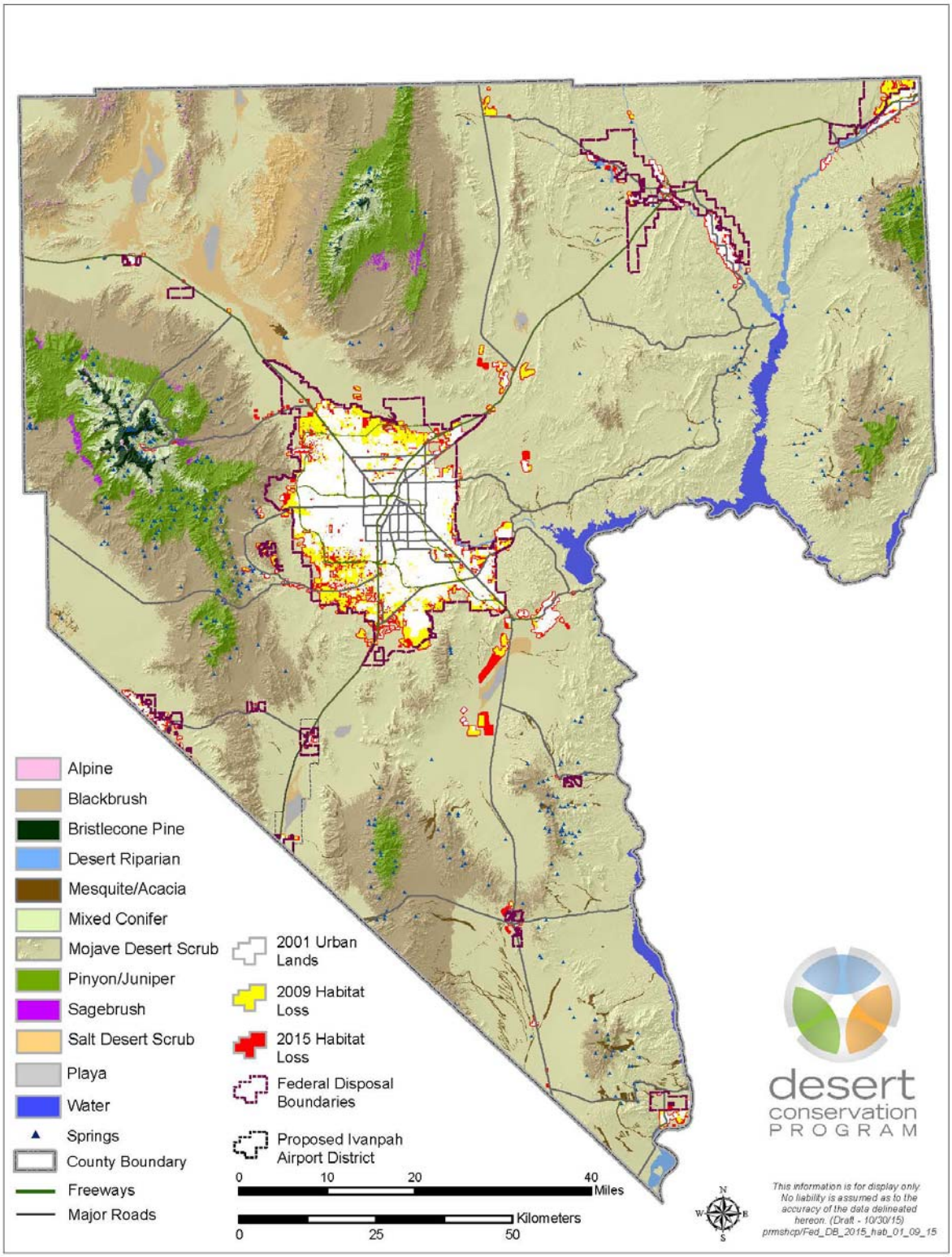
The 2009 dataset used a spring 2009 Clark County aerial imagery and 2006 National Agriculture Imagery Program (NAIP) imagery. Clark County imagery had a finer resolution (1-foot) and minimum mapping unit (0.5-acre) for disturbed acres within the urban core. The NAIP imagery had a 1-meter resolution.

The 2015 dataset used the 2015 Clark County spring aerial imagery, 2010 NAIP imagery, and January 2015 satellite imagery from Google Earth©. Clark County imagery had a 6-inch resolution and a 0.5-acre minimum mapping unit for disturbed acres within the urban core. New freeways and major roads within the urban core areas were added to the dataset. Solar, large gravel and mining operations, flood detention basins, and agriculture areas were added to the dataset outside of the urban core.

A new ecosystem map (Heaton et al. 2011) with updated disposal area boundaries was used for assessing disturbed acres by ecosystems (Figure 2-1). The original ecosystem map was developed in 2001 by RECON for the MSHCP and was used in previous AMRs. The new ecosystem map, using an advanced remote sensing classification method, edaphic data, screen digitizing, and field mapping has an overall better accuracy than the original map (87 percent versus 74 percent; Heaton et al. 2011). Additionally, the boundaries for the Las Vegas Valley Disposal Boundary have been updated. This disposal area was modified in 2014 by the establishment of the Tule Springs Fossil Beds National Monument. The data in Table 2-1 include these modifications.

The change in disturbed acres since the initiation of the MSHCP could not be assessed using the 2011 ecosystem map. The newer map included a single coverage of all disturbed acres before 2009. Combining all acreage disturbed before 2009 into one mapping unit did not allow the calculation or mapping of disturbed lands since the initiation of the MSHCP, which is an important measure for the Adaptive Management Program. To resolve this, an integrated ecosystem map was generated by DCP. The integrated ecosystem map for this assessment used the 2011 map of ecoregions (Heaton et al. 2011) but replaced the disturbed lands category with the 2001 mapping data from RECON. As a result, approximately 277,000 acres from the RECON 2001 ecosystem data was incorporated into the Heaton et

Figure 2-1. Locations of Habitat Loss, Ecosystems, and Federal Disposal Areas



al. 2011 dataset. Of the ecosystem categories merged into the 2011 dataset, 90 percent was Mojave Desert scrub, 5.5 percent was salt desert scrub, 3 percent was mesquite/acacia, and 1.5 percent was desert riparian.

With any spatial assessment, there are many sources that influence the areal estimate of any unit area, and in this case it is disturbed acres and ecosystem boundaries. These include:

- Resolution of aerial imagery: Clark County aerial imagery improved in resolution from 1 foot in 2001 and 2009 and to 6 inches in 2015.
- Resolution of imagery for rural areas: imagery improved from the 30-meter resolution of Landsat to the 1 meter resolution of NAIP imagery.
- Minimum mapping units for digitizing the aerial imagery: minimum mapping unit for digitizing improved from 2 acres to 0.5 acres.
- Mapping of disturbance and ecosystem features: gravel pits, flood control basins, and agriculture were added in 2009 and playas were added in 2015.

Other sources of change included the use of different geographic information system (GIS) software analysis functions, conversion errors when converting from square meters to acres, and updated datasets (e.g., a gain of approximately 16,000 acres is attributed to a new county border dataset of Clark County). There will always be differences in the datasets generated by different entities (Heaton et al. 2011) and as imagery improves.

2.3.2 Spatial Analysis of Disturbed Lands

Table 2-1 shows the results of the spatial analysis of disturbed acres of non-federal lands. This analysis provides a summary of disturbed acres from inception of the MSHCP in 2001 through March 2015, as well as a summary of disturbed acres since the last analysis provided in the 2010 AMR through March 2015 (2009-2015). Disturbed acres are assumed to be habitat loss. A total of 85,806 acres have been disturbed in Clark County between 2001 through the end of March 2015. As expected, the number of acres of habitat loss (as determined from spatial analysis) is less than the numbers of acres for which disturbance fees have been paid (90,768.04), since clearing of the land can take place any time after the disturbance fees are paid.

It should be noted that the baseline disturbance acreages for 2001 and 2009 have been recalculated since the last AMR (Clark County 2010). The previous AMR disturbed lands datasets for 2001 and 2009 inadvertently included federal disturbed lands and federal lease lands. These have been removed from the 2001, 2009, and 2015 disturbed land datasets and analyses. The federal disturbed and lease lands were determined by using the BLM Ownership GIS dataset (8/19/2014) and verified with Clark County OpenDoor property information. Additionally, since the last AMR (Clark County 2010), a higher-quality county aerial imagery was made available for 2001 as well as GIS-enhanced screen digitizing techniques. This allowed for further refinement of the 2001 baseline disturbed area dataset and resulted in an overall reduction of disturbed acres for the 2001 baseline. The revised baseline disturbed acres datasets for both 2001 and 2009 have also been applied to the analysis of habitat loss by ecosystem (see Section 2.3.3). Between removing federal lands and using more detailed

imagery than was previously available, these numbers should be more accurate to actual on-the-ground conditions than estimates provided in previous AMRs.

2.3.3 Habitat Loss: Ecosystems

The MSHCP tracks habitat loss by ecosystems as an assessment of the impacts of development (take) on the 78 covered species. There are 12 ecosystems described for Clark County. Figure 2-1 shows the spatial distribution of the ecosystems. Table 2-2 summarizes the acres of habitat loss by ecosystem for the time periods of 2001 to 2009, 2009 to 2015, and cumulatively from 2001 to 2015.

The majority of habitat loss since 2001 has taken place in desert riparian (1.5 percent), salt desert scrub (3.1 percent), mesquite/acacia (3.5 percent), and Mojave desert scrub (2.3 percent). These are the dominant ecosystems at low elevations and along watercourses where development has taken place. It should be noted that many of the projects implemented since the 2010 AMR have focused on conservation in the desert riparian and Mojave desert scrub ecosystems.

The decline, pattern of decline, and the effect of the new ecosystem map are discussed below for each ecosystem:

TABLE 2-1. Acres of Habitat Loss within Clark County

Areas	Total Acres	Acres Disturbed			Habitat Loss in Acres[3]			% of Total Acres		
		2001[1]	2009[2]	2015[2]	2001-2009	2009-2015	2001-2015	2001-2009	2009-2015	2001-2015
Non-federal Lands Disturbed		180,754	255,563	266,560	74,809	10,997	85,806			
Total Acres – Clark County	5,159,738							1.5%	.2%	1.7%

[1] Baseline [2] Cumulative; calculated by spatial analysis [3] Difference in acres disturbed between time periods

TABLE 2-2. Acres of Habitat Loss by Ecosystem within Clark County

Ecosystem	Total Acres	Acres Disturbed			Habitat Loss in Acres[3]			% of Total Acres		
		2001[1]	2009[2]	2015[2]	2001-2009	2009-2015	2001-2015	2001-2009	2009-2015	2001-2015
Alpine	306	0	0	0	0	0	0	0.0%	0.0%	0.0%
Blackbrush	1,027,144	1	593	630	592	37	629	0.1%	0.0%	0.1%
Bristlecone Pine	18,692	0	0	0	0	0	0	0.0%	0.0%	0.0%
Desert Riparian	27,717	3,005	3,389	3,425	384	36	420	1.4%	0.0%	1.5%
Mesquite/Acacia	50,008	5,546	7,051	7,274	1,505	223	1,728	3.0%	0.5%	3.5%
Mixed Conifer	67,556	31	33	37	2	4	6	0.0%	0.0%	0.0%
Mojave Desert Scrub	3,377,939	165,412	231,587	242,201	66,175	10,614	76,789	2.0%	0.3%	2.3%
Pinyon/Juniper	286,400	36	41	41	5	0	5	0.0%	0.0%	0.0%
Sagebrush	11,632	0	0	6	0	6	6	0.0%	0.1%	0.1%
Salt Desert Scrub	204,329	6,723	12,869	12,946	6,146	77	6,223	3.3%	0.0%	3.1%
Playa	19,180	0	0	0	0	0	0	0.0%	0.0%	0.0%
Water	68,835	0	0	0	0	0	0	0.0%	0.0%	0.0%
Total	5,159,738	180,754	255,563	266,541	74,809	10,997	85,806	1.5%	0.2%	1.7%
Springs[4]	512	16	19	20						

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

- ***Alpine:*** There was no change in alpine acreage during the time periods of 2009 to 2015 and 2001 to 2015. The new ecosystem map has a more accurate representation of this system by screen digitizing its boundaries, reducing its total acreage.
- ***Blackbrush:*** There has been a 0.1 percent decrease in the acreage of this ecosystem over the 14 years of assessment, with the majority of habitat loss occurring prior to 2009. The new ecosystem map increased the acreage of this system with more accurate mapping of the blackbrush, Mojave Desert scrub, and sagebrush ecosystems.
- ***Bristlecone Pine:*** There was no loss of acreage in this ecosystem over both periods of assessment. The new ecosystem map added acreage to Bristlecone Pine system from refined boundaries and the addition of two areas previously not mapped as Bristlecone Pine.
- ***Desert Riparian:*** Desert riparian has declined 1.5 percent since 2001 with a majority of the disturbance occurring between 2001 and 2009. Desert riparian covers 27,717 acres in the county and provides habitat for several of the rarest covered species. The new ecosystem map added acres to this system as a result of more accurate mapping and more developing riparian habitat as the shoreline of Lake Mead retreats.
- ***Mesquite/Acacia:*** This ecosystem declined by 3.5 percent over the last 14 years, with most of the loss occurring between 2001 and 2009. The new ecosystem map greatly increased the acreage of this ecosystem in the county, a result of field mapping.
- ***Mixed Conifer:*** There was no change in the acreage of this ecosystem over the period of assessment. The new ecosystem map added acres to this system as a result of more accurate mapping of its southern boundaries in the Spring Mountains and Sheep Mountains.
- ***Mojave Desert Scrub:*** This is the dominant ecosystem at lower elevations and throughout the county, consisting of 65 percent of the total acreage within the county. There has been over 75,000 acres of loss in this ecosystem since 2001, which is 2.3 percent of its total acreage. The majority of the loss took place between 2001 and 2009.
- ***Pinyon/Juniper:*** There was no change in the acreage of this ecosystem over the period of assessment. The small increase in acreage of pinyon/juniper is an artifact of the mapping process.
- ***Sagebrush:*** This ecosystem showed very little change over the period of assessment. The new ecosystem map greatly reduced the acreage of this ecosystem using a refined edaphic model. This ecosystem was over-mapped in 2001 because of the original GAP map of Nevada, while the current map probably underestimates its occurrence (Heaton et al. 2011).
- ***Salt Desert Scrub:*** This ecosystem showed the second largest change among the systems assessed, with a 3.1 percent change since 2001. The majority of this change took place during the first 8 years of the MSHCP and was located in the urban areas of the Las Vegas Valley.
- ***Playa:*** Playas were added to the 2015 ecosystem assessment, so there is no measure of change since 2001.
- ***Water:*** Water was added in 2015 to the ecosystem assessment, so there is no measure of change since 2001.
- ***Springs.*** Data on springs in Clark County are reported by spring location, not acreage. A geodatabase feature class compiled by the Environmental Protection Agency (Bradford and Cuartas, undated) provided the original data layer for aquatic resources in the county. This

included a wide range of water features, from natural springs to sewage disposal ponds. The DCP selected the categories of intermittent perennial springs, intermittent springs, marsh, perennial spring, perennial springs, spring, springs, springs and reservoirs, and streams to capture the different spellings of each type of spring. A spring was considered disturbed if any part of the spring vegetation or location appeared disturbed in the spatial assessment. There has been very little change in the disturbed status of this ecosystem during the period of assessment.

3.0 IMPLEMENTATION STATUS

3.1 Introduction

Status of the implementation of the MSHCP is reported to the public by different methods, including the Quarterly Project Report, Quarterly Administrator Update, Annual MSHCP Progress Report Symposium, and Biennium Progress Report. These reports provide a "big picture" view of management and conservation actions that implement the broad goals and objectives of the MSHCP. However, a function of the Adaptive Management Program is to determine if these management and conservation actions are effective at mitigating or minimizing the impacts of incidental take of species and habitat, and therefore, requires a more specific focus on tracking and assessment.

In the early years of establishing the Adaptive Management Program and the processes by which conservation and management decisions were made, projects were implemented and tools were developed to evaluate species and ecosystems and calculate land disturbance. Land disturbance was, and continues to be, used as a measure of habitat loss or take (see Chapter 2). The DCP has since evolved such that the evaluating the effectiveness of implemented management and conservation actions at meeting the MSHCP broad goals and objectives can be assessed through an adaptive management process (see Chapter 5).

This chapter evaluates the two primary tools, management plans and a database, which DCP uses to track the implementation of conservation and management actions, along with how these tools can assess the effectiveness of actions in meeting the broad MSHCP goals of conservation and recovery.

3.2 Management Plans

Management plans for the reserve units identify actions needed to restore, protect, and conserve species covered by the MSHCP. These plans explicitly link management actions to the conservation goals and objectives, establish overall management direction, and clarify priorities and management responsibilities. They serve as a guide for day-to-day activities, compile the primary information on the reserve unit in one document for easy access, and define future discretionary and non-discretionary actions to achieve desired conditions. Additionally, management plan set the stage for measuring effectiveness and implementing adaptive management. Overall, management plans identify and track the implementation of the MSHCP conservation actions.

Since the 2010 AMR, management plans have been prepared for the reserve units of the Boulder City Conservation Easement and the Muddy River and Virgin River riparian properties. The plans were completed in early 2015 and are available on the DCP web site at http://www.clarkcountynv.gov/depts/dcp/Pages/default.aspx.

This section reviews the current status of management actions, day-to-day use of the plans in the management of the reserve units, updating the plans, and incorporation of the plans into quarterly reporting. It also reviews efforts to implement effectiveness monitoring of management actions.

3.2.1 Review of Management Actions and Updates to Management Plans

The management plans were released in early 2015; however, there are sections of each plan that already should be updated. The BCCE plan does not reflect the recent translocation of desert tortoises to the reserve or the subsequent translocation monitoring study. Additions to the text and table of management actions should refer to the specific study designs developed for each project. Additionally, any actions reported in quarterly reports should be included in the management plan; for example, the periodic review of the BLM LR2000 land use authorization system for new right-of-way applications that could affect the BCCE.

The riparian reserve unit plan does not reflect the changes in management actions due to property damage sustained from large 2014 and 2015 flood events along the Muddy River and Virgin River. The Muddy River floodwaters damaged the groundwater source to Perkins Pond, expanded the floodplain below the pond, and interrupted habitat restoration activities in Parcels A, B, and E. The flooding provided an opportunity to reassess the relict leopard frog restoration project and develop a new habitat restoration project in the area below Perkins Pond. In addition to flooding, other access and safety issues have restricted monitoring and further restoration at the Virgin River 1 site. The staff vacancies have postponed many management actions.

Updating both plans would require additions to the management action tables and additions to the text, with more effort anticipated to update the Riparian Reserves Unit Management Plan to address the changes due to the flooding damage.

Recommendations

The current schedule of reviewing and revising management plans, as necessary, every two years in conjunction with the Implementation Plan and Budget process is adequate. However, the plans should include guidance as to what would trigger an interim update. Management plans should be updated when significant new information is available that modifies or adds to the list of management actions, including new projects (e.g., translocation, restoration), significant changes in ecological condition (e.g., flood, fire), changes to internal and surrounding land use (e.g., solar facilities, right-of-ways, roads), and when additional properties are acquired. Consistent terminology should also be used to describe the maintenance and revision of management plans, to ensure clear communication of intent. Proposed terminology includes:

- Review: scheduled quarterly with the completion of the quarterly report, assessing only the action table and making recommendations for updates.
- Update: editing of selected components of the plan, including the action table and limited sections of the text.
- Revise: reviewing and editing all components of the plan on a two-year schedule.

A specific DCP staff position and/or person should be assigned the responsibility for reviewing, updating, and revising each management plan, with assistance from the Science Advisor Panel.

3.2.2 Incorporate Management Plans into Quarterly Reports

Science Advisor had noted that many of the activities that were occurring on the BCCE and reported on quarterly tracked closely with the management actions listed in the plan. While the plans are not used specifically as guides for the day-to-day activities on the reserve units, staff is implementing the management actions in the plan. To increase the use of the management plans based on this observation, DCP staff have begun linking the management actions to the quarterly reporting for each reserve through use of a Management Actions Tracking Table. The quarterly reporting of activities on the BCCE and riparian properties now ensures frequent review of the goals, objectives, and management actions for these reserve units. The tracking tables for the BCCE and Riparian Reserve Units can be viewed at http://www.clarkcountynv.gov/depts/dcp/Pages/CurrentProjects.aspx.

3.2.3 Review Priorities of Management Actions

A review of the management actions for the BCCE and Riparian Reserve Units shows that the majority of actions are prioritized as high, as shown in Table 3-1. The management plans established a qualitative priority ranking based on the importance of the action in meeting the management objective.

TABLE 3-1. Number of Management Actions by Priority

Reserve Unit	Priority			
	Very High	High	Medium	Low
BCCE	6	31	11	0
Riparian	4	25	5	0

Whether the higher priority management actions are an issue depends if the resources are available for implementation, including funding and staffing. Most of the very high or high priorities have an estimated low to medium cost (<$50,000) to implement. Discussions with the BCCE manager suggest that prioritizing actions to implement was not an issue since progress was being made on the majority of management actions across all objectives. However, as the program continues, and particularly with the possibility of additional reserve units to manage and fluctuations in funding, refined priorities should lead to better management decisions. For example, restoration of vegetation on a closed road, spatially covering less than 0.001 percent of the BCCE may not be a high priority for the objective of restoring and enhancing habitat for the desert tortoise.

Recommendations

The DCP should consider using the qualitative ranking to establish a criteria-based matrix based on the management objectives for reviewing and (re)assigning priorities to management actions, and for projects that fulfill specific actions. It is envisioned that a matrix would be in a context similar to what DCP developed for acquiring riparian properties. Development of a criteria-based matrix prior to the 2017-2019 Implementation Plan and Budget and revision to the management plans should be the goal.

3.2.4 Implementation of Effectiveness Measures

Effectiveness measures are metrics that assess whether a management action is successful or achieving its intended outcome. Effective measures can range from an informal qualitative assessment to a detailed quantitative assessment; the later overlaps with the concept of adaptive management. This assessment focuses on informal effectiveness measures, ones that should be addressed for the majority of management actions. Effectiveness measures for the BCCE management actions, for example, address questions such as:

- Is there less trash?
- Are there fewer invasive species?
- Are tortoise fences, road crossing guards, gates, and culverts repaired?
- Is law enforcement reducing prohibited uses?

In addition to the ability to assess the effectiveness of an action, effectiveness measures provide the basis to assess the return on investment (cost to obtain an outcome) and adapt future management actions, such as reduce law enforcement presence, or use a stronger grade of fencing. Effectiveness measures and the frequency of measurement are listed for each of the management actions in the plans.

Recommendations

The DCP has been inconsistent in measuring the effectiveness of management actions or integrating the results into the reporting on management actions. An annual summary of effectiveness measures, similar to the quarterly reporting, should be included with the tracking table for each management plan. The annual summary should include fields for the effectiveness measurement used (e.g., number of citations, survivorship success rate of plants in restoration project), selected measurement time period (e.g., monthly, annually), results of the measurements (e.g., a listing of the number citations over the selected time period, success rate or percent cover), an interpretation of the results, and recommended actions. This review of effectiveness would best be completed by the DCP staff assigned to the reserve unit, with assistance and oversight by the Adaptive Management Review Team.

3.3 Implementation Database

The 2010 AMR described the history of the development of an Implementation Database that was to compile data on projects implemented to address the achievement of MSHCP goals and objectives. The initial objective of the database was as a mitigation action status tracking system to "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 objective was refined and the resulting fundamental purpose changed to a tool to identify, track, and account for implemented mitigation activities (Clark County 2008).

A database is only as useful as the data entered. At the time of the 2010 AMR, the Implementation Database was running in Microsoft Access®. Since this was the second or third upgrade to the initial

database, many records did not convert fully to Access®, and the upgrade had data fields not included in the initial database which meant these fields were empty of older projects. Additionally, many of the data fields were already being entered in the DCP's contracting and financing tracking systems, which created a duplicate effort and opportunity for mistake in tracking the same project. Together with a not-so-smooth upgrade to a newer version of Access®, maintaining the Implementation Database became a low priority within the DCP.

The DCP recently finished the conversion of the Implementation Database from Access® to a web-based format available internally to the DCP Senior Biologist/Adaptive Management Coordinator. Converting to a web-based format addressed the recommendation listed in the 2010 AMR pertaining to text versus integer data fields for sorting; otherwise, the conversion basically mirrored the data fields that were in Access®. The DCP staff has been working on the backlog of project data from approximately the last two years and updating older project records.

The Adaptive Management Coordinator created a Project Metrics Form in Microsoft Word® for project managers to complete for ongoing and future projects to assist with maintaining the database. The form has the same tabs (metrics) as the database, including spatial overlay, habitat restoration, water rights, tortoise data, public outreach, and law enforcement as some examples. Each metric is subdivided into further details, such as acres of habitat restored, number of tortoises translocated, and number of miles patrolled as some additional examples.

The web-based database format includes the fields that represent the MSHCP "elements" of species, ecosystems, threats, and conservation actions. As was described in the 2010 AMR, many elements and sub-elements were checked by project proponents as applicable to a project to facilitate approval and funding, regardless of the tenuous connection between project and element. Acknowledging the shortcomings of the database based on past data entry, it remains a useful tool by which to tally certain statistics and measurements.

The practice of relying on project proponents to determine the applicability of a project to a conservation action or addressing a species or habitat threat has long since ended. This information should now be addressed in a project scope or study design with specific project goals and objectives (see Section 5.2), so that future data queries from the Implementation Database can be used in conjunction with the adaptive management review to better assess the effectiveness of projects in implementing the MSHCP. The DCP Adaptive Management Coordinator has access to and the responsibility for entering project data into the "elements" part of the Implementation Database.

Recommendations

The expectations of an implementation database have changed since its conception as a tool that would be responsive to the tasks outlined in the Biological Opinion (see Section 1.3). However, with the recent web-based conversion and anticipation of clearing the project backlog for data entry, the Implementation Database will likely be the best available information to use in evaluating and negotiating an amendment to the Permit. The advantage of an Access® database is its capability to create queries of different data fields to analyze the data from different perspectives. As currently

configured, the web-based Implementation Database can provide “linear” data from the different matrices, elements, and sub-elements. For example, the miles of tortoise fencing can be reviewed, but this data cannot be combined or overlapped with any other matrix or data field for combined or intersecting review of the results. The DCP should consider improving the functionality of the database to create queries from more than one matrix or tab, similar to the functionality of an Access® database.

The Adaptive Management Coordinator should permit access to the database for DCP project managers or support staff to enter project data from the Project Metrics Form after review and approval by the Coordinator. The time and effort needed for data entry may best be focused on other aspects of the Adaptive Management Program.

4.0 STATUS AND TRENDS OF COVERED SPECIES

4.1 Introduction

The MSHCP directs the DCP to monitor the status and trends of covered species and their habitat to prevent loss or fragmentation of habitat within priority lands for the benefit of stabilizing or increasing population numbers within Clark County (Clark County 2000, USFWS 2002). No quantitative goals were established at the initiation of the MSHCP, but were to be developed over time through surveys, monitoring, and adaptive management.

Over the term of the MSHCP, the DCP has funded many projects to assess the status and/or trend of covered species. In addition, data obtained from other sources such as federal and state agency partners (National Park Service, Nevada Department of Wildlife, and Nevada Natural Heritage Program) and resource organizations (Great Basin Bird Observatory) report on the occurrence and condition of covered species populations.

This chapter describes the revisions made to the Species Status Database since the 2010 AMR, outlines options for measuring the status and trends of covered species, and makes recommendations for status and trends monitoring for the proposed permit amendment.

4.2 Species Status Database

A Species Status Database was developed in 2009 "to assess the temporal and spatial changes in abundance and distribution" of covered species (Clark County 2009a). The database had the "aim of calculating quantified population metrics capable of providing statistical summaries (such as means and standard deviation) over a period of several years, from which a measure of population trend could be generated" (Clark County 2009a).

A review of the Species Status Database found that it fell substantially short of its objective, in both the design of the database and the quality of data available to assess species (Clark County 2010). The core premise of the database was flawed because the summary of population trends did not provide information on how the data was collected and whether it was collected consistently. The same monitoring design needs to be used every sample period to be able to make comparisons. Monitoring design issues that need to be considered include the monitoring data that comes from the same geographic location, the monitoring method is consistent, and the concept of the individual counting unit is the same (McEachern & Sutter, 2010).

Additionally, available data to assess status and trend had many internal problems (Clark County 2011b, 2011c, 2012). The most common were data entry error, incomplete data entry, and lack of sufficient metadata. Various discrepancies and inconsistencies were identified, including mismatched information between the report and the data related to the report. Despite these problems, there were approximately 60,000 records available to populate the database with useful information for future conservation planning in Clark County.

As a result of the review, the DCP funded the Science Advisor to reassess the database (Clark County 2011b, 2011c, 2011d, 2012). The Species Status Database was redesigned and populated in 2011 and 2012. The purpose of the Species Status Database was revised from assessing changes in abundance and distribution to identifying datasets that can be used to assess trends in species status. Thus, the database is a catalogue of monitoring information that can be accessed to assess species status.

The new database was populated with data from 71 sources, including all project reports funded by the DCP since the inception of the MSHCP and submitted before 2012, and several local and state databases, including Clark County occurrence records maintained by the Nevada Natural Heritage Program. The final version of the database has 107,000 records of species of concern to the MSHCP. Each record is for one location of a species and includes population and/or site name, locational data by x and y UTM coordinates, the source of the data (both report and surveyor), monitoring methods, monitoring data, and environmental data, all entered when available. The three project reports (Clark County 2011b, 2011c, 2012a) for the database provided summaries of each of the 71 sources of information.

The database retains its value as a catalogue of monitoring information from past DCP projects. Only a few of the projects that have been funded in recent years have collected data are appropriate for this database. While tracking the status and trend of covered species may use a new approach with the proposed permit amendment, the Species Status Database will be valuable for those species that are covered under both the original MSHCP and the amended permit.

4.3 Tracking Status and Trends

As mentioned in the introduction, the MSHCP explicitly directs the DCP to monitor the status and trends of covered species and their habitat. Tracking the status and trends of species and/or their habitat is common to all HCPs (Federal Register 2000).

There are many methods of tracking the status and trend of a species, habitat, or an ecological system, each providing different types of data that have different levels of accuracy. How each of these methods is implemented also determines their precision and accuracy. The following is a summary of some primary methods of tracking status and trend, illustrating that there is a range of methods that can be used to meet this goal.

4.3.1 Using Ecosystems and Habitat as Surrogate of Species Status and Trend

4.3.1.1 *Habitat Loss in Ecosystems*

The method of using undisturbed habitat within ecosystems as a surrogate for the status of species is the current method used by the DCP to assess status and trends of MSHCP covered species. The method uses a map of ecosystems, a cross reference of covered species by ecosystems, and remote sensing to measure disturbed lands within each ecosystem. Currently, the DCP maps disturbed lands from aerial imagery with a 0.5-acre minimum mapping unit.

This method assumes a one-to-one relationship between the status of species and the condition of the ecosystem, such that if disturbed lands increase in an ecosystem the associated covered species decline. The primary assumption of this method has many weaknesses. It does not take into account that the presence and distribution of species are determined by specific abiotic (aspect, slope, elevation, soil type, and availability of water), biotic (habitat quality, habitat structure, food sources, predators, historic land use, and historic take [hunting, trapping, collecting]), and landscape conditions (fragmentation, corridors, edge effect). Thus species are not uniformly distributed in an ecosystem. The quality of assessment is also determined by the accuracy of the ecosystem map and the correct assignment of species to ecosystems.

4.3.1.2 *Loss in Predicted Habitat*

This method uses predicted habitat as a surrogate for the status of covered species. Models are developed for each species, correlating the presence of known population occurrences with a suite of environmental variables. The principle steps of developing a species distribution model are compiling and processing species distribution and environmental data, selecting the modeling algorithm, and testing model performance. Resolution of imagery, the completeness and accuracy of presence data, and the selection of the modeling algorithm affect the accuracy of the predicted habitat.

This method also assumes a one-to-one relationship between species and habitat, and that modeling of appropriate habitat is interpreted as the species being present. Several issues affect its accuracy, including the population data used to build the habitat data is representative of the species throughout its range in the area being modeled, and that the environmental data is accurate and available throughout the range of the species. The assumption works well in cases where a species has high fidelity to a specific, easily mapped habitat type (e.g., riparian birds and riparian vegetation, Phainopepla and Mesquite/Acacia). In other cases, the assumption does not work well. While this method does model many of the abiotic and biotic factors above, it still does not include the effect of food sources, predators, historic land use, and historic take.

The DCP has recently initiated a contract to develop species accounts and species distribution models for a suite of species being considered for the proposed permit amendment. Developing a detailed species distribution model of desert tortoise is the goal of the ongoing occupancy and covariate monitoring projects.

4.3.2 Monitoring Populations to Assess Species Status and Trend

4.3.2.1 *Presence or Absence of Populations*

Presence/absence data is a one-dimensional measure of a population that only provides information on whether a population is present or not. This method does not provide any data on changes in population size, spatial distribution, or demographic condition. It has no anticipatory value for a population's status, whether it is declining or increasing in size or condition.

This method assumes only that the population is present, nothing about its size or condition. It is sensitive to changes in the number of populations of a species and can reflect changes in species distribution, habitat preference and use, and other spatial aspects of a species.

Comprehensive species data are not available in most planning areas and is expensive to acquire (Albuquerque and Beier 2015). The location of every population of a species is rarely known, especially for species that do not have very specific habitat requirements or the requirements are unknown, and thus, the populations that are visited for presence/absence are usually not representative of the whole species range. There are also issues of species identification (visual or sound) and detectability (visible when surveyed). Both need to be maximized in any efforts to monitor populations, difficult when regional program obtain data from multiple sources and investigators.

Presence/absence is valuable when used in combination with habitat monitoring, in situations in which habitat is easy to map but the species is difficult to monitor. Riparian habitat and riparian bird species is an example. Presence/absence is a verification that the species of concern occurs in the habitat.

4.3.2.2 *Qualitative Estimate of Population Size and Vigor*

This method extends presence/absence data to include a qualitative estimate of the number of individuals in a population and, in some cases, the condition of those individuals. Numbers and condition (flowering, size, nesting, fledglings) are determined by surveying the whole population. The method does provide a whole population assessment.

This method has the potential of numerous non-sampling errors, including the influence of the investigators on the data. These include the ability to accurately estimate numbers, surveying in all the same areas, and being able to identify and detect the species. Natural Heritage Programs and NatureServe have developed methods to minimize non-sampling errors when surveying populations. The same issue of representation of all the populations in a species range holds for this method.

4.3.2.3 *Spatial Extent of a Population*

Measuring the spatial extent of a population, with a sub-meter global positioning system (GPS) unit, can provide precise quantitative data to assessing change over time. A careful survey of the population is required because boundaries are difficult to determine when numbers are at low densities or are patchily distributed. This method is appropriate for species whose populations vary in number from year to year, where spatial extent of the population and its habitat is more precise an estimate of trend than population numbers.

The assumption of this method is that the spatial extent reflects the status of the population. At low relative population densities, changes in population size can be reflected in the spatial extent of the population (Elzinga et al. 2001). This method is limited in that it does not provide data on the numbers and condition of the population. For example, a large population can greatly increase or decrease in numbers before these changes are indicated by the spatial extent of the population.

Occupancy sampling, as is being tested by the Occupancy Sampling Pilot Study for the BCCE, also provides an assessment of the spatial extent of a population using randomly placed plots.

4.3.2.4 *Quantitative Estimate of Population Size and Vigor*

There are several methods that can be used to assess a population's size and vigor. A complete count can be done when a population is relatively small, and when species populations are small. If the counting is done well, the population size is accurate and absolute changes in the population can be assessed. No statistics are needed. This type of monitoring has often been called a census, but that term has multiple and confusing meanings.

A statistical estimate of a population is obtained when populations are too large to count every individual and instead samples are taken of the population. The sample is used to estimate, or infer, the total population size and condition of the population. Sampling requires a sound sampling design and a statistical analysis to obtain the estimates. The sampling design needs to define the statistical population and determine the appropriate size and shape of the sample unit, how to randomly allocate sample units, the number of sample units required for a selected level of precision, and the frequency of sampling. This is a common method of assess status and trends, yet one that is often poorly done. Line-distance transects used to sample desert tortoise populations are an example of sampling to infer population size.

For both of these methods, being able to identify the species and its detectability need to be considered.

4.3.2.5 *Use of Indices to Estimate Population Size and Condition*

For many plant and animal species, estimating absolute abundance of a population is extremely time-consuming and expensive (Elzinga et al. 2001). Index sampling uses a nonrandom sample to assess population condition, but cannot be used to infer or estimate the total numbers of individuals or their condition in a population. Rather, the data from an index sample is used to extrapolate conditions of the whole population. At a species scale, non-randomly selected populations are surveyed, with those conditions extrapolated to all the populations of the species in the area of interest.

The assumption of index sampling is that the non-random sample approximates the condition of the whole population or species range. Its reflection of the whole population or species range depends on the representativeness of the sample, a condition that can be improved but is ultimately unknown.

For wildlife species, there is a substantial use of indices of animal abundance as a surrogate (Elzinga et al. 2001). An index is any measurable correlative of density. These indices include track densities, scat, and counts of singing birds.

4.3.2.6 *Demographic Assessment of Population*

Demographic monitoring follows the fate of individuals in populations over time and space. The data include estimates of survivorship, mortality, and reproduction for specific age or size classes of individuals. The data can be used to forecast the future state of the population and identify

components of the life history that most influence population size over time. Examples of following the fate of individuals include placing tags on desert tortoises, banding individual birds, placing tags on or in the location of a plant species, and GPS coordinates on nests.

Demographic monitoring is expensive and time-consuming. It requires long-term data collection for any species, especially for species that fluctuate in size over time or are long-lived. Some life stages of a species are very difficult to obtain data on. This method requires a high level of expertise for implementation and a sound sampling design to insure precise data when sampling a population.

4.4 Recommendations

Assessing the status and trends of covered species is a core directive of the MSHCP. Currently, status and trend are primarily assessed through habitat loss in ecosystems, and for a few species by the qualitative or quantitative monitoring of populations.

Science Advisor recommends that DCP develop a structured approach to select the most appropriate method for each covered species under the proposed permit amendment. One method of assessing status and trend does not fit all species. To determine the most appropriate method, criteria need to be developed to assess both the priority of the covered species and a feasible method for assessing status and trend. The priority of a covered species could include criteria based on legal status (a federally listed species would be a high priority), historic decline, current population numbers and sizes, uncertainty about status, and stakeholders' interest. Feasibility could be based on characteristics of the species biology (detectability, difficulty in identifying, number of populations) and location (type of habitat and accessibility of populations). Science Advisor recommends that the assumptions of the methods selected be explicitly communicated in summaries of status and trends.

5.0 IMPLEMENTING ADAPTIVE MANAGEMENT

5.1 Introduction

The MSHCP explicitly directs the DCP to use an adaptive management approach to gauge the effectiveness of management practices and conservation activities (USFWS 2002). The Adaptive Management Program (AMP) within DCP was established to implement the adaptive management process, specifically developing a science-based program to: (1) monitor the status of species, habitats, and the environmental factors, including threats; (2) monitor and evaluate the effectiveness and efficiency of conservation and management actions; and (3) recommend modification of management practices and conservation strategies (USFWS 2002).

Past AMRs have reviewed specific tools and databases developed to build an adaptive management program, including:

- Species Status Database to assess the temporal and spatial changes in the abundance and distribution of covered species (Clark County 2009a, 2009b; see Section 4.2).
- Implementation Status Database to track tangible products and other outcomes of implementation activities (Clark County 2008; see Section 3.3).
- Conceptual models for 11 ecosystems to understand the ecological processes that maintain habitat for covered species (Clark County 2008).
- Decision-support system to make project level recommendations for planning (Clark County 2008).
- Recommendations on the implementation of adaptive management within the context of the MSHCP (Clark County 2010).

None of the previous AMRs reviewed the actual implementation of adaptive management. At the time there were few projects that had been designed within an adaptive management context and no projects had collected enough data to warrant an adaptive management review. This illustrates that conservation programs have to evolve to a point to actively implement adaptive management, to develop projects that collect enough data about management that then can be reviewed, lessons learned, and management adapted. The DCP has evolved to a place where an assessment of their implementation of adaptive management can now be assessed.

There is a range of definitions for adaptive management (Williams and Boomer 2012, Runge and Knutson 2012, Williams et al. 2009). The key components of these definitions are that adaptive management:

- Is a framework for management.
- Recognizes the uncertainty about management results.
- Is an iterative decision-making process.
- Learns through the process of management.

- Improves management based on learning.

As described in the 2010 AMR, a broad definition for adaptive management is more functional for a multi-jurisdictional HCP. The narrow definitions of adaptive management put its implementation out of reach of the great majority of land management agencies and land managers.

Adaptive management is defined as a structured and sequential learning process that increases knowledge and reduces uncertainty, iteratively leading to improved and more effective programmatic, management, and conservation decisions. As a learning process, adaptive management uses the best available information to understand how a species or system works, through development of conceptual ecological models and results of management data. As an action tool, adaptive management allows the implementation of management actions in the context of uncertainty. As a results tool, adaptive management leads to more effective, efficient, and enduring programmatic, management, and conservation actions.

While this interpretation of adaptive management is broad, it does not mean that an adaptive management approach is appropriate for every management situation (Runge and Knutson 2012). Adaptive management is best used for more formalized, quantitative assessments of management in conditions where: (1) measurable objectives can be established; (2) management options exist; (3) scientific uncertainty about the selection and outcomes of management options is significant and the value of reducing it is high: (4) consequential decisions are necessary for the future of the species or system; (5) there is an opportunity to learn; and (6) a monitoring system can be established to assess outcomes and learn (Runge and Knutson 2012, Clark County 2010).

A disputed issue surrounding the definition of adaptive management is the difference between active and passive adaptive management and the value of passive adaptive management. Active adaptive management is defined as the simultaneous implementation of two or more management options, structured by an experimental design, to test competing hypotheses about management impacts (Lawson et al. 2013). The focus of active adaptive management is on learning, to understand the causal factors for management responses, and selecting the most appropriate management option. Active adaptive management requires more planning and coordination. Active adaptive management is the explicit focus of most adaptive management papers (Lawson et al 2013).

Passive adaptive management is defined as using the best available science and management data, selecting and implementing one management option, assessing management results, and adapting management. Different management options are applied sequentially over time, if earlier options do not meet management objectives. Learning through passive adaptive management is slower than the experimental design of active adaptive management, and in some instances, could be too slow to determine an appropriate management regime in the context of changing conditions. Passive adaptive management is widely used, often due to geographic (unable to test multiple management options within the management area) or resource (unable to fund or staff a more complex experimental design) limitations.

Unfortunately, the scientific literature projects a negative opinion of passive adaptive management, using phases such as learning as a bi-product of management, learning is a useful but unintended consequence of management, lacks scientific rigor, and reactive management (Williams and Boomer 2012). Even the use of the adjective passive is prerogative.

Rather than restricting the concept of adaptive management, effort should focus on maximizing learning and improving management no matter what form of adaptive management is implemented. Passive adaptive management learns at a slower pace, but learning is an outcome. This type of adaptive management still needs to establish objectives, select management options, record assumptions, monitor the outcomes of management, and communicate results. With multiple passive adaptive management projects, meta-analysis can provide enhanced learning.

Active adaptive management is not being implemented by the DCP. Rather, most projects (Virgin River restoration projects, Muddy River restoration projects, invasive species control in both reserves, and desert restoration projects in the BCCE) are using a passive approach. The potential does exist for several active adaptive management projects in the future, such as testing different riparian restoration options within and across floodplain properties in the Virgin and Muddy Rivers and testing different seeding methods for the restoration of roadways in the BCCE.

The purpose of this chapter is to review the implementation of specific components common to both active and passive adaptive management across a range of projects and the DCP as a whole, and make recommendations to further the implementation and integration of adaptive management in the program.

5.2 Assessment of Projects

Six projects currently implemented by the DCP were reviewed for their incorporation of an adaptive management approach, including:

- The BCCE Management Plan focusing on habitat restoration and law enforcement (Clark County 2015c).
- Occupancy Sampling Pilot Study (Clark County 2011).
- Covariates Monitoring Project (Clark County 2012).
- BCCE Desert Tortoise Predation Study Phase 2 (Boarman 2015).
- Eldorado Valley Translocation Project (Clark County 2013).
- Virgin River Riparian Vegetation Restoration Project (Stillwater Sciences 2013).

These projects span a range of planning and implementation scenarios, with some addressing complex management issues, some designed by the Science Advisor and others by contractors, and some implemented under the close oversight of DCP staff, while contractors primarily implement others.

The assessment is structured around the three components described in the following sections – structured decision-making; management and monitoring; and communicate, share, and preserve. This

assessment is expanded and structured differently than the six-question approach used in the 2010 AMR. The changes were made based on the literature and personal experience of the Science Advisor.

5.2.1 Structured Decision-Making

Structured decision-making is a structured application of knowledge and common sense to determine potential solutions for complex problems (Runge 2012). There are five steps to structured decision-making: (1) define the problem; (2) select objectives; (3) determine actions; (4) model consequences; and (5) assess trade-offs (Runge 2012). Structured decision-making is used here to include the selection of priority projects and development of focused objectives. The specific questions asked for this assessment are:

- Have DCP projects focused on priority covered species and/or ecosystems?
- Have DCP projects addressed information needs that will improve management decisions?
- Has the DCP developed focused objectives for each project?

The DCP does focus projects and funding on priority covered species and ecosystems. The majority of projects address federally-listed species, including the Mojave desert tortoise (BCCE habitat restoration and law enforcement, Occupancy Sampling Pilot Study, Covariates Monitoring Project, BCCE Desert Tortoise Predation Study Phase 2, and Eldorado Valley Translocation Project), and the southwestern willow flycatcher and yellow-billed cuckoo (Virgin River riparian vegetation restoration projects). Funding was also provided this year for habitat restoration for the Mount Charleston blue butterfly, a federally-endangered species. The majority of funding in the 2015-2017 Implementation Plan and Budget is dedicated to these species. Projects restoring Mojave desert scrub and riparian vegetation also positively impact other covered and rare species.

The program also has addressed informational needs that will improve management decisions, including the priority management issues for habitat restoration, translocation, tortoise fences, and the effects of predators for the Mojave desert tortoise; and habitat restoration for the southwestern willow flycatcher and yellow-billed cuckoo. The management plans describe priority management actions in the BCCE and riparian reserve units. The program has not developed conceptual ecological models or threat assessments (TNC 2007) for most of these species or projects to provide structured assessment into priority management issues. All ongoing projects have focused objectives.

Some agencies and organization spend much of their resources on the planning stage (Moir and Block 2001). This is not an issue with the DCP as the focus has been on actively managing the reserve units.

5.2.2 Management and Monitoring: Plan, Collect, Analyze, Manage, and Improve

The core components of adaptive management are represented by the four phases of the commonly published adaptive management cycle of plan, act, monitor, and adapt (Montambault et al. 2015, Larsen et al. 2013, Williams et al. 2009). The cycle links planning and data collection to adapting and learning. The specific questions asked for this assessment are:

- Are DCP projects designed to effectively, precisely, and efficiently answer project objectives?
- How does DCP ensure that the data collected for projects are accurate, repeatable, and correctly managed?
- How does DCP ensure the repeatability and understanding of the analysis routine?
- How does DCP manage data from projects?
- How does DCP learn and adapt from the results of management?

Examples of DCP projects that have study designs that are responsive to the questions listed above include the Occupancy Sampling Pilot Study, Covariates Monitoring Project, and the Eldorado Valley Translocation Project. These three projects have study designs that document:

- Background on the species, study area, sampling method
- Project goals, objectives, and assumptions
- The selection of variables to measure
- Sampling design
- Data acquisition
- Data completeness and quality
- Data management
- Data analysis
- Implementation of the project

The same level of detail and structure is not found in other project plans. The Virgin River Restoration Plan (Stillwater Sciences 2013) provides excellent information on existing site conditions and plant installation but does not provide objectives, assumptions, description of the study design, or any recommended monitoring or data management guidance. The study design for the Desert Tortoise Predation Study Phase 2 (Boarman 2015) has no clear project objectives and no discussion of sample size. It has been a challenge to the program to get proposals and contractors to provide adequate study designs.

The management of the Occupancy Sampling Pilot Study and the Covariates Monitoring Project has ensured that the data collected are accurate, repeatable, and managed correctly. These study designs integrate many aspects of data quality and data management through training, collection and instrument standards, file naming standards, and quality control of data during and post collection. Other projects should use the standards set by these projects. It is unclear if project management will be implemented at the same level for the Desert Tortoise Predation Study Phase 2.

The projects reviewed for this assessment do not provide many insights into how the DCP ensures the repeatability and understanding of analysis routines. The analysis of project data is done both by contractors and DCP staff. Contractors are required to provide a summary of their analysis of the data. The in-house analysis that the program has done recently is of the occupancy data from the Occupancy

Sampling Pilot Study, and the AMP has maintained no analysis routine for this project. A record of the analysis routine is needed for all projects to document when and how analyses were done.

Several projects (Occupancy Sampling Pilot Study, Covariates Monitoring Project, and Eldorado Valley Translocation Project) have had detailed data management plans developed as part of the project and all contracted projects are required to submit a data management plan.

Learning and adaptation does not exist in a formal process within the DCP. The AMP has initiated work on a simple, effective, and efficient method of assessing and retaining lessons learned from completed projects. The draft document assesses whether the objectives of the project were met, lists a number of questions to be answered if the objectives were not met, and summarizes the assessment with recommendations and lessons learned. Science Advisor previously recommended specific fields and questions for the document, along with the recommendation that the information be recorded in a standardized database.

5.2.3 The Last Steps: Communicate, Share, and Preserve

The adaptive management cycle is not complete without preserving project information so it is available to the program and other researchers in the future. In the short-term, preserving data is essential for multi-year analyses. In the longer-term, the information from a project could be used to resample sites or re-analyze the data. Information to be preserved includes certified data, metadata, reports, and analysis products. These products need to be stored in lossless and nonproprietary file formats, using an appropriate storage media, and include a record retention schedule and an archive location.

Sharing and communicating project information is also part of the adaptive management cycle, one that improves the work of other conservation and management entities and informs decision-makers and selected audiences.

The specific questions asked for this assessment are:

- How does DCP prepare the results from projects for different interested audiences, e.g., Permittees, Board of County Commissioners, agency partners, public, and others?
- How does DCP share the results from projects to improve the work of other conservation and management entities?
- How does DCP archive the data so that it is available to the program and other researchers in the future?

The DCP shares and communicates information on projects through three primary vehicles – Quarterly Administrator Update; DCP website, and MSHCP Progress Report Annual Symposium. The website provides summaries of programs for a broad audience; there are no tailored messages to different stakeholders or decision-makers.

A web-based management system customized for the DCP manages non-spatial files. Hardware and software are located on a dedicated server located with the DCP and is managed by DCP staff. There is a weekly backup of the data. The Clark County Geographic Information Systems Management Office (GISMO) manages GIS data, and maintains hardware and software including scheduled daily and weekly data backups.

5.3 Assessment of the Adaptive Management Program

Implementing an adaptive management program for an HCP is challenging (Wilhere 2002, Sutter et al. 2009, Atkinson et al. 2004, Stankey et al. 2003). It is a complex series of integrated actions, starting with the conceptualization of a project to the long-term archive of project information and data. A successful adaptive management program is more than the core actions of managing, monitoring, and adapting.

A major hurdle to integrating adaptive management in projects and programs is the lack of a formalized institutional process (Jacobson et al. 2006, Stankey et al. 2003, Sonja Kokos, personal communication). Institutionalization implies that adaptive management is ingrained in the way that work is performed and there is a commitment and consistency to perform the process.

There are multiple levels at which institutionalization needs to take place, including:

- Organizational structure: aligning the organization to give leadership the authority for its implementing adaptive management.
- Leadership: choosing and training individuals who can successfully implement adaptive management.
- Values: articulating the values associated with adaptive management including thorough planning, structured decision making, testing assumptions, adaptation, openness, learning, humility.
- Policy and guidance: developing policies and guidance that support the implementation of adaptive management.
- Rewards: rewarding individuals and project teams for exceptional integration of adaptive management in their work.

The lack of institutionalization is evident in the DCP by the inconsistent application of adaptive management across projects and the program, a nascent effort of learning from projects, and a lack of understanding and dedication to adaptive management across staff.

To improve the integration of adaptive management in the DCP the Science Advisor recommends:

- ***Develop a simple review sheet to determine if an adaptive management approach is appropriate for a new project*** that would address where: (1) measurable objectives can be established; (2) management options exist; (3) scientific uncertainty about the selection and outcomes of management options is significant and the value of reducing it is high: (4) consequential decisions are necessary for the future of the species or system; (5) there is an

opportunity to learn; and (6) a monitoring system can be established to assess outcomes and learn. Addressing these issues should ensure that adaptive management is implemented for the appropriate projects.

- ***Develop a structured review process for the evaluation of proposals and projects*** that are appropriate for an adaptive management approach, including appropriate staff assigned to the project, a process of review, and guiding questions.

- ***Strengthen the role of the adaptive management coordinator*** to coordinate and lead the review of all proposals, projects, and programmatic functions to ensure that they address adaptive management. The adaptive management coordinator should have the authority to ensure that all the components of adaptive management are implemented for a project.

- ***Ensure that all staff understands what adaptive management is and how it is implemented*** by developing a teaching module on adaptive management for program staff using information from this document, USFWS National Conservation Training Center courses, and other sources.

- ***Strengthen the structured decision making for projects*** by developing conceptual models and threat assessments for each covered species and ecosystem. Conceptual models and threat assessments are valuable in providing decision support for selecting project objectives and the development of conceptual models compiles and increases knowledge of the species or system.

- ***Strengthen management and monitoring plans*** by building on the standards set by the Occupancy Sampling Pilot Study and the Covariates Monitoring Project. Science Advisor recommends that the program ensure that the current and future management and monitoring plans equal or improve on those prepared recently.

- ***Provide guidance in Requests for Proposals for the desired detail for study designs*** to better assess proposals and streamline the initiation of fieldwork.

- ***Maintain the standards for the accuracy, repeatability, and management of data*** set by Occupancy Sampling Pilot Study and the Covariates Monitoring Project.

- ***Maintain a record of analysis methodology and modifications for project data.***

- ***Complete documentation and implement a lessons learned review of projects*** to capture what is learned and how it will be used to adapt conservation and management projects.

- ***Develop a more active effort at sharing and communicating the results of projects*** including an expanded mailing list to include appropriate researchers outside of southern Nevada and land managers whose work is in the Mojave Desert, desert riparian systems, and with covered species; presentations at the Desert Tortoise Council Symposium and other appropriate venues; and publication of projects. It is recommended the DCP tailor the summaries of programs and

projects for different audiences, such as the Permittees, Board of County Commissioners, agency partners, public, and others. A recent adaptive management paper recommends developing communication plans for the primary stakeholders and decision-makers (Montambault et al. 2015).

5.4 Summary

The DCP is at a significant threshold in the implementation of adaptive management. The AMP has been successful in implementing adaptive management in many projects and is gaining extensive knowledge on topics such as occupancy sampling, the fine-scale determinants of desert tortoise occurrence, translocation of desert tortoise, and restoration of riparian habitat. While the program has strengths in the development of projects, it has not integrated adaptive management in a way that will guarantee its continuation and growth. Science Advisor expects that this to be a normal evolution of an adaptive management program.

The value of a strong and integrated adaptive management program will be seen in the design of more focused and appropriate projects, increased conservation success, improved management decisions, expanded learning, less uncertainty, and greater compliance with the goals of the MSHCP. Overall, it will increase the recognition and respect for the DCP.

The DCP has a greater potential than most HCPs to successfully integrate adaptive management into program operations. The DCP has the mandate to mitigate and manage covered species in the face of ecological uncertainty and has the institutional mission and capacity to implement and sustain an adaptive management program. The program has committed and experienced staff, with substantial expertise. The program designs and contracts for projects that address important management decisions. The program has access to funding. And the program is proposing, through an amendment to the incidental take permit, to expand the reserve system, where they will have the control needed to implement adaptive management.

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