Adaptive Management and Monitoring Plan

Version 2.0

Prepared for:
Desert Conservation Program

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Acronyms and Abbreviations

AIM	Assessment, Inventory, and Monitoring
AMMP	Adaptive Management and Monitoring Plan
AMP	Adaptive Management Process
BCCE	Boulder City Conservation Easement
BGO	Biological Goals and Objectives
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
CM	Conservation Measures
CWHR	California Wildlife Habitat Relationships
DCP	Desert Conservation Program
HCP	Habitat Conservation Plan
LPI	Line-point Intercept
MSHCP	Multiple Species Habitat Conservation Plan
NDOW	Nevada Division of Wildlife
RFCD	Regional Flow Control District
SAP	Science Advisor Panel
USFWS	United States Fish & Wildlife Service

Units

ha	hectare
km	kilometer
km^2	square kilometer
m	meter
mi^2	square mile

Section 1 Introduction: Authorization and Need for Adaptive Management and Monitoring in Clark County, Nevada

The U.S. Fish and Wildlife Service (USFWS) initiated Habitat Conservation Plans (HCPs) to accommodate economic development while authorizing incidental take of species listed under the Endangered Species Act. Development of a monitoring plan is an explicit requirement for HCPs under the current *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (Chapter 3.B.4, USFWS 1996). Guidance for monitoring plans is to periodically estimate the rate of incidental take of species, determine species' status in project or associated mitigation areas, and to report progress on achievement of mitigation requirements.

The Desert Conservation Program (DCP) administers a Multiple Species Habitat Conservation Plan (MSHCP, Clark County 2000) for Clark County, Nevada, to meet the USFWS' HCP requirements. Though the existing MSHCP does not require estimates of take, it does require biennial progress reports. The MSHCP also outlines the general role that adaptive management is to serve throughout the lifetime of the incidental take permit.

While the MSHCP currently discusses the conceptual and policy needs of adaptive management, this Adaptive Management and Monitoring Plan (AMMP) is the roadmap that details the actions and walk-throughs for conducting Clark County's monitoring-associated adaptive management process. First, the adaptive management process is described from a technical standpoint as applied to two criteria for success: 1) achievement of Biological Goals and Objectives (BGOs) through conservation actions, and 2) sustained or improved populations and/or habitats of MSHCP-covered species. Second, the activities used to monitor and inform the adaptive management process are described at the species and habitat level. Finally, the document ends with a note about the importance of stakeholder involvement and recommendations for future revisions.

Chapter 2.8.2 of the MSHCP (Clark County 2000) states that:

"*The Clark County MSHCP will implement an AMP [Adaptive Management Process] designed to provide an objective, quantitative evaluation of the effectiveness of (a) management actions in attaining program goals and (b) inventory, monitoring, and research results and interpretation. The AMP is intended to provide a scientifically sound approach, which is preferred by many resource managers when funding and scientific resources are available. The AMP is intended to provide resource managers with objective scientific data and analysis upon which to base management decisions as well as scientifically valid evaluation of management actions.*"

Section 2 Adaptive Management Process

The concept of adaptive management for natural resources was formalized by Holling (1978) and Walters (1986) as a method to incorporate and systematically reduce uncertainty that can be inherent in natural resource management. Traditionally, adaptive management is broken down into six iterative steps:

1) assess the problem,

2) design a solution,

3) implement the action,

4) monitor the results,

5) evaluate results in light of the problem, and

6) adjust the solution (adapted from Williams et al. 2007 and Rist et al. 2013).

In short, adaptive management can be formulated as a process that explicitly incorporates learning from past conservation actions to improve the outcome of those actions (Rist et al. 2013). A key component of the process is the collection, incorporation, and assessment of species- and habitat-specific monitoring data in relation to conservation thresholds (see next paragraph), which allows for an objective assessment of the success of conservation actions in meeting management goals. The adaptive management process outlined in this document was designed with a clear focus on improving the outcomes of conservation actions on MSHCP-covered species and their habitats.

2.1 Thresholds

Defining and incorporating species- and habitat-specific ecological conditions into the adaptive management framework are integral to ensuring conservation actions are effective. If monitoring results show that an explicit, quantifiable, and undesired state of MSHCP-covered species' populations or habitats is reached (e.g., there is widespread failure to maintain or increase populations or habitats), an action process is triggered. Note that increasing populations of covered species is neither a specific requirement of the MSHCP nor of habitat conservation plans in general (USFWS 1996 Chapter 3.B.3.b.). Therefore, whether or not thresholds are exceeded is not an indication of compliance with the conditions of the MSHCP. Rather, thresholds are used to measure the conservation success and net benefit of the conservation actions above and beyond the legal requirements and expected outcomes detailed within the MSHCP (USFWS 1996 Chapter 3 B.3.b.).

Adaptive management, as described in this document, is applied to two general classes of performance criteria:

1) achievement of BGOs (see Section 3)

2) status of MSHCP-covered species' populations or habitats (See Section 4)

For each of these performance criteria, the process is broken into two parts:

1) **evaluation process** - a regular, systematic process to be performed every 4 years. It involves assessing the thresholds associated with the BGOs using the compiled results from individual conservation actions and the ongoing monitoring activities (see Section 4). If BGOs are being achieved and species or habitat thresholds are not being exceeded, the adaptive management process is complete.

2) **action process** - initiated when BGOs are not being achieved or some species' thresholds are exceeded and continued until all BGOs are achieved and no thresholds are exceeded. While the adaptive management evaluation process occurs every 4 years without exception, the action process only occurs when necessary, beginning at the 4-year evaluation interval and continuing until the actions have proven successful.

2.2 Adaptive Management Applied to BGOs

The goal of applying adaptive management to the BGOs is to provide quantitative rigor in ensuring that conservation actions are successfully achieving BGOs and, if they are not, how management actions should change in order to fully achieve them.

The evaluation process (Figure 1) with respect to the BGOs should involve the following steps for each BGO:

1) compile relevant data as prescribed by each BGO and conservation project),

2) conduct analysis prescribed by each BGO,

3) compare compiled results with the desired outcome, and

4) if necessary, begin the adaptive management action process (Figure 3).

If the evaluation process determines that any BGOs are not being achieved, the action process (Figure 3) must be completed separately for each of those biological objectives.

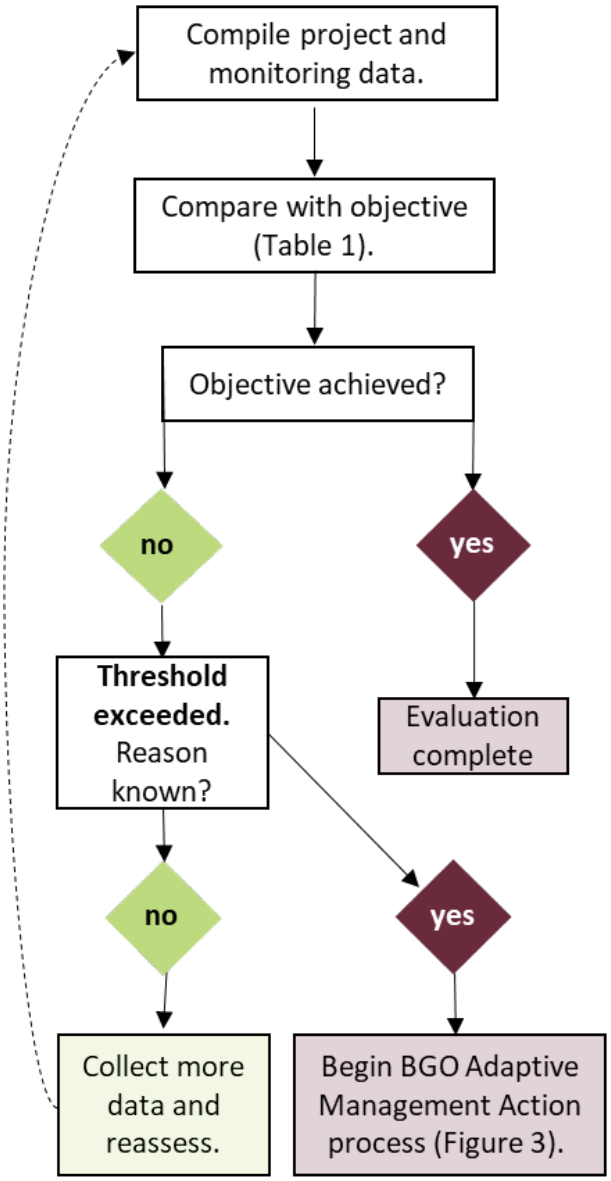

Figure 1. Evaluation Process for the Biological Goals and Objectives

2.3 Adaptive Management Applied to MSHCP-Covered Species' Populations

The goal of applying adaptive management to the status of MSHCP-covered species' populations and habitats is to ensure that, even when all BGOs are being successfully achieved, the desired benefits to MSHCP-covered species are also being realized. Monitoring the status of populations and the habitats of MSHCP-covered species provides additional information on the benefits of conservation actions conducted as part of implementing the MSHCP. Additionally, it can serve as a safeguard against the possibility that MSHCP-covered species fare poorly despite successful implementation of the MSHCP. Thus, the monitoring activities will be used to record and evaluate species' population and habitat trends, and potentially, to demonstrate a net benefit from the conservation actions on the populations of MSHCP-covered species.

The evaluation process (Figure 2) with respect to the thresholds for the populations of MSHCP-covered species and their habitats is to be completed every 4 years. This process for each threshold should involve the following steps:

1) compile all relevant monitoring data,

2) conduct appropriate statistical analysis to compare trends and state variables within the DCP reserve system,

3) compare results with the associated thresholds,

4a) if a threshold has not been exceeded, no action is required, or 4b) if a threshold has been exceeded, coordinate new data collection or inter-agency data sharing for that species or habitat off the DCP reserve system for an appropriate time period (e.g., 2-3 years), and

5) if a threshold is exceeded only within the DCP reserve system but not off the DCP reserve system, begin the action process (Figure 3).

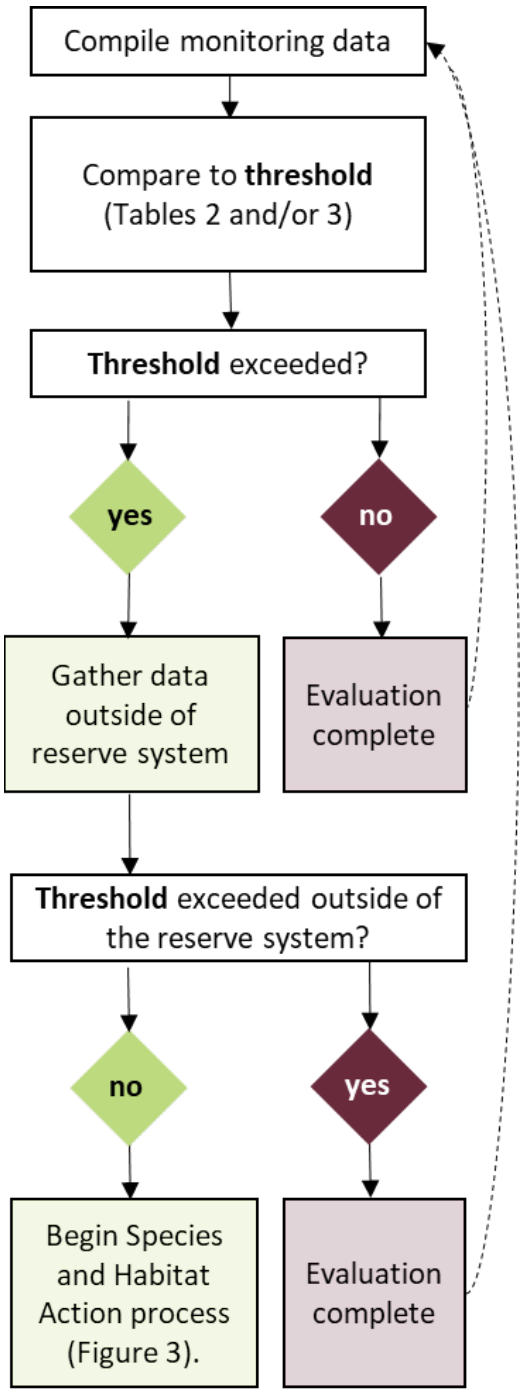

Figure 2. Evaluation Process for Species and Habitats

2.4 Adaptive Management Action Process for BGOs and Species and Habitat Monitoring

If the adaptive management evaluation process (Sections 2 and 2.3) determines that any thresholds are being exceeded, the adaptive management action process must be completed for the individual BGOs, species, or habitats. The basic steps in the action process are to:

1) determine why the threshold is being exceeded,

2) engage partners and stakeholders to discuss reasons behind the undesired condition.

3) identify changes or new projects designed to improve the achievement of the BGO, species population, or its habitat,

4) conduct the changes or new projects, and

5) monitor the results on a more frequent time frame than the 4-year adaptive management evaluation process.

This process is intended to continue until all thresholds are no longer being exceeded. This is the process whereby changes to the conservation actions are made.

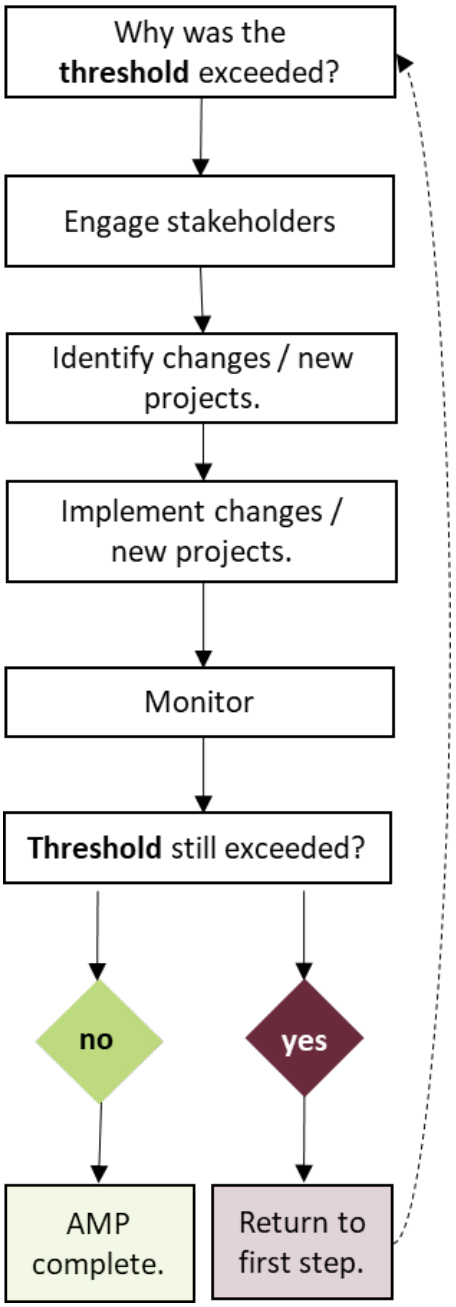

Figure 3. Action Process for Species and Habitats

Section 3 Biological Goals and Objectives

Together, the BGOs (Table 1) provide the rationale behind the MSHCP's terms and conditions, guide monitoring, and when appropriate, inform adaptive management. Biological goals provide rationale for the conservation actions needed to minimize and mitigate adverse effects on MSHCP-covered species to the maximum extent practical. Biological objectives aid achievement of biological goals through implementation, evaluation, and adaptive refinement of conservation actions that are generally grouped into categories of conservation measures. The Adaptive Management Process (Section 2) describes how to determine if the BGOs are being achieved and how to proceed if they are not being met. See DCP (2016) for a thorough discussion of the development of the BGOs. The BGOs have since been revised to improve clarity and achievability, and, most importantly, to better align with current guidance from USFWS on implementation of HCPs. Specifically, this means adhering to the SMART design: ensuring that biological objectives are Specific, Measurable, Achievable, Result-oriented, and Time-fixed (USFWS 2016). Appendix A summarizes how each biological objective meets SMART principles.

3.1 Conservation Measures

Within the HCP framework, conservation measures (CMs) are themes or categories of conservation actions that may be implemented by the Permittee and other Participants to achieve the BGOs and to minimize, mitigate, and monitor the impacts of take of species covered by the MSHCP (Clark County 2000). A single conservation project can support multiple CMs, and a single CM can cover multiple projects. Over 650 specific actions were identified in the original MSHCP (Clark County 2000). The MSHCP groups these actions into seven categories of CMs: public information and involvement, research, inventory, monitoring, protective measures, habitat restoration and enhancement, and land use policies and actions. The DCP implements conservation projects under each of the seven CMs, but each project is also tied to specific BGOs. For the purposes of the adaptive management process in general for DCP, the CMs are not directly involved and therefore not discussed further in this document.

3.2 Project Effectiveness

The evaluation of each project is designed to quantify the conservation outcomes and benefits and is tied to specific BGOs tailored to each project (Appendix B). The timeline, methods, and complexity of evaluating project-level effectiveness are highly variable between projects. For example, acquiring a riparian property is a required action under the MSHCP, but does not lend itself to quantitative analysis at the end of the project. In contrast, a restoration project may require both short- and long-term monitoring (e.g., 5 – 20 years) to determine project efficacy and benefits to the ecosystem. Project-level effectiveness is one of the types of evaluations used to determine if the BGOs are being achieved (Section 2.2) and the worksheet in Appendix B should be filled out for each project.

Project Effectiveness evaluation is designed to quantify the conservation outcomes and benefits and is tied to specific BGOs tailored to each project.

Table 1. Biological Goals and Objectives

Biological Goal 1: Maintain or improve habitat quality and quantity within DCP reserve system lands to promote resiliency, redundancy, and representation for covered species.	
Obj 1.1	Utilize invasive species treatment methods to maintain or decrease the 8-year average area requiring weed management.
Obj 1.2	Acquire riparian acreage at an equivalent rate as take over the life of the permit. An 8-year lag after riparian acreage is developed is allowed to account for the willing-seller, willing-buyer basis of property exchange, within the life of the permit.
Obj 1.3	Protect, restore, or otherwise increase the quality and quantity of habitat for MSHCP-covered species, as determined by the monitoring methods, definition of quality, and timeframes specified in the AMMP.
Obj 1.4	Incorporate natural ecological, hydrological, and geomorphological processes into restoration design and implementation to maintain ecological integrity, ecosystem function, and biological diversity. Include consideration that climate change may result in significant changes in these processes over historical frequencies and magnitudes. Review quadrennially as part of every other Adaptive Management Report (AMR) using project level worksheets (Appendix B).
Obj 1.5	Identify critical uncertainties (e.g., climate change, human population growth) of MSHCP-funded projects on DCP reserve system lands and report on them in biennial updates to the DCP Reserve System Management Plans.
Obj 1.6	Incorporate concepts of ecosystem redundancy and representation to promote ecological resiliency in the biennial updates to the DCP Reserve System land Management Plans.
Obj 1.7	Protect and enhance connectivity (i.e., road restoration, culvert placement) within DCP reserve system lands for Desert Tortoise and other high priority covered species. Review and report on the status of these projects quadrennially in every other AMR.
Biological Goal 2: Maintain stable or increasing populations of covered species occurring within DCP reserve system lands.	
Obj 2.1	Monitor covered wildlife species as described in the AMMP. Report quantitative population data, as described in the AMMP, for covered species biennially in the AMR and report statistical analyses of population trends quadrennially in every other AMR.
Obj 2.2	Conduct surveys for covered plant species as described in the AMMP. Protect, conserve, and monitor known occurrences of these species annually. Report quantitative population data as described in the AMMP biennially in the AMR, and report statistical analyses of population trends quadrennially in every other AMR.

Obj 2.3	Translocate and augment desert tortoise populations in accordance with USFWS guidance through translocation programs that achieve survivorship rates within 10 percentage points of resident tortoise survival rates in the same areas (or with survivorship as prescribed by USFWS guidance). Report survivorship data biennially in the AMR and report analysis on aggregated translocated tortoise survivorship compared to aggregated resident tortoise survivorship quadrennially in every other AMR.
Obj 2.4	Ensure the best available scientific information is being evaluated and incorporated into population management efforts for covered species, including monitoring methods and identification of critical uncertainties (e.g., climate change, human population growth), by completing a focused literature review (or Systematic Review) and updating it quadrennially in the AMMP.
Biological Goal 3: Foster community and stakeholder engagement to maintain or improve covered species populations and their habitats.	
Obj 3.1	Develop and disseminate educational materials that cover the following topics: 1) the value of the desert ecosystem in Clark County; 2) promoting responsible recreation; 3) promoting following development procedures; and 4) avoiding and minimizing impacts to the environment. Re-evaluate material's relevance quadrennially (branding, technology, social and recreation trends, etc.).
Obj 3.2	Protect habitats within the Boulder City Conservation Easement (BCCE) from unauthorized land use through vigilance (by patrolling an average of at least 100 hours each month) and education (by providing information during encounters). Compile data annually and report quadrennially in every other AMR.
Obj 3.3	Provide information to permitted users (project proponents, construction personnel, researchers, biological consultants) about best management practices for the desert tortoise and associated reporting procedures. If BMPs are developed for other covered species, this objective would expand to apply to them also. Compile data annually and report quadrennially in every other AMR.

Section 4 Monitoring Activities

4.1 Integration of Monitoring and Adaptive Management

Monitoring serves as the fundamental basis of adaptive management and is a critical component of any large-scale, long-term applied conservation program. Relevant, quantitative data obtained through regular monitoring is used in the periodic evaluation of conservation success, with a key focus on learning from past actions and making improvements. Thus, monitoring and adaptive management are complementary – neither can be successfully achieved without the other. When monitoring occurs adaptively, both monitoring and analysis methods can/should be revisited if goals are not being met or could be met more efficiently. This could occur, for example, with changes in technology or circumstances (including both changed/catastrophic and unforeseen circumstances), or if the collected monitoring data are not answering the management questions.

The Adaptive Management Process (Section 2) describes how to use the data collected by the methods described in this section to evaluate the two criteria: the BGOs, and the status of species or habitats. Many of the BGOs are not associated with specific MSHCP-covered species, and conversely, many of the species are not directly associated with a BGO. This is the result of two separate goals: the BGOs were developed to guide conservation actions given the larger goals of the MSHCP, while monitoring activities were developed to directly "keep a finger on the pulse" of species and habitats to ensure maximum realized benefit of the conservation actions. Integral to the process is the strong ability to quantify actions and impacts and a recursive timeline to guide both the adaptive management and monitoring activities.

The following subsections describe the levels of monitoring that should be conducted and provide guidance on which components of the ecosystem should be monitored (i.e., 'what' should be monitored). Appendix C provides additional methodological details related to the suggested monitoring methods (i.e., 'how' monitoring should be conducted).

4.2 Levels of Species and Habitat Monitoring

The DCP will perform monitoring at two levels for species and habitats:

1) Consistent monitoring of species and habitat within the DCP reserve system, and
2) Monitoring outside of the DCP reserve system. If thresholds are exceeded (i.e., populations are declining), monitoring data at this larger scale should be obtained (e.g., from other agencies) or collected (e.g., new DCP monitoring efforts) to determine if the threshold was exceeded due to factors within or outside of DCP's ability to control (e.g., declines in habitat quality within the DCP reserve system vs. regional population declines).

There are several caveats to consider when assessing these monitoring data.

- Conservation projects conducted to-date occur at **multiple spatial scales**. Some projects occur only within the DCP reserve system, and their benefits are expected to be realized within the DCP reserve system. Other projects occur without a specific spatial scale (e.g., public information and education) and their benefits may occur county-wide.
- **Long-term trends** in habitat and populations of MSHCP-covered species are **influenced** both by **local** processes (e.g., development, restoration, etc.) and **regional processes** (e.g., long-term drought cycles). Thus, if a threshold is exceeded, a critical component of the monitoring plan is the capacity to initiate assessment of the status of populations and habitats both within and outside the reserve system to quantify the

impact of the conservation actions as nested within the larger impacts of regional factors.

- Plant and animal populations can experience **time lags in their response to conservation actions**, particularly for long-lived species with low reproductive rates such as Mojave Desert tortoises. Therefore, the benefits of conservation actions may take multiple years before they are realized.
- The MSHCP was enacted in 2001 so there is a **long history of both development and conservation actions** that have occurred over the life of the permit **prior to this monitoring plan** being instituted. Thus, the use of adaptive management with the monitoring data is not a true impact analysis and should be interpreted as a safeguard moving forward to ensure maintenance of populations of MSHCP-covered species.

4.3 Data and Reporting

Monitoring data will be collected by either DCP staff or external contractors. Specific details on data collection methods will be determined at the beginning of the monitoring effort. Future modifications to the monitoring methods should be made if necessary and should be done in consultation with DCP staff and the independent Science Advisor Panel (SAP) to ensure continuity of monitoring results collected under different methodologies. All data will be stored by the DCP and will be available to other MSHCP Participants.

Thresholds are defined here as statistically significant measurements of failing populations, such as significant declines in abundance, density, occupancy rate, etc. and are defined specifically to each monitored metric.

The presentation of monitoring results for reporting purposes can occur at any time, but at a minimum will be conducted every two years as part of the Biennial Adaptive Management Report to serve as a benchmark for conservation progress. This is not a new feature of the Biennial Adaptive Management Report but is one whose importance deserves emphasis here. Additionally, the statistical quantification and reporting of project-level progress (Appendix B) informs how well biological objectives are being achieved as part of the adaptive management process that occurs every four years and will occur as described in the Adaptive Management section (see Section 2).

4.4 Species Monitoring

Monitoring plans may include a variety of different methods to measure species occupancy and population trends. While some species (e.g., threatened and endangered species) have very specific protocols that must be followed to make results comparable to other areas or previous studies, other species (or groups of species) may be monitored simultaneously using a single survey method. Ultimately, not all species' populations are able to be monitored due to various reasons such as rareness, crypticism, and budget constraints. The MSHCP's monitoring program addresses federally listed species directly, and then aims to capture as many current MSHCP-covered species or species proposed for future listing as possible with a handful of survey methods. The key metrics that are being monitored for all species are 'thresholds' (Table 2). Thresholds are defined here as statistically significant measurements of failing populations, such as significant declines in abundance, density, occupancy rate, etc. and are defined specifically to each monitored metric. 'Target' or 'desired' conditions are not defined because, from a statistical standpoint, a failure to detect a significant trend does not necessarily indicate its absence and therefore "no trend identified" could be either good (e.g., populations are at a steady state) or bad (e.g., a lack of data to detect declining population trend).

Additionally, constantly increasing populations are not realistic in perpetuity and are thus not a desired condition. Therefore, only thresholds are defined, such that if there is statistical evidence that a monitored population or habitat is known to be faring poorly, the adaptive management process is enacted to identify causes and possible remedies to the decline(s).

Table 2. Adaptive Management Criteria for Species Monitoring

Species[a]	Monitoring Survey	Covered Species Group	Threshold[b] Exceeded?
Desert tortoise	Occupancy sampling	Desert upland reptiles[a]	
Great Basin collared lizard			
Desert iguana			
Large-spotted leopard lizard			
Yellow-billed cuckoo	Federal protocol	-	
Southwestern willow flycatcher	Federal protocol	-	
Blue grosbeak	Point count / passive acoustic occupancy	Riparian birds	
Summer tanager			
Vermillion flycatcher			
Arizona Bell's vireo			
Ridgway's rail			NA
American peregrine falcon		Desert upland birds	
Phainopepla			
Western burrowing owl			NA
Gilded flicker			NA
Loggerhead shrike			NA
Bendire's thrasher			NA
Le Conte's thrasher			NA
Golden eagle			NA
Silver-haired bat	Passive acoustic occupancy	Bats	
Long-eared myotis			
Long-legged myotis			
Townsend's big-eared bat			NA
Spotted bat			NA

Table 2. Adaptive Management Criteria for Species Monitoring

Species[a]	Monitoring Survey	Covered Species Group	Threshold[b] Exceeded?
Sticky ringstem	Three-tiered sampling	Desert upland plants[c]	
Las Vegas bearpoppy			
White bearpoppy			
Threecorner milkvetch			

[a]Species in **bold** are federally listed under the Endangered Species Act. Species in *italics* are proposed to be covered under a future amended MSHCP. Currently covered and proposed species not included here are sufficiently rare, cryptic, or unknown as to whether they are specifically surveyed for; these species are assumed to be covered using desert upland or riparian habitat quality as a surrogate.

[b]The threshold is a statistically significant downward trend in populations on reserve lands during the assessment period. Proposed covered species under the upcoming MSHCP amendment should have data and trends presented in reports, but do not have associated thresholds because they are not currently covered by the MSHCP.

[c]Additional MSHCP-covered and proposed plant species should be included in monitoring as populations are located through targeted surveys. Currently covered species should have associated thresholds; proposed species should not.

4.1.1 Desert Tortoise (*Gopherus agassizii*) and other reptiles

Mojave Desert tortoises range across the southwestern United States northwest of the Colorado River (Murphy et al. 2011). The species is in decline despite significant conservation and management efforts since federally listed as threatened in 1990 (USFWS 1990, USFWS 2011). This species is threatened by the concomitant effects of habitat loss (Heaton et al. 2008, Darst et al. 2013), disease (Jacobson et al. 1991, Jacobson 1994), and predation (Boarman et al. 2006), all of which may vary spatially and temporally.

Desert tortoise. *Photo credit: Seth Harju*

Desert tortoises are philopatric, establishing home ranges between 15 and 45 hectares (O'Connor et al. 1994, Harless et al. 2009), depending on region and local conditions. Home ranges and cover sites are associated with a wide range of desert scrub communities and generally occur where robust perennial vegetation provides above-ground shelter (Todd et al. 2016), cover from predators, and presumably, structure for underground burrows. Desert tortoise activity varies daily and seasonally where most activity occurs during the warmer months (March through October) and becomes crepuscular during the hottest times of the day or season (Nagy and Medica 1986, Agha et al. 2015). During the cooler winter months when tortoises brumate (November through February), above-ground movement is very limited (Nagy and Medica 1986, Nussear et al. 2007).

Occupancy modeling is of promise for desert tortoises because it efficiently balances lower survey effort (species detection/non-detection data from multiple visits) while tracking a state variable of fundamental importance: whether the species is present or not at a site, given imperfect detection of the species during field surveys (MacKenzie et al. 2002). The DCP has conducted a desert tortoise occupancy monitoring program in the BCCE since 2013 (Harju and Cambrin 2019).

Desert collared lizard. *Photo credit Grigory Heaton*

There are 12 additional reptiles on the MSHCP-covered species list in addition to the desert tortoise. Three of these are expected to be encountered using the same monitoring protocol as for desert tortoise (Great Basin collared lizard [*Crotaphytus bicinctores*], desert iguana [*Dipsosaurus dorsalis*], and large-spotted leopard lizard [*Gambelia wislizenii wislizenii*]). At a minimum, these species should be surveyed concomitantly with the desert tortoise occupancy monitoring. Detections of these MSHCP-covered reptile species during desert tortoise surveys should be noted by field crews and where sufficient data are available for each of these species, the appropriate occupancy analyses should be conducted. The remaining lizard (banded gecko [*Coleonyx variegatus*] and eight snake species (glossy snake [*Arizona elegans*], sidewinder [*Crotalus cerastes*], speckled rattlesnake

[*Crotalus mitchellii*], Mojave rattlesnake [*Crotalus scutulatus scutulatus*], California kingsnake [*Lampropeltis getulus californiae*], western leaf-nosed snake [*Phyllorhynchus decurtatus*], western long-nosed snake [*Rhinocheilus lecontei lecontei*], and Sonoran lyre snake [*Trimorphodon biscutatus lambda*]) are highly cryptic and are unlikely to be encountered in sufficient numbers for statistical trend analysis using the desert tortoise sampling protocol or possibly even with a more targeted protocol. Therefore, monitoring and ensuring high-quality desert upland habitat will be used as a surrogate for directly monitoring these nine species.

4.4.2 Yellow-Billed Cuckoo (*Coccyzus americanus*)

Yellow-billed cuckoos are a slim, ~30 cm bird that inhabit deciduous woodlands and are rare in western North America. The western distinct population segment of the yellow-billed cuckoo is a federally listed threatened species inhabiting riparian habitats. Yellow-billed cuckoos are difficult to detect during traditional avian surveys; therefore, federally approved protocol-level surveys must be conducted to adequately detect the species at the level of confidence approved of by the USFWS (Appendix C, see Halterman et al. 2016).

4.4.3 Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

Southwestern willow flycatchers are small, < 15 cm passerines that have specific riparian habitat requirements in the southwestern U.S. Breeding habitat specifically requires dense trees or shrubs (> 3 m tall) with a dense twig structure and high amounts of green vegetation (Sogge et al. 2010). Surveys for the federally listed endangered southwestern willow flycatcher must follow the USFWS-approved survey protocol (Appendix C, see Sogge et al. 2010).

4.4.4 Other MSHCP-covered Bird Species

Other MSHCP-covered bird species that occur in riparian or riparian-adjacent habitats include the summer tanager (*Piranga rubra*), vermillion flycatcher (*Pyrocephalus rubinus*), Arizona Bell's vireo (*Vireo bellii arizonae*), phainopepla (*Phainopepla nitens*), and blue grosbeak (*Passerina caerulea*). These species occur in cottonwood-willow habitat and associated desert washes composed of shrubby woodland habitat, such as mesquite, oak, and non-native tamarisk. Standard point count survey methodologies or passive acoustic monitoring on riparian reserve units should be used to monitor all of these species (Appendix C).

Blue grosbeak. *Photo credit: Ad Konings.*

The American peregrine falcon (*Falco peregrinus anatum*), also covered by the MSHCP, was delisted due to recovery of the species in 1999 and a monitoring plan was developed to detect declines in territory occupancy, nest success, and productivity (USFWS 2003). There are no suitable peregrine falcon nesting substrates within the current reserve system and no known nests adjacent to the reserve system. The BCCE, however, may serve as foraging habitat for peregrine falcons. Peregrine falcons will be recorded as observed as part of point counts or passive acoustic monitoring for non-listed MSHCP-covered bird species. Additionally, monitoring and maintaining high-quality upland desert habitat will be considered a surrogate for monitoring peregrine falcon populations.

4.4.5 Bats

All three MSHCP-covered bat species (silver-haired bat [*Lasionycteris noctivagans*], long-eared myotis [*Myotis evotis*], and long-legged myotis [*Myotis volans*]) may use riparian areas for foraging, day roosts, and maternity roosts. Silver-haired bats may also use riparian areas for hibernacula as they are known to hibernate under sloughing bark in low-elevation, xeric habitats. Two of the species (long-eared myotis and long-legged myotis) may use desert upland areas for foraging and roosting habitat and may hibernate in surrounding caves, abandoned mines, cliff crevices, and rocky outcrops.

Silver haired bat. *Photo credit: Jason Headly*

All three bat species would be most efficiently monitored using an occupancy approach via passive acoustic monitoring during summer (i.e., during the breeding season; Weller 2008). They also have the potential to hibernate within Clark County and use the reserve system lands prior to, after, and potentially during winter so it may be advantageous to conduct surveys in late fall or early spring to document their use of reserve system lands during these seasons in addition to the breeding season survey.

4.4.6 Plant Species

There are several MSHCP-covered plant species that may occur on private land within Clark County. These include seven species whose "population groups" (sensu TNC 2007) are known to include private lands: sticky ringstem (*Anulocaulis leiosolenus*), Las Vegas bearpoppy (*Arctomecon californica*), white bearpoppy (*Arctomecon merriamii*), threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*), alkali mariposa lily (*Calochortus striatus*), forked [Pahrump Valley] buckwheat (*Eriogonum bifurcatum*), and sticky buckwheat (*Eriogonum viscidulum*) (NPS 2010, D. Hinderle, pers. comm.). An additional three species have been documented in the Plan Area but whose "population groups" are only known from public lands: Blue Diamond cholla (*Cylindropuntia multigeniculata*), white-margined beardtongue (*Penstemon albomarginatus*), and Parish's phacelia (*Phacelia parishii*).

The National Park Service has developed three-tiered monitoring protocols for four of the above species (see Bangle et al. 2010). DCP is advised to adopt/adapt these protocols for sticky ringstem, Las Vegas bearpoppy, white bearpoppy, and threecorner milkvetch (Appendix C). For the remaining species, DCP should adopt protocols established by Nevada Division of Natural Heritage, Bureau of Land Management (BLM), or U.S. Forest Service, when those exist. Where established monitoring protocols have not yet been identified, DCP will adapt the National Park Service's three-tiered protocol, in collaboration with the above agencies. Adoption of regional methods will allow for easy comparison of plant population trends on reserve system lands and population trends in the general region.

Las Vegas bearpoppy. *Photo credit: Corey Lange*

There are 31 additional plants currently covered by the MSHCP, but their locations and habitat requirements are not sufficiently known to develop a monitoring program.

4.4.7 Invertebrate Species

There are ten invertebrate species currently covered by the MSHCP. There are no proposed monitoring methods for them because they all occur in habitats not expected to be impacted by private land development in Clark County. None of the ten currently MSHCP-covered invertebrates are proposed for future covering under an amended permit.

4.4.8 Proposed Covered Species

The DCP is preparing for an amendment to the MSHCP, which also proposes a modified list of MSHCP-covered species. The proposed species list is intended to better reflect current conservation status of species within Clark County and to better focus on species that are likely impacted by private land development. It would be advantageous to collect monitoring data for the proposed future covered species to better inform future conservation and management actions even if spending money on monitoring currently non-covered species is difficult to justify under the current MSHCP. It is therefore recommended that those species are monitored incidentally as part of monitoring efforts for current MSHCP-covered species. Proposed species expected to be observed during existing monitoring efforts include:

- Two proposed bat species (Townsend's big-eared bat [*Corynorhinus townsendii*] and spotted bat [*Euderma maculatum*])
- Seven proposed bird species (golden eagle [*Aquila chrysaetos]*, western burrowing owl [*Athene cunicularia hypugea*], gilded flicker [*Colaptes chrysoides*], loggerhead shrike [*Lanius ludovicianus*], Ridgway's rail [*Rallus obsoletus yumanensis*], Bendire's thrasher [*Toxostoma bendirei*], and Le Conte's thrasher [Toxostoma lecontei]).

An additional proposed mammal species (desert pocket mouse [*Chaetodipus penicillatus sobrinus]*), a proposed reptile (banded Gila monster [*Heloderma suspectum cinctum*]), two proposed invertebrate species (monarch butterfly [*Danaus plexippus*] and Mojave poppy bee [*Perdita meconis*]), and four proposed plant species (silverleaf sunray [*Enceliopsis argophylla*], Las Vegas buckwheat [*Eriogonum corymbosum* var. *nilesii*], St. George blue-eyed grass [*Sisyrinchium radicatum*], and eastern Joshua tree [*Yucca jaegeriana*]) are not expected to be observed using existing monitoring methods and are assumed to be covered by monitoring desert upland habitat quality (see below and Appendix C) or specific host plant species (e.g., Las Vegas bearpoppy is a food source for Mojave poppy bee).

Proposed covered species that are encountered during monitoring surveys of current MSHCP-covered species should have trend analyses conducted the same as current MSHCP species, but proposed species do not have population thresholds (Table 2)

4.5 Habitat Monitoring

Monitoring habitat condition is a critical component of the adaptive management process and is necessary in order to fully comply with the MSHCP. Collecting quantitative data enables rigorous characterization and analysis of ecosystem status and trends and provides information necessary for timely management intervention to slow or reverse undesirable trends. The key metrics that are being monitored for each habitat (riparian and upland, respectively) are 'thresholds' (Table 3). The following sub-sections describe long-term monitoring for riparian and upland habitats on DCPs durable lands and are detailed in Appendix C.

Table 3. Adaptive Management Criteria for Habitat Monitoring

Habitat	Monitoring Survey	Monitored Habitat Characteristics	Threshold	Threshold Exceeded?
Desert upland	AIM protocol augmented with remote sensing	Foliar Cover	Statistically significant decline	
		Species Richness	Statistically significant decline	
		Vegetation Height	Statistically significant decline	
		Percent Bare Ground	Statistically significant increase	
		Proportion of Soils Surface in Gaps	Statistically significant increase	
		Soil Aggregate Stability	Statistically significant decline	
Riparian	Remote sensing with ground truthing	Cover: • Vegetation composition • Total cover • Cover by functional group or species • Cover by canopy (understory vs overstory)	Thresholds are not defined for each riparian habitat characteristics because the MSHCP-covered avian species have widely diverging habitat requirements. A mosaic of habitat for all species should be maintained across all properties. The collective threshold for riparian habitat is a significant increase in acreage across all DCP durable riparian lands that does not meet requirements for any MSCHP-covered avian species (Appendix C, Table C1; increase must not be due to natural event [e.g., severe flooding] nor the result of active restoration [e.g., tamarisk mastication]).	
		Vegetation Height: • Overall / average height • Height by canopy level		
		Vegetation Density		
		Vigor / greenness		

4.5.1 Riparian

DCP should monitor the covered avian riparian species and their habitats in addition to overall riparian ecosystem health. The covered avian species have diverging habitat requirements; for example, the yellow-billed cuckoo requires a dense canopy > 5 m tall with a diverse vertical structure, whereas the vermillion flycatcher requires open habitat with scattered trees and does not tolerate a dense understory or canopy (Appendix C; Table C1). Designing a monitoring strategy with the aim of identifying quality habitat for all MSHCP-covered avian species is not straightforward because what may be habitat for one species may be non-habitat for another. Aiming to measure the habitat characteristics that indicate overall riparian health and that are common between species is a necessary compromise. Generally, these characteristics to describe riparian habitat include **cover, height, vegetation density, and vigor**. A multitude of

Designing a monitoring strategy with the aim of identifying quality habitat for all MSHCP-covered avian species is not straightforward because what may be habitat for one species may be non-habitat for another. Aiming to measure the habitat characteristics that indicate overall riparian health and that are common between species is a necessary compromise.

methods exist to measure these characteristics, from on-the-ground detailed surveys to remotely-sensed methods. Dense vegetation in riparian areas makes some traditional, on-the-ground methods such as line-point-intercept (as used in the BLM's Assessment, Inventory, and Monitoring [AIM] protocols) time-consuming and potentially inaccurate or not representative of habitat conditions. Therefore, riparian habitat monitoring methods described in Appendix C focus on remotely sensed data with ground-truthing elements.

The California Wildlife Habitat Relationships (CWHR) has in depth descriptions of each MSHCP-covered avian species' habitat and has guidelines for identifying habitat for each species (Garrison et al., 2017). The CWHR provides a matrix of vegetation characteristics and ranks them for each species' suitability for reproductive, cover, and feeding habitat. This matrix should be used across all species to pursue maintenance of high-quality habitat for any given subset of MSHCP-covered avian species (Appendix C, Attachment C2).

Technologies are expected to change and grow over time; therefore, tools, analyses, and data sensitivity requirements specified in Appendix C are representative of a minimum level of accuracy or resolution to maintain over time rather than be prescriptive and inflexible. Some data may be acquired opportunistically on a project-by-project basis that can be used to detect intermediate changes at high resolutions. Baseline data should be collected for all new durable parcels as they are acquired by DCP, and subsequent large-scale remotely sensed data collection (with appropriate ground-truthing) should occur at the frequency specified in Appendix C.

DCP acquires land by the parcel on a willing-seller, willing-buyer basis and although DCP's interest in a riparian property is largely for its riparian habitat, they typically include both upland and riparian habitat. While long-term monitoring methods are focused on the health of the riparian habitat, they should be employed across the entirety of each riparian property (parcel) to inform future management decisions and potential restoration opportunity.

4.5.2 Desert Upland

Monitoring within the desert upland reserve system will be designed and implemented to inform on the status and trends of ecosystem structure and function (Table 4, Appendix C). Specifically, the monitoring methods should be those used in the BLM's AIM protocols because they are well researched and widely used, and they will allow DCP to assess ecosystem trends on reserve lands in context with larger regional trends and patterns. Monitoring will include quantitative measures of vegetation composition, vertical structure (e.g., vegetation height), bare ground, soil surface, and soil aggregate stability, as well as a qualitative record of conditions observed at the time of data collection (Table 4). Because climate is a driver of ecosystem structure and function, collection of weather data should also be integrated into the monitoring program (See Section 4.5.3).

Table 4. Key Attributes for the Assessment, Inventory, and Monitoring Strategy and their Recommended Collection Methods

Attribute	Method
Qualitative Record *includes recent weather, erosion signs, land use observations*	Plot observations & characterization
	Fixed-point photographs
Vegetation Composition *foliar cover (LPI), species richness, invasive species & rare species presence/absence*	Line point intercept (LPI)
	Species inventory
Vertical Structure	Vegetation height
Bare Ground	Line point intercept (LPI)
Proportion of Soil Surface in Gaps	Canopy gap intercept
	Basal gap intercept
Soil Aggregate Stability	Soil stability test

The DCP should implement the BLM's AIM protocols. Use of the AIM protocols will result in monitoring outcomes that can be easily compared to results obtained by the BLM and other agencies and institutions on surrounding lands. AIM methods cover all attributes listed in Table 4, above. The AIM methods are described in *Volume 1: Core Methods, Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems* (Herrick et al 2017); additional resources that describe applications and implementation of the AIM strategy are listed in Appendix C.

4.5.3 Weather and Climate

Temperature, precipitation, and humidity are important weather characteristics and ideally would be measured at each reserve land parcel. Publicly available data is the preferred method for obtaining weather data since there are multiple entities that collect these data regularly. Currently, relevant weather data are available from Clark County Regional Flow Control District (RFCD; Table 5). There are weather stations collecting temperature, relative humidity, and precipitation near the BCCE (RFCD Sensors #4836, #4835, #4834), while only precipitation is collected at weather stations near the Bunkerville and Muddy River reserve lands (RFCD Sensors #2784 and #3264).

The publicly available data (Table 5) are not available in the vicinity of every DCP property and in some locations where only one weather station is collecting data, multiple weather stations would be necessary for complete spatial coverage. In addition, only a subset of desired characteristics (temperature, precipitation, and humidity) are being collected at some stations. In lieu of DCP establishing weather stations to secure complete spatial coverage on every durable land, the publicly available data will suffice to provide some measure of background information if a BGO, species, or habitat threshold is exceeded and the adaptive management process is necessary. If more detailed weather data are desired, individual weather stations will need to be installed on each property (See Alta 2022 for initial research on weather/climate stations).

Table 5. Clark County Regional Flow Control District Weather Data

Location	Attributes measured	Station ID
North side of BCCE	Temperature Precipitation Relative humidity	RFCD Sensors #4836, #4835, #4834
Bunkerville	Precipitation	RFCD Sensor #2784
Muddy River	Precipitation	RFCD Sensor #3264
Mormon Mesa	None	NA

Section 5 Recommendations

5.1 Stakeholder Involvement

Regular constructive stakeholder involvement is critical to the success of both the monitoring and adaptive management portions of this plan. Stakeholders may have insight into species ecology, strengths and weaknesses of existing monitoring methods, or emerging monitoring methods. Stakeholders may also prove invaluable in the adaptive management process, particularly if the adaptive management action process must be initiated. They can identify causes of problems and potential projects and solutions to remedy undesired conditions of species and their habitats. Incorporating stakeholder involvement can thus improve the overall quality and effectiveness of the AMMP.

5.2 Revisions to the Adaptive Management and Monitoring Plan

Monitoring and adaptive management should be an active and engaged process. The AMMP can be considered comprehensive adaptive management because it provides a thorough framework for monitoring methods, expected results, and assessment of the efficacy of conservation actions in light of internal BGOs and external species and habitat data. The AMMP functions as a handbook for design and implementation of a monitoring program and adaptive management process for the MSHCP. In the future, however, revisions to the AMMP may be warranted. For example, new monitoring techniques or ecosystem indicators may be developed, additional species may be added, or the adaptive management evaluation and action processes may need to be revised. The AMMP is therefore a living document and should be reviewed, revised, and updated at least every four years as part of the adaptive management evaluation process. Revisions to the AMMP and the rationale behind such revisions should be documented in Appendix D.

One critical caveat is that any modifications to monitoring methods must be incorporated in such a way that all previous monitoring data are directly comparable to new monitoring data. For example, new methods should be conducted simultaneously with old methods for more than 1 year to allow for statistical adjustment of any method-dependent biases in the resultant data (e.g., a comparison of relative abundance). If cost prohibits full spatiotemporal overlap of old and new monitoring methods, it should be noted that newly observed patterns in the monitored metric may be due to methodology, underlying changes in the population, or a combination of both. Therefore, at least some temporal overlap is strongly recommended (e.g., monitoring half of the sites using the old methodology and half of the sites using the new methodology for two years before using new methodology at all sites). Proper planning will ensure continuity in the estimates of trends in species and their habitats to comprehensively monitor and successfully manage implementation of the MSHCP.

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Appendix A
Biological Goals and Objectives Linked to SMART Principles

Biological Goals and Objectives		Summary of how BGOs meet SMART principles (Specific, Measureable, Achievable, Result oriented, Time fixed)				
Biological Goal 1	**Maintain or improve habitat quality and quantity within Reserve System lands to promote resiliency, redundancy, and representation for Covered Species.**	**Specific**	**Measur-able**	**Achiev-able**	**Result-oriented**	**Time-fixed**
Objective 1.1	Utilize invasive species treatment methods to maintain or decrease the 8-year average area requiring weed management.	Treated acreage	Acres treated for invasives each year	Yes	Yes, maintain or decrease invasives	8-yr
Objective 1.2	Acquire riparian acreage at an equivalent rate as take over the life of the permit. An 8-year lag after riparian acreage is developed is allowed to account for the willing-seller, willing-buyer basis of property exchange, within the life of the permit.	Acquire riparian at rate of take	Acres treated for invasives each year	Yes; 8-yr lag to accommodate willing seller / willing buyer	1:1 acreage	8-yr lag and life of permit
Objective 1.3	Protect, restore, or otherwise increase the quality and quantity of habitat for MSHCP-Covered Species, as determined by the monitoring methods, definition of quality, and timeframes specified in the AMMP.	Restore and monitor	Quantitative methods in AMMP	Yes	Increased quality/quantity	Assess biennially; continue by following AMMP habitat monitoring timeframe
Objective 1.4	Incorporate natural ecological, hydrological, and geomorphological processes into restoration design and implementation to maintain ecological integrity, ecosystem function, and biological diversity. Include consideration that climate change may result in significant changes in these processes over historical frequencies and magnitudes. Review quadrennially as part of every other AMR using project level worksheets (Appendix B).	Incorporate three processes into restoration design and implementation	Count tally of projects	Yes; relies on self-reporting in B1 worksheets	Improved restoration success	Quadrennially
Objective 1.5	Identify critical uncertainties (e.g., climate change, human population growth) of MSHCP-funded projects on Reserve System lands and report on them in biennial updates to the Reserve System Management Plans.	Identify uncertainties in Reserve System projects	Presence of section updates	Yes	Improved management success	Biennially
Objective 1.6	Incorporate concepts of ecosystem redundancy and representation to promote ecological resiliency in the biennial updates to the Reserve System land Management Plans.	Incorporate two concepts into plan updates	Presence of section updates	Yes	Improved management success	Biennially
Objective 1.7	Protect and enhance connectivity (i.e., road restoration, culvert placement) within Reserve System lands for Desert Tortoise and other high priority Covered Species. Review and report on the status of these projects quadrennially in every other AMR.	Initiate projects	Countable within Implementation Plan and Budget plans	Yes, especially if Reserve System grows	Improved connectivity	Quadrennially
Biological Goal 2	**Maintain stable or increasing populations of Covered Species occurring within Reserve System lands.**	**Specific**	**Measure-able**	**Achieve-able**	**Result-oriented**	**Time-fixed**
Objective 2.1	Monitor Covered Wildlife Species as described in the AMMP. Report quantitative population data, as described in the AMMP, for Covered Species biennially in the AMR and report statistical analyses of population trends quadrennially in every other AMR.	Survey and report	Methods in AMMP	Yes	Collect actionable data.	Biennially AND Quadrennially
Objective 2.2	Conduct surveys for Covered Plant Species as described in the AMMP. Protect, conserve, and monitor known occurrences of these species annually. Report quantitative population data, as described in the AMMP, biennially in the AMR and report statistical analyses of population trends quadrennially in every other AMR.	Survey and report	Methods in AMMP	Yes	Collect actionable data.	Biennially AND Quadrennially
Objective 2.3	Translocate and augment desert tortoise populations in accordance with USFWS guidance through translocation programs that achieve survivorship rates within 10 percentage points of resident tortoise survival rates in the same areas (or with survivorship as prescribed by USFWS guidance). Report survivorship data biennially in the AMR and report analysis on aggregated translocated tortoise survivorship compared to aggregated resident tortoise survivorship quadrennially in every other AMR.	Translocate and monitor survival	Translocation events; quantify survival rates	Yes, assuming availability/permission for translocations	Equivalent survivorship	Quadrennially

Biological Goals and Objectives		Summary of how BGOs meet SMART principles (Specific, Measureable, Achievable, Result oriented, Time fixed)				
Objective 2.4	Ensure the best available scientific information is being evaluated and incorporated into population management efforts for Covered Species, including monitoring methods and identification of critical uncertainties (e.g., climate change, human population growth), by completing a focused literature review (or Systematic Review) and updating it quadrennially in the AMMP.	Review and incorporate	Updated AMMP sections	Yes	Using best available scientific information	Quadrennially / when AMMP is updated
Biological Goal 3	**Foster community and stakeholder engagement to maintain or improve Covered Species populations and their habitats.**	**Specific**	**Measure-able**	**Achieve-able**	**Result-oriented**	**Time-fixed**
Objective 3.1	Develop and disseminate educational materials that cover the following topics: 1) the value of the desert ecosystem in Clark County; 2) promoting responsible recreation; 3) promoting following development procedures; and 4) avoiding and minimizing impacts to the environment. Re-evaluate material's relevance quadrennially (branding, technology, social and recreation trends, etc.).	Education materials on four topics	List of products developed/disseminated annually	Yes	Public and developer education	Annually with re-evaluation quadrennially
Objective 3.2	Protect habitats within the BCCE from unauthorized land use through vigilance (by patrolling an average of at least 100 hours each month) and education (by providing information during encounters). Compile data annually and report quadrennially in every other AMR.	Law enforcement presence	Hours / month; numbers and descriptions of encounters	Yes	Reduce unauthorized uses	Annually and Quadrennially
Objective 3.3	Provide information to permitted users (project proponents, construction personnel, researchers, biological consultants) about best management practices for the desert tortoise and associated reporting procedures. If BMPs are developed for other Covered Species, this objective would expand to apply to them also. Compile data annually and report quadrennially in every other AMR.	Education	Counts / events	Yes	Developer and biologist education	Annually and Quadrennially

Appendix B
Effectiveness Monitoring for Individual Conservation Projects

Appendix B
Effectiveness Monitoring for Individual Conservation Projects

Section 1 Introduction

This appendix is supplementary only and should not be read, used, or cited without first consulting the main AMMP document.

Monitoring is a critical part of conducting conservation actions at multiple levels - from monitoring entire species, populations, and habitat at the level of the landscape down to monitoring the results of individual projects. This Appendix serves as a complement to the AMMP in that while the AMMP describes the large-scale, landscape-level monitoring plan for MSHCP-covered species and their habitats, this Appendix describes the importance, rationale, and utility of project-level effectiveness monitoring.

Effectiveness monitoring is necessary to determine the realized benefits and to quantify the success of an individual conservation project. How it is implemented and what variables are monitored can thus be viewed more broadly. Even clear-cut and/or short-term projects with no expected change over time involve instantaneous post-project "monitoring" which may simply be the quantification of project results. With this broad category of effectiveness monitoring and quantifying realized project outcomes, all projects conducted as part of implementing the MSHCP require monitoring and evaluation.

The type of effectiveness monitoring that is conducted depends on the nature of the conservation action. For example, effectiveness monitoring for a public information and education project might involve tallies of website hits, estimates of video viewership, or follow-up surveys with the target audience. In contrast, effectiveness monitoring for a research project might involve assessment of the field effort and sample size, a compilation of management-oriented results, or counting the number of resultant peer-reviewed publications.

The timeline for conducting effectiveness monitoring also depends on the nature of the project. For example, a fencing project can have one period of "monitoring" immediately following construction (e.g., quantifying the length of fence built) or multiple periods of effectiveness monitoring (e.g., revisiting the fence line 5 years later to determine structural integrity, leading to a distance-time quantified benefit, such as 5 fence mile-years for a 1-mile fence that stood for 5 years). In contrast, a restoration project requires a longer timeline, such as vegetation surveys at the time of restoration completion and again at 3 and 6 years post-restoration to determine plant survival and ecosystem process establishment. Thus, a time period of "0 days" is still on a timeline. This allows for a consistent requirement of post-project quantification of success, whether the nature of the project only requires immediate quantification of success (e.g., number of kilometers of fence constructed) or delayed quantification of success (e.g., proportion of seedlings surviving 10 years post-planting).

Section 2 Effectiveness Monitoring Linked to BGOs and Adaptive Management

All projects conducted as part of implementing the MSHCP are designed to support or accomplish one or more of the MSHCP Biological Objectives. Project-level effectiveness monitoring and documentation lends itself to an informal adaptive management approach. Lessons learned (or realized shortcomings) at the conclusion of a project should be used to

improve study design and/or implementation of future projects that aim to achieve the same Biological Objectives. In order to effectively quantify outcomes, project expectations including performance periods and performance indicators should be set up during project inception and used as a measuring stick at the conclusion of the project (or at pre-determined milestones for a long-term project). To facilitate and thoroughly document project expectations and outcomes with respect to the BGOs, Worksheet B1 represents a version of the Performance Periods and Criteria Table that has been modified to apply to individual projects. This also applies to adaptively managing long-term projects with this process being conducted at pre-determined milestones.

Discussion and explanation for the Project Effectiveness Worksheet (Table B1) is included in the next sub-section.

Table B1. Project Effectiveness Worksheet

Project Title:
Is the project a stand-alone project, part of a long-term on-going project, or SNPLMA project?
Ongoing projects linked to this project:
First year this project can be evaluated for meeting performance indicator:

Contract #	Start Date:	End Date:		Project Status:	Biological Objectives													
Project Performance Period	Performance Indicator(s)	Anticipated Year(s) for Evaluation	Performance Evaluation Results	Lessons Learned/ Take-home Message	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4	3.1	3.2	3.3	Important Interim Notes
Project Objective 1																			
Project Objective 2																			
Project Objective 3																			

Contract #	Start Date:	End Date:		Project Status:	Biological Objectives													
Project Performance Period	Performance Indicator(s)	Anticipated Year(s) for Evaluation	Performance Evaluation Results	Lessons Learned/Take-home Message	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	2.4	3.1	3.2	3.3	Important Interim Notes
Project Objective 1																			
Project Objective 2																			
Project Objective 3																			

2.1 Description and Explanation for the Project Effectiveness Worksheet

The *Project-Level Performance Periods, Performance Indicators, and Indicator Results Worksheet* (Worksheet B1) will be partially filled out at the inception of each project, revisited as needed, and completed at the conclusion of each project. Some projects may only use a very small portion of the table (i.e., are meant to achieve only a few specific objectives) and the evaluation may be very straightforward (e.g., building fence). The following are descriptions and guidance for each column of the worksheet.

Project Title and Header Information:

The header portion of the B1 worksheet is used to track and give context to which contract numbers are grouped together for evaluation. Many DCP projects have multiple phases and/or are recurring over several years. Professional judgement is required to determine how these types of projects should be lumped or split for practical and meaningful performance evaluation.

Project Performance Period Column:

The performance period should be determined by DCP during project inception and/or when the Scope of Work (SOW) is finalized and can be unique for each phase of a project, as well as for each objective for the same project (i.e., for the same restoration project, the performance period for quantifying the final breeding habitat may be different than the timeframe for determining the success in reducing invasive plants). These can also be interim timeframes to evaluate milestone achievement of a project.

Performance Indicators Column:

The performance indicators should be determined by DCP during project inception (and/or during SOW finalization) and should be based on prior knowledge, data, and/or predictions.

Performance Indicator Results Column:

The performance indicator results should be quantified / summarized once the timeframe (or interim timeframes) for the Performance Period has been met. Information in this column should succinctly and quantitatively report whether performance indicators were met.

Lessons Learned / Take-Home Message Column:

Information in this column should be tied to the *Performance Indicator Results*, but may also include other project information or findings that contribute to adaptive management. Follow-up discussion and documentation at the end of the project should be conducted as needed to apply informal adaptive management to upcoming projects, including topics such as: potential reasons performance indicators were or were not achieved, the appropriateness of the performance period—was it too short or too long?, what made the study design effective or not?, are there new methods or techniques that should be considered if a similar project is proposed in the future?, etc.

Section 3 Reporting Project Effectiveness

All conservation projects should have a post-project effectiveness / monitoring component, regardless of the timeline and project expectations, and outcomes should be documented in the Project Effectiveness Worksheet (Table B1). These quantified outcomes should be included in the Biennial Adaptive Management Report. Quantifying the outcome of projects is an opportunity to showcase and highlight the realized benefits of all conservation projects that have

concluded or have monitoring data from the previous two years. It is also a chance to disseminate the species and habitat monitoring data and results on a more frequent basis than the 4-year Adaptive Management Evaluation period. Formal adaptive management is not part of this progress assessment. Quantifying project successes in the Biennial Adaptive Management Report is a place to disseminate species and habitat data and information gained from all post-project effectiveness monitoring actions.

Appendix C
Details of Monitoring Methods for MSHCP-Covered Species and Their Habitats

Appendix C

Details of Monitoring Methods for MSHCP-Covered Species and their Habitats

The AMMP aims to measure the populations and habitats of all covered and proposed species (Attachment C1). Several species, including those listed federally, require full survey efforts to gather sufficient data to inform adaptive management. The following expands on monitoring activities for those species, as well as riparian and upland desert habitats. This appendix is supplementary only and should not be read, used, or cited without first consulting the main AMMP document.

Section 1 Species Monitoring

1.1 Mojave Desert Tortoise and Other Reptiles

Developing effective plans for monitoring populations of rare and cryptic species is essential to help guide conservation efforts. The low number of individuals usually detected for such species, however, generally limits the robust density or abundance estimation methods that can normally be used on more abundant animals. Mojave Desert tortoises are one species for which sampling is challenging due to their low capture probability as related to their fossorial life history, cryptic nature, and patchy spatial distribution.

The goal of monitoring desert tortoise populations within and adjacent to the Boulder City Conservation Easement (BCCE) is to establish baseline data and compare population trends over time on reserve lands to those that occur regionally. These trends can be used to develop triggers for management actions as needed, which may include an increased monitoring effort, predator control, or population augmentation through targeted translocation efforts. Survey methods used previously include belt transects, occupancy (Zylstra and Steidl 2009, Zylstra et al. 2010), study plots of varying size (4 km^2, 1 ha; Berry et al. 2008, Keith et al. 2008), and line-distance sampling (Anderson et al. 2001, Averill-Murray and Averill-Murray 2005). However, line-distance sampling is more appropriate for use over very large scales (e.g., range-wide; Averill-Murray and Averill-Murray 2005) and mark-recapture is prohibitively expensive to consistently achieve reliable estimates for desert tortoises.

Occupancy modeling determines the proportion of habitat within an area that contains evidence of a targeted species (MacKenzie et al. 2002). This method uses detection/non-detection data to estimate species occurrence, and explicitly recognizes that the probability of detection on a single survey may be less than one. In 2011, a pilot project was implemented to test the efficacy of occupancy sampling to monitor desert tortoise populations. The BCCE occupancy monitoring protocol states, “the use of occupancy sampling is based on the assumption that the status and change over time of a population can be assessed by changes in the proportion of the sample units that are occupied or used by the species. This approach assumes that the species will respond to changes in habitat, habitat alteration, or management practices by their occupancy or use of an area. For increases in the population or management success to be detected, tortoises would have to increase in their occupancy of the sample units, and alternatively, a decrease would only be measured by a reduction of sample units occupied by the species” (Desert Conservation Program 2011).

The advantages to using occupancy to sample desert tortoise are that it has been previously used in this region and there is an established protocol and dataset to which results can be

compared. Occupancy modeling is inexpensive when compared to other methods (e.g., line-distance sampling or census mark-recapture plots) and can provide both abundance/density and presence/absence data. Previous research on occupancy modeling of other turtle and tortoise species indicates that it has sufficient power to detect moderate levels of population change within 20 years' time (Zylstra et al. 2010, Erb et al. 2015). Occupancy monitoring is also useful in that it measures the most important state variable for a population – whether a species occurs in part of the landscape. Finally, occupancy can include ecological or management covariates (e.g., vegetation, soil type, invasive species control, and closing roads) within the plot design. The disadvantages of using occupancy are statistical challenges when detection probability is extremely low and a coarse level of inference (e.g., it does not provide robust demographic information, although it can provide abundance/density estimates).

We recommend developing a robust occupancy monitoring plan given its efficiency and its focus on a fundamental population state variable. A set of 4-ha sample units (preferentially including those that were sampled during the pilot occupancy study on the BCCE, where feasible; DCP 2011, Harju and Cambrin 2019) will be sampled annually. Sample size should be determined based on results of simulations, incorporating sampling and process noise in detectability and availability for detection (Harju and Cambrin, in review). Additional guidance can be found in Guillera-Arroita & Lahoz-Monfort (2012), who provide an overview of power analysis for determining sample size for occupancy monitoring studies.

Surveyor(s) should walk 10-m belt transects across the entire plot to complete 100% coverage. Surveyor(s) are expected to investigate all vegetation and burrows for presence of live tortoises, active tortoise burrows, and tortoise sign within each 4-ha sample unit. The low detection probability of tortoises requires an increased number of sampling events than were initially proposed in the pilot study, so each sample unit will be surveyed seven times during the season (between March 1 – May 15). Desert tortoises will be marked using current acceptable methods upon detection and given a visual health assessment. Additional information will be recorded, including sex, midline carapace length, tortoise ID, location, and behavior. Information on desert tortoise burrows will also be recorded, including burrow width, substrate type, burrow location, and any tortoise sign associated with the burrow.

Statistical analysis should follow the equations and methods originally outlined in MacKenzie et al. (2002) and detailed in numerous subsequent papers and books. A variety of statistical programs can be used, including Program R, MARK, PRESENCE, and E-SURGE. Results from the pilot study can be used to determine which level of modeling complexity will be required for the monitoring data and the most appropriate statistical software can then be chosen. Appropriate weather or date covariates should be used in the estimation of detection probability. Harju and Cambrin (2019) discuss modeling strategies robust to inter-annual variation in availability for detection of desert tortoises, but over sufficiently long-time frames, such process noise can be either explicitly modeled or ignored for long-term trend estimation.

There are 12 additional reptile species currently covered by the MSHCP. Three of them (Great Basin collared lizard [*Crotaphytus bicinctores*], desert iguana [*Dipsosaurus dorsalis*], and large-spotted leopard lizard [*Gambelia wislizenii wislizenii*]) will likely be encountered during desert tortoise occupancy surveys. The nine remaining species (banded gecko [*Coleonyx variegatus*], glossy snake [*Arizona elegans*], sidewinder [*Crotalus cerastes*], speckled rattlesnake [*Crotalus mitchellii*], Mojave rattlesnake [*Crotalus scutulatus scutulatus*], California kingsnake [*Lampropeltis getulus californiae*], western leaf-nosed snake [*Phyllorhynchus decurtatus*], western long-nosed snake [*Rhinocheilus lecontei lecontei*], and Sonoran lyre snake [*Trimorphodon biscutatus lambda*]) are not expected to be encountered incidentally because of low population densities and highly cryptic or nocturnal behavior. Nonetheless, encounters of

all 12 additional reptile species should be recorded to allow for possible statistical trend analysis.

1.2 Yellow-Billed Cuckoo

The USFWS-approved survey protocol (Halterman et al. 2016) for yellow-billed cuckoos consists of a minimum of four surveys during the breeding season: once between June 15 – July 1, twice between July 1 – July 31, and once between July 31 – Aug 15. There should be a minimum of 12 and a maximum of 15 days between surveys for each site. Surveys are conducted using call-playback methods in cottonwood-willow habitat. A survey station should be established in each patch of potential habitat > 5 ha and > 300 m from the next nearest patch. The total number of stations depends on the number and size of patches of habitat. Multiple stations should be surveyed in large patches, such that the number of stations (N_s) equals hectares divided by 5 (N_s = hectares / 5). Stations should be evenly spaced. The number of survey stations depends on the amount of potential breeding habitat but should be high enough to allow for robust statistical inference on the proportion of occupied survey sites on riparian reserve system lands. Station locations should be determined prior to June 15 and the same survey stations should be surveyed in consecutive years, where possible. Surveys for the yellow-billed cuckoo and southwestern willow flycatcher may not be conducted simultaneously (i.e., each species requires a separate survey effort). Surveyors must attend a training session and be approved by USFWS to conduct the surveys. See Halterman et al. (2016) for survey protocol details.

1.3 Southwestern Willow Flycatcher

The USFWS-approved survey protocol (Sogge et al. 2010) for southwestern willow flycatcher requires a minimum of three surveys during the breeding season: once between May 15 – May 31, once between June 1 – June 24, and once between June 24 – July 17. Surveys must occur a minimum of 5 days apart. Surveys should occur in potential breeding habitat and should be conducted from within, rather than adjacent to, the patch of habitat. The number of survey sites depends on the amount of potential breeding habitat but should achieve a density of one survey point per 0.4 ha of potential breeding habitat (Sogge et al. 2010). Surveys for yellow-billed cuckoos and southwestern willow flycatchers may not be conducted simultaneously (i.e., each species requires a separate survey effort). Surveyors must attend a training session and be approved by USFWS to conduct the surveys. Surveyors should be experienced at differentiating calls and appearance of similar species, such as other *Empidonax* flycatchers. Consult Sogge et al. (2010) for additional details on survey methods and descriptions of potentially suitable habitat.

1.4 Other MSHCP-covered Bird Species

Surveys for MSHCP-covered bird species without USFWS-approved survey protocols should be conducted in potential habitat annually. This can be accomplished using standard point count survey methods which have been historically used (Ralph et al. 1995, Rosenstock et al. 2002). Alternatively, surveys can also be accomplished using novel passive acoustic recorders which can be cheaper and more effective than human observation (Darras et al. 2019). Species anticipated include summer tanager (*Piranga rubra*), vermillion flycatcher (*Pyrocephalus rubinus*), Arizona Bell's vireo (*Vireo bellii arizonae*), phainopepla (*Phainopepla nitens*), blue grosbeak (*Passerina caerulea*), and American peregrine falcon (*Falco peregrinus anatum*). Point count or passive acoustic stations should be established in riparian reserve units, spaced

a minimum of 250 m apart. Both point count and passive acoustic methods allow for the estimation of species occupancy or abundance/density estimation (e.g., distance sampling, count regression models, N-mixture modeling incorporating imperfect detection [Royle 2004]). A sufficient number of point count or passive acoustic stations should be determined on reserve system lands to allow for robust statistical inference. Multiple visits for point counts, separated by a minimum of 5 days, should be made to each station during the general bird breeding season (early-mid April through mid-June). At least two visits are required for passive acoustic monitoring in order to deploy the units and retrieve the data, although additional visits may be necessary for general maintenance, repair, and battery replacement. The passive nature of passive acoustic units means that surveys can be conducted for 24 hours per day over long time periods. Because of the specific habitat and high attention requirements of federal protocols for surveying for southwestern willow flycatcher and yellow-billed cuckoo, other MSHCP-covered bird species must be surveyed separately.

1.5 Bats

Passive acoustic bat call surveys should be used for efficient monitoring of trends in occupancy of MSHCP-covered bat species (silver-haired bat [*Lasionycteris noctivagans*], long-eared myotis [*Myotis evotis*], and long-legged myotis [*Myotis volans*]). Passive acoustic recorders should be used (e.g., Anabat SD2 Active Bat Detector). These detectors can be coupled with battery power sources and left in the field during surveys. The results are stored on the unit and can be downloaded for species assessment of each recorded call using the Analook software.

A series of fixed sampling stations has been found to be more effective at estimating spatial heterogeneity in bat species occurrence than continuous walking surveys (Stahlschmidt & Brühl 2012, Loeb et al. 2015). Thus, a series of fixed-location stations should be set up within the riparian and desert upland reserve systems. By surveying the same locations in multiple years, comparisons of changes in occupancy can be made while removing the effect of noise derived from sample site variability. Sampling stations should be located randomly or systematically random such that the entire reserve system is sufficiently sampled, and all acoustic detectors are at least 2 km apart. A multi-year pilot study on the DCP reserve system found high site-to-site variation in the number of species detected (S. Ferrazzano, pers. comm.). Because the goal of this monitoring is to monitor trends of as many MSHCP-covered species as possible (ideally all covered species), choosing sites with the highest diversity observed in the pilot study is recommended. Temporally, Skalak et al. (2012) found that bat species accumulation curves in acoustic monitoring programs indicate that it took 30-45 days to detect all species present at a site. Therefore, acoustic detectors should be deployed for at least 30 days (i.e., ~4 weeks) and up to 45 days (i.e., ~6 weeks). There is also a spatio-temporal intensity consideration, whereby a fixed number of acoustic detectors can be deployed for short periods at a higher number of stations or for longer at a lower number of stations. It is recommended that fewer sites be surveyed more frequently among years to better estimate long-term trends of species' populations at the high diversity sites. There is also the potential that grid cells (10 km x 10 km) selected by the North American Bat Monitoring Program (Loeb et al. 2015) fall within Clark County reserve lands and could be used as sampling stations to monitor bats across multiple years if survey methods align. The added benefit of using these grid cells is that the data collected would be added to a larger database that is monitoring bat species nationwide (Loeb et al. 2015). Analysis of acoustic recorder data should follow standard occupancy analysis methods that account for imperfect detection (e.g., package 'unmarked' in Program R). Environmental covariates (e.g., temperature, moon phase, wind speed, etc.) and date should be considered as potential covariates on detection probability.

1.6 Plant Species

Personnel for the National Park Service (NPS) Lake Mead National Recreation Area (LMNRA) have designed and implemented appropriate protocols for long-term monitoring for at least five rare plant species covered by the MSHCP (Bangle et al. 2010). These protocols have been in use since 2007 on both NPS- and Bureau of Land Management (BLM)-managed lands in Clark County. These protocols will be adopted by the DCP for monitoring populations and habitats of Las Vegas bearpoppy (*Arctomecon californica*), white bearpoppy (*Arctomecon merriamii*), sticky ringstem (*Anulocaulis leiosolenus*), threecorner milkvetch (*Astragalus geyeri* var. *triquetrus)*, and sticky buckwheat (*Eriogonum viscidulum*) that occur on reserve system lands. In the event Clark County surveys private lands or other durable lands for these species, DCP will implement these protocols where appropriate. These protocols can be adapted for monitoring additional covered plant species in collaboration with personnel from NPS, BLM, and NNHP. There are 32 additional MSHCP-covered plant species, and if populations are located and accessible, they should be monitored using these methods as well as the five species detailed here.

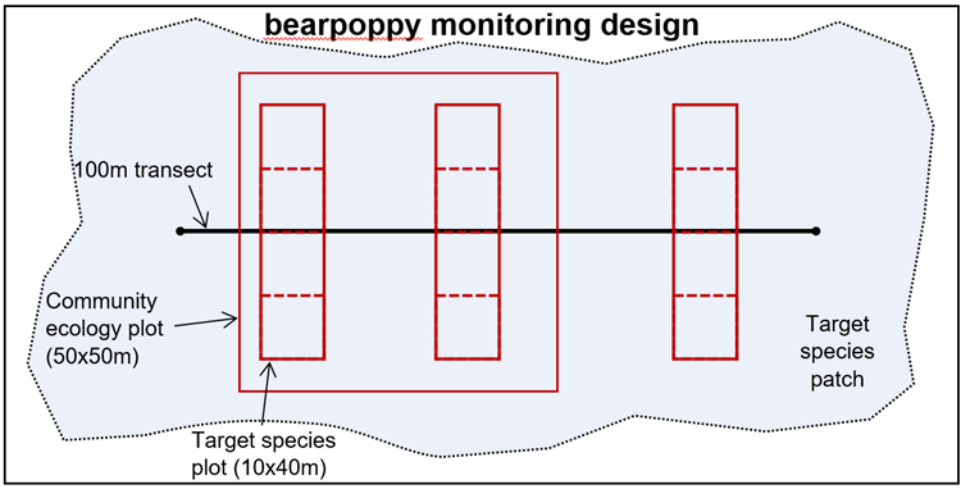
The three-tiered NPS monitoring approach is described in detail by Bangle et al. (2010). This approach will result in data that can be used to evaluate progress towards Biological Objective 2.2. Below is a brief summary of the protocols being used for bearpoppy population and habitat monitoring.

The NPS program is designed to achieve the following monitoring objectives:

- Determine if the current density of [Covered Plant Species] at monitored populations occurring on [private land and durable public lands] within Clark County remains within 30% of the first measurement over the next 10 years.
- Determine the abiotic factors that influence the density of [Covered Plant Species] monitored populations occurring on [private land and durable public lands] within Clark County and over the next 10 years.
- Determine if native plant community biodiversity at monitored [Covered Plant Species] populations occurring on [private land and durable public lands] within Clark County remain within 30% of the first measurement over the next 10 years.

A 100-m transect is established within a patch (population or “sub-population”) and the ends are permanently marked (Figure C1). To address trends in density of bearpoppies, three permanent 10x40-m plots are located in a restricted random manner along the transect. Annually, all bearpoppy plants are recorded along with size class, condition, and phenology of each plant, and each plant’s location is mapped. Every 5 years (and/or in years of above average rainfall), all plant species found within a single large 50x50-m plot are recorded. Additionally, within this “community ecology plot," the number of rare plant individuals, foliar cover for all plant species, and levels of disturbance and invasive plant species presence are noted. Abiotic factors (soil moisture, texture, and chemistry) will be measured in 1x1-m temporary plots subjectively located in areas with high, low, and zero densities of bearpoppies during the first monitoring year and periodically after that.

Figure C1. Example Plot Layout Design for Three-Tiered Monitoring of Las Vegas and White Bearpoppy Species (adapted from Bangle et al. 2010)



Data on rare plant species observations will be reported biennially in the AMR and statistical analyses of population trends will be reported quadrennially (in every other AMR). Data from the community ecology plots will be reported during the first AMR following data collection and trend analyses will be reported during the next AMR when population trends are reported.

Further details on objectives, sampling design, monitoring periods, field methods and equipment, data storage and analysis, and reporting are available in Bangle et al. (2010) Appendices 1-3.

1.7 Invertebrate Species

There are ten invertebrate species currently covered by the MSHCP. There are no proposed monitoring methods for them because they all occur in habitats not expected to be impacted by private land development in Clark County. None of the ten current MSHCP-covered invertebrates are proposed for future listing under an amended permit.

1.8 Proposed Covered Species

Proposed covered species are those currently being considered for listing under an amended MSHCP and Incidental Take Permit. Because they are not covered by the current MSHCP, they are not required to be monitored as part of this AMMP. To balance their currently non-covered and potentially future-covered status, these species should be included in existing monitoring efforts for a better, longer-term understanding of population trends. Individual monitoring efforts should be designed and enacted following inclusion of these species in an amended MSHCP.

Specifically:

- Proposed bird species (golden eagle [*Aquila chrysaetos]*, western burrowing owl [*Athene cunicularia hypugea*], gilded flicker [*Colaptes chrysoides*], loggerhead shrike [*Lanius ludovicianus*], Ridgway's rail [*Rallus obsoletus yumanensis*], Bendire's thrasher [*Toxostoma bendirei*], and Le Conte's thrasher [*Toxostoma lecontei*]) should be monitored using existing point count surveys.

- Proposed bat species (Townsend's big-eared bat [*Corynorhinus townsendii*] and spotted bat [*Euderma maculatum*]) should be monitored using existing passive acoustic surveys.
- Proposed mammal species (desert pocket mouse [*Chaetodipus penicillatus sobrinus*]) are assumed to be covered by monitoring desert upland habitat quality (see below).
- Proposed reptile species (banded Gila monster [*Heloderma suspectum cinctum*]) are assumed to be covered by monitoring desert upland habitat quality.
- Proposed invertebrate species (monarch butterfly [*Danaus plexippus*] and Mojave poppy bee [*Perdita meconis*]) are assumed to be covered by monitoring desert upland habitat quality and populations of Las Vegas bearpoppy.
- Proposed plant species (silverleaf sunray [*Enceliopsis argophylla*], Las Vegas buckwheat [*Eriogonum corymbosum* var. *nilesii*], St. George blue-eyed grass [*Sisyrinchium radicatum*], and eastern Joshua tree [*Yucca jaegeriana*]) are assumed to be covered by monitoring desert upland habitat quality but may be included in existing monitoring of MSHCP-covered plant species if nearby populations are located. Eastern Joshua tree populations may require different monitoring methods.

Section 2 Habitat Monitoring

Monitoring "habitat area conditions" is a critical component of the adaptive management process and is necessary in order to fully comply with the MSHCP. Collecting quantitative data enables rigorous characterization and analysis of ecosystem status and trends and provides information necessary for timely management intervention to slow or reverse undesirable trends. Qualitative assessments (e.g., fixed-point photography) are also extremely useful for communication with a broader audience and for illustrating the conclusions from quantitative analyses.

2.1 Riparian

Characterizing riparian habitat condition or 'quality' includes measures of vegetation cover, vegetation height and complexities of height, vegetation density, plant vigor, and assessment of stream stability. Habitat quality can be derived from these characteristics, but context and specificity need to be provided; quality for who, or what? Species that rely on riparian areas vary widely in habitat requirements and high-quality habitat for one species may be unusable habitat for another. To aide in defining riparian habitat quality for DCP durable properties, we use the MSHCP-covered avian species habitat requirements as a proxy, and more specifically, we focus on breeding habitat requirements because they are a prerequisite for supporting species populations.

Suitable breeding habitat may remain unoccupied over short timespans due to larger fluctuations in bird population size, irruptive dispersal patterns, and microclimate variability that influences prey resources. Yet breeding habitat remains critical for bird populations over long time spans. Monitoring changes in the extent and quality of breeding habitat can therefore complement species surveys of breeding populations. Several well–studied species (e.g., yellow-billed cuckoo, southwestern willow flycatcher, and Arizona Bell's vireo) have specific habitat requirements (e.g., patch size, vegetative species composition, etc.), while specific guidelines and benchmarks that define habitat suitability for lesser-studied species are not always available (GBBO 2010, Sogge et al. 2010, Halterman et al. 2016). In contrast, the general habitat associations for MSHCP-covered bird species are known (Table C1) and,

combined with the California Wildlife Habitat Relationship (CWHR) information (Section 2.1.1 and Table C2), should form the backbone of long-term monitoring on DCP's riparian properties.

Riparian habitat monitoring includes measuring **vegetation cover, height, density, vigor**, and periodic evaluation of **stream bank metrics** using remotely sensed data with ground-truthing. These characteristics inform overall habitat trends. Of these characteristics, vegetation cover and height are further relied on to identify whether the habitat is likely useable for each of the MSHCP-covered avian species. The following sections and tables describe and quantify habitat characteristics important for MSHCP-covered avian species, then describe monitoring methods and sensors, and finally describe monitoring frequency and timelines.

2.1.1 MSHCP-Covered Avian Species Habitat Characteristics

MSHCP-covered avian species that likely use riparian areas are included in Table C1, with a concise summary of best available information on their habitat preferences.

Table C1. General Habitat Requirements of MSHCP-Covered Bird Species

Species	Habitat	Habitat Mosaic	Plant Density	Required Patch Size for Breeding	References
SWFL	Lowland riparian (Mojave and Great Basin), springs, marsh	Extensive thickets of willow or other riparian shrubs with saturated soils and nearby surface water	Dense riparian veg. >4 m high, >50% cover, tall canopy trees scattered / absent	2 acres (min) / >15 acres (optimal)	GBBO 2010 USFWS 2013
YBCU	Lowland riparian (Mojave and Great Basin), springs	Large, intact patches of riparian forest, or tall, riparian shrub thickets, diverse vertical structure	High (>50% cover) with canopy heights varying from 5-30 m	>50 ac (min) / >200 ac (optimal)	GBBO 2010 USFWS 2014
PEFA	Open environments with suitable nesting cliffs (ledges / holes on rocky cliffs)	Open environments including water, desert shrub, and marshes, adjacent to suitable nesting cliffs	-	-	USFWS 2003, NDNH 2016
BEVI	Lowland riparian (Mojave Mesquite-Acacia), springs	Structurally diverse habitat and saturated soils; currently in saltcedar, native trees increase habitat value	Dense shrub understory up to 3 m high; tree overstory relatively open / absent	>12 ac (min) / >49 ac (optimal)	GBBO 2010
BLGR	Lowland riparian (Mojave and Great Basin)	Shrubby woodland edges of riparian habitat	Open canopy, forest edges, shrubby and herbaceous understory	-	White 1998
PHAI	Riparian, shrubland, woodland, desert	Habitat with suitable structure, associated with desert trees bearing mistletoe	-	-	NDOW 2011, Crampton & Sedinger 2011
SUTA	Lowland riparian (Mojave and Great Basin)	Well-developed, continuous cottonwood-willow stands	Dense canopies and trees <9 m tall	100 acres can support 20-30 birds	BLM 2016
VEFL	Lowland riparian (Mojave and Great Basin)	Riparian woodlands and adjacent scrublands	Open habitat with scattered trees, does not tolerate dense, shrubby understory or dense canopy	-	BLM 2016

Distilling the information provided in Table C1 into quantitative measurements that can be consistently applied is challenging; however, the CWHR system was designed to address this type of situation. The CWHR system evaluates a plethora of habitat data and information for each species and condenses it into basic metrics that can be consistently measured and summarized. The CWHR provides a matrix of vegetation characteristics and ranks them for species' suitability for reproductive, cover, and feeding habitat (Garrison et al., 2017). Each matrix and rating are specific to ecosystem type (e.g., desert riparian) and to the season each species is present.

We used habitat criteria for each species, as described in CWHR, in companion with the habitat descriptions for MSHCP-Covered species in Table C1. We consolidated CWHR information into a single table showing which vegetation size classes and closure/cover classes meet high or moderate suitability ratings for reproduction for each MSHCP-covered species (Table C2). Full reports on CHWR habitat for each MSHCP-covered riparian avian species are included in Attachment C2.

Table C2. Matrix showing which habitat classes are 'High' (Optimal) or 'Medium' for breeding habitat for each MSHCP-Covered Riparian Avian Species (Adapted from Garrison et al. 2017)

Size Class	Closure & Cover Class for Desert Riparian Habitats (CWHR, Garrison et al 2017)			
	S: Sparse Cover (2.0 - 9.9%)	P: Open Cover (10.0 - 39.9%)	M: Moderate Cover (40.0 - 59.9%)	D: Dense Cover (≥ 60.0%)
1: Seedling Tree/Shrub (<2.0 ft)	None	None	None	None
2: Small Tree/Shrub (2.0-9.9 ft)	VEFL	YBCU BLGR BEVI VEFL	YBCU BLGR BEVI VEFL	YBCU BLGR BEVI VEFL
3: Medium Tree/ Shrub (10.0-19.9 ft)	VEFL	YBCU BLGR SUTA BEVI VEFL	YBCU SWLF[a] BLGR SUTA BEVI VEFL	YBCU SWFL BLGR SUTA BEVI VEFL
4: Large Tree (20.0+ ft)	SUTA	YBCU BLGR SUTA BEVI	YBCU BLGR SUTA BEVI VEFL	YBCU BLGR SUTA BEVI VEFL

[a]Southwestern willow flycatcher ratings in this table are based on information in Table C1, above, because the California Wildlife Habitat Relationship document indicates it is a migrant species in desert riparian ecosystem types and does not include 'reproductive' habitat ratings; however, it is known to breed in desert riparian habitat in Clark County (DCP, unpublished data).

The CWHR also identifies specific habitat elements that are known to influence or support the presence of each avian species. These elements are presented as a checklist datasheet that can be completed any time while on DCP's riparian properties (Attachment C3). Each species' CWHR information sheet (Attachment C2) indicates which habitat elements are desired for reproduction, cover, and feeding. This information is consolidated into a matrix that shows the habitat elements relevant for reproduction of each MSHCP-covered species (Table C3). These select habitat elements should be attainable through remotely sensed derived data. The full datasheet may be used when visiting each property and the resultant information can be used as companion data, but a thorough use of the habitat element checklist is likely not required (i.e., determining presence/absence of every habitat element on the checklist may be time consuming and unwarranted when only a select few habitat elements are relevant for the six riparian MSHCP-covered avian species).

Table C3. California Wildlife Habitat Relationship Habitat Elements for Breeding Habitat by species (Adapted from Garrison et al. 2017)

Habitat Elements		Essential[a]	Secondary Essential[b]	Preferred[c]
HABITAT EDGE ELEMENTS	SHRUB/WATER		SWFL BEVI VEFL	
	SHRUB/AGRICULTURE		BLGR	
	SHRUB/GRASS		BLGR	PHAI
	TREE/GRASS			PHAI
	TREE/SHRUB		YBCU PHAI	SUTA BEVI
	TREE/AGRICULTURE		VEFL	
	TREE/WATER		YBCU SWFL[d] SUTA VEFL	
LIVE VEGETATIVE COVER	LAYER - SHRUB		BLGR	PHAI BEVI
	LAYER - TREE		YBCU	BLGR VEFL PHAI
	RIPARIAN INCLUSION	BEVI	YBCU SWFL BLGR SUTA VEFL PHAI	
	TREES - HARDWOOD		YBCU SUTA	BLGR VEFL PHAI

[a]Essential = Required for the species to exist; must be present in habitat if species is to be present.

[b]Secondarily Essential = Required but may be replaced by other secondarily essential elements.

[c]Preferred = Used, but marginally helpful for survival; enhances habitat suitability, but is not essential for species to be present.

[d]Southwestern willow flycatcher ratings in this table are based on information in Table C1

2.1.2 Riparian Habitat Monitoring Methods and Sensors

Long-term riparian monitoring will rely on remote sensing, with field work required for ground-truthing. There are many sources and resolutions of remotely sensed data available, and capabilities (i.e., finer resolution / sensitivity) will increase over time. Therefore, tools and analyses specified in this section are not prescriptive of the types or sources of remotely sensed

data, but instead, represent a minimum level of accuracy / resolution / sensitivity to maintain over time (Table C4 and Table C5).

Table C4 presents the recommended habitat attributes to describe riparian habitat condition, associated minimum change-detection, example analyses, and the recommended sensor(s) for each analysis. They are summarized here:

- Habitat attributes are those identified as informing overall habitat condition: vegetation cover, height, density, vigor, and geomorphology.
- Minimum change-detection (resolution) for each attribute is defined by using information from Table C2. The smallest plant height increment listed in Table C2 is 2 feet (0.61 m), which means that the sensitivity of the tool or sensor used to quantify plant height should be able to detect a 2-foot change in plant height. The smallest cover/closure class increment is 2% (the minimum threshold for 'sparse' cover); however, it is unrealistic to achieve a 2% sensitivity in vegetation cover. In this case, the threshold between 'sparse' and 'open' cover (10% cover) can be used as the minimum increment for cover/closure class detection. Minimum change detection is not defined for vegetation density, vigor, or geomorphology because those attributes inform overall habitat condition but are not directly related to quality of breeding habitat for the MSHCP-covered avian species.
- Specific attributes and analyses are nested within each overarching habitat attribute. They provide more detail on the exact metric(s) that should be extracted from the remotely sensed data. Analysis methods to calculate these attributes are expected to change over time with technology and software advances. Multiple analyses can provide similar metrics that represent the same habitat attribute (e.g., Leaf Area Index (LAI) and Leaf Area Density (LAD) both quantify vegetation density but are derived from different sensors; practitioners may choose which metric to calculate, as long as it is kept consistent/comparable between monitoring events). Currently, these analyses can be completed using a combination of proprietary and freeware software, such as Global Mapper, FUSION, QGIS/GRASS, and Program R (See Alta [2022] for specific analysis packages used).
- Recommended sensors to produce quantitative results for each metric are based on technologies currently considered very high-resolution (i.e., low elevation drone-based), and include 4+ band multispectral (MS) imagery, Light Detection and Ranging (LiDAR), and Red-Green-Blue (RGB) imagery. Table C5 provides more information on specifications for these sensors.

Table C4. Habitat attributes, minimum change-detection, and recommended analyses and sensors for long-term riparian habitat monitoring

Habitat Attribute	Minimum Change-detection (resolution)	Specific Attribute / Analysis	Recommended Sensor for Quantitative Results
Cover[a]	10% cover change (Table C2, above)	Vegetation and ground composition	4+ Band MS
			LiDAR
		Total cover	4+ Band MS; and/or LiDAR (CRR analysis)
		Cover by group and/or species	4+ Band MS
		Understory vs overstory	LiDAR
Height[a]	2.0-ft height change (Table C2, above)	Overall/average height	LiDAR
		Height by canopy level	LiDAR
Vegetation Density[b]	Not required for CWHR	LAI/LAD	4+ Band MS (LAI); and/or LiDAR (LAD)
		NDVI / MSAVI	4+ Band MS
Vigor/ Greenness[b]	Not required for CWHR	NDVI/MSAVI/TGI (visible bands)	4+ Band MS
		Live vs stressed vs dead	RGB and/or 4+ Band MS (neither sensor will result in a reliably quantitative analysis)
Geomorphology[b]	Not required for CWHR	Slopes/bank height	LiDAR

CWHR = California Wildlife Habitat Relationships

LAD = Leaf Area Density
LAI = Leaf Area Index
LiDAR = Light Detection and Ranging
MS = multispectral
MSAVI = Modified Soil-Adjusted Vegetation Index
NVDI = Normalized Difference Vegetation Index
RGB = Red-Green-Blue
TGI = Triangular Greenness Index

[a] Required attribute for CWHR.
[b] Not required, but highly recommended for characterizing general riparian habitat health and to document change over time. These habitat attributes are calculated from the same dataset as those required for CWHR.

Data sources for 4+ Band MS and LiDAR may vary over time and across each parcel. Some data may be acquired opportunistically on a project-by-project basis that can be used to detect intermediate change-detection resolutions. A very high resolution (e.g., low-elevation drone-based) of baseline data should be collected for all new durable parcels as they are acquired by DCP, and subsequent large-scale data collection (remote sensing with appropriate ground-truthing) should occur at appropriate frequencies (Table C5). Coarser-resolution data, such as

0.5-meter NAIP imagery (including NAIP 4-band), may be used for interim analyses, while higher-resolution data should be collected periodically (Table C5), or on a project-by-project basis. As site-specific data is obtained at varying resolutions, resulting analyses will inform minimum sensor resolution requirements that can achieve the minimum change detection specified in Table C4.

Table C5. Minimum requirements for sensor resolution / sensitivity and frequency of data collection

Sensor Type	Estimated Resolution Requirements	Frequency of Data Collection
4+ Band MS	≤10-cm GSD	Baseline data collection when property is acquired, then every 4 yrs for habitat change-detection
LiDAR	Average ≥ 100 returns/m²; (current technology means that this density of returns requires drone-based LiDAR)	Baseline data collection when property is acquired, then every 10 yrs for vegetation height, canopy layer, and geomorphic change-detection
RGB Camera	≤2 cm GSD	Opportunistic data collection; anticipated collection for specific projects; data should be retained for interim qualitative analysis

MS = Multispectral imaging
GSD = Ground Sampling Distance
LiDAR = Light Detection and Ranging
RGB = Red-Green-Blue

2.2 Desert Upland

Monitoring within the desert upland reserve system is designed to provide timely information on the status and trends of key attributes of ecosystem structure and function (Table C6). A quantitative approach will facilitate assessments and trend detection of important ecosystem attributes and processes that contribute to biotic integrity, soil and site stability, and hydrologic function (Belnap et al. 2008, Herrick et al. 2009, Herrick et al. 2017). Biotic integrity is the capacity of a site to support characteristic functional and structural communities in the context of normal variability, to resist loss of this function and structure, and to recover following disturbance (Herrick et al. 2009). Soil and site stability is the capacity of the site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water erosion (Herrick et al. 2009). Hydrologic function is the capacity of the site to capture, store, and safely release water from rainfall, run-on, and snowmelt (Herrick et al. 2009).

DCP's durable desert upland property consists of the BCCE which is the focus for long-term monitoring. However, the monitoring methods and measured attributes described here are

adaptable to other lands that may fall under DCP management in the future. This will ensure that methods, and therefore results, can be compared to surrounding lands and lend context to habitat and ecosystem trends on DCP properties.

Monitoring will include quantitative measures of five key attributes as well as a qualitative record of conditions observed at the time of data collection (e.g., fixed-point photos, narratives about erosion features and land uses; Table C6). Because climate is a driver of ecosystem structure and function, weather data collection will also be integrated into the monitoring program.

Table C6. Key Attributes for the Assessment, Inventory, and Monitoring Strategy, their Recommended Collection Methods, and Estimated Time Requirements

		Estimated Time (hours/plot)*		
Attribute	**Method**	**Year 1**	**Year 2**	**Additional Comments**
Qualitative Record *includes recent weather, erosion signs, land use observations*	Plot characterization and observation	0.5-1.0	0.2	After initial setup only updates are necessary – recent weather, erosion signs, land use observations
	Fixed-point photographs	0.1-0.2	0.1	
Vegetation Composition *foliar cover (LPI), species richness, invasive species & rare species presence/absence*	Line point intercept (LPI)	0.5-1.5	0.5-0.75	
	Species inventory	0.25	0.25	
Vertical Structure	Vegetation height	0.25-0.5	0.2-0.5	
Bare Ground	LPI			Bare ground is collected simultaneously with the foliar LPI
Proportion of Soil Surface in Gaps	Canopy gap intercept	0.1-1.0	0.1-0.5	Canopy and basal gap methods are reported separately, but are typically performed simultaneously, thus the time to complete the gap methods is a combined 0.2-1.0 hrs
	Basal gap intercept	0.1-1.0	0.1-0.5	
Soil Aggregate Stability	Soil stability test	0.4-0.6	0.0-0.4	After Year 1, there is little benefit from repeating this measurement unless there is evidence of change in erosion/deposition, or knowledge that there may be a change in erosion susceptibility, e.g., road construction or maintenance, change in recreation activities

* The AIM Core Method is a quantitative approach that generally takes 2-6 hours to complete per plot (Herrick et al 2017) in the initial year. The time commitment can be expected to decrease to 1.5-3 hours in subsequent years as crews gain experience and as the list of identified species becomes more comprehensive.

2.2.1 Quantitative Monitoring Methods

The DCP should implement the BLM Assessment, Inventory, and Monitoring strategy (AIM). Use of the AIM strategy will result in monitoring outcomes that can be easily compared to the results obtained by BLM on surrounding lands in Clark County and throughout the Mojave

Desert. Other government agencies, including the Nevada Department of Wildlife, the U.S. Agricultural Research Service, U.S. Forest Service, and U.S. Natural Resources Conservation Service are using AIM strategies and methods, as are private organizations such as The Nature Conservancy.

The AIM strategy and methods are described in *Volume 1: Core Methods, Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems* (Herrick et al 2017; hereafter *Core Methods*). Development of the sampling design can be a collaborative activity between DCP staff and the Science Advisor Panel, along with experienced BLM and Nevada Department of Wildlife personnel, to ensure implementation is feasible and that the results will be comparable with surrounding area monitoring programs.

The *Core Methods* manual guides users through the parts of the decision-making process for setting up the sampling design, including options to fit the needs of specific users (e.g., the DCP), while still ensuring compatibility and comparability across all AIM sites. The following are elements for initiating the proposed upland long-term monitoring protocol:

- Frequency of monitoring – We estimate a sampling frequency of 1-5 years for attributes being measured using AIM, with the exception of the soil aggregate stability which likely will be measured on a 10-year interval. Weather/climate is the only attribute identified during the workshop that is not measured using AIM protocols (see Section 4.5.3 in the main text).
- Number of plots (sample size) – Based on power analyses of existing AIM data for the metrics listed in Figure C2, it is recommended that 35 plots be established. After three years of data collection the power analyses can be re-run to determine if the number of plots can be decreased based on observed vegetation variability on the BCCE. Future expansions of the upland reserve system will require revisiting the collected data and power analyses.

Plot locations – Plots should be randomly distributed across the BCCE. The *Core Methods* manual provides several examples for compatible plot layouts (Figure C2). The most frequently used plot layout is panel *(a) 'spoke design'* in Figure C2 and is the recommended design for the upland monitoring plan. This design, as instituted by the BLM in Nevada, consists of three 25 meter (m) transects radiating from a central point. All quantitative ecosystem data from Figure C2 is collected using these transects: vegetation composition, vertical structure, bare ground, canopy and basal gaps, and soil stability.

Figure C2. Example Plot Layout Designs for AIM Core Methods (taken from Figure 5, Core Methods, Herrick et al. 2017)

PLOT LAYOUT	DESCRIPTION	
(a) Spoke Design	25 m spoke design covers ~0.3-hectare (~0.7 acres). 50 m (~75 ft) spoke design covers a 1 hectare (~2.35 acres) area. Transects begin 5 m (15 ft) from the plot's center to focus trampling around center stake and minimize disturbance effects on transects.	
(b) Intersecting Design	The NRI intersecting transect design covers ~0.2 hectares (~0.4 acres). Two 50 m (150 ft) transects intersect at the 25 m (75 ft) mark at plot center. The transect arms are oriented 45 degrees in both directions from magnetic north.	
(c) Parallel Transect Design	Standard transect length is 25 m (75 ft). Parallel transects are evenly spaced. Transects may run perpendicular to the slope or perpendicular to a randomly selected azimuth.	
(d) Single Transect Design	Standard transect length is 25 m (75 ft); a multiple single transect design is often used to maximize replication at landscape scale.	
(e) Linear Feature Design (e.g., riparian)	Standard transect length is 25 m (75 ft); a multiple single transect design is often used to maximize replication at landscape scale. Length may vary depending on linear feature size, extent, or potential impact.	

2.2.2 Qualitative Monitoring Methods

Two types of qualitative monitoring methods are described below that could be used for monitoring vegetation on desert upland reserve system lands.

- Photo points repeated over time can be used to observe gross changes in vegetation structure and soil erosion and are important for a visual record of each location. Photographs are also effective for illustrating the patterns and trends characterized by the quantitative data.
- Indicators of rangeland health may precede, or subsequently augment, quantitative measurements. Site attributes of soil stability, hydrologic function, and biotic integrity can be assessed by evaluating indicators including: rills (small erosional rivulets), water flow patterns, pedestals, gullies, areas with soil deposition or blowouts, soil compaction, soil stability, plant mortality, and evidence of reproduction and recruitment (flowers, fruits and seedlings). A standardized protocol for the assessment and interpretation of these range health indicators is readily available (i.e., Attachment C4, Pellant et al. 2005).

2.2.3 Distribution and Number of Sampling Locations

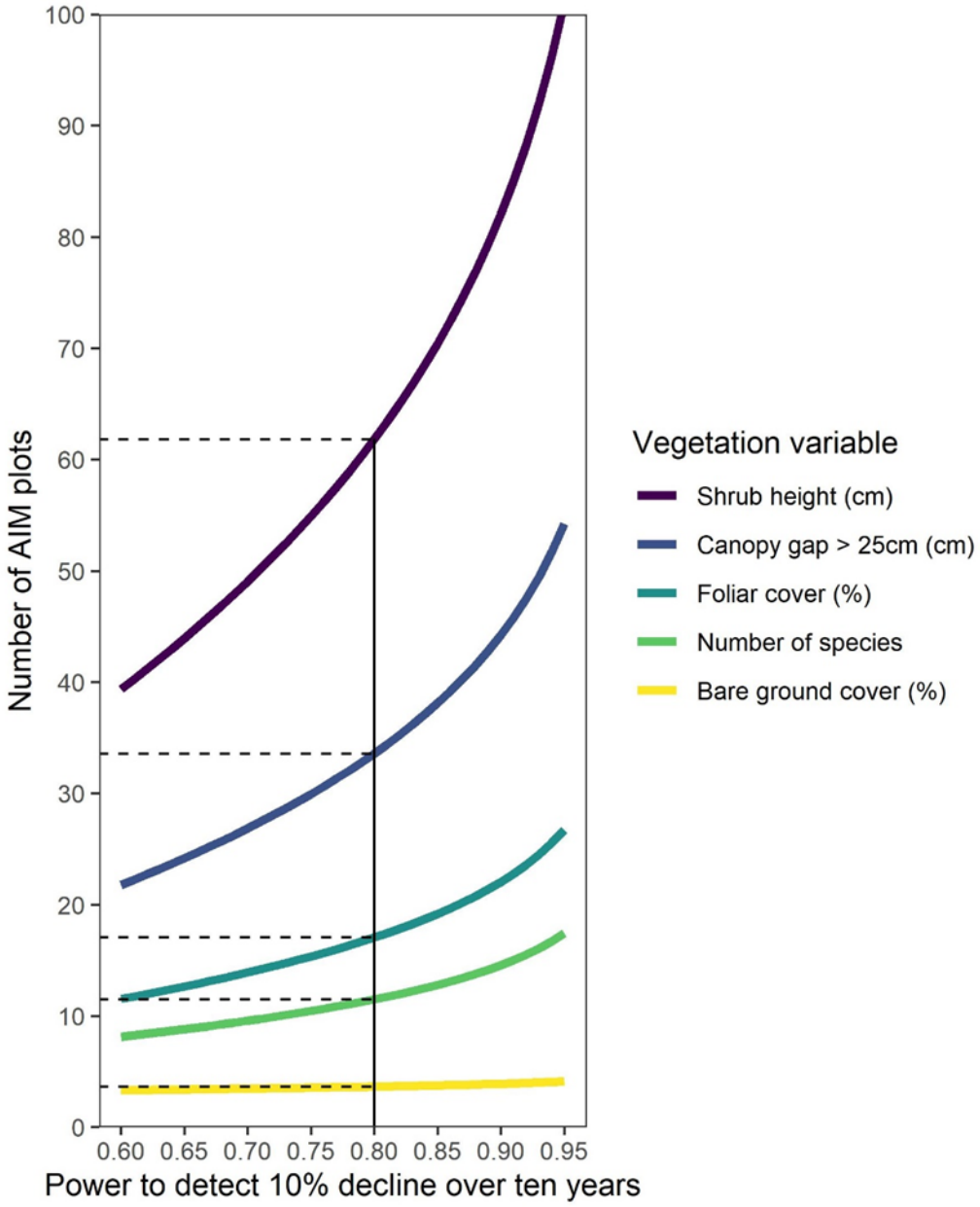
Distribution of plots: random

Number of sampling locations: 35

Upland vegetation monitoring plots should be randomly distributed across the BCCE with a minimum spacing of 1 km between points to avoid double sampling and to ensure full spatial

coverage of the BCCE. Initially, 35 plots should be established. The number of plots was determined from power analyses of existing AIM vegetation within Clark County and below 1,220 m from 2011 to 2021. The data were filtered to plots with samples taken in > 1 year to estimate annualized rates of change in the measured variables for each plot. The standard deviation of the across-plot annualized rate of change was used in power analyses to estimate the range of sample sizes needed for a range of power levels to detect a 1% point decline in each of the five assessed variables over a ten-year period (i.e., 10% point decline over 10 years). The five assessed variables were percent foliar cover, percent bare ground, length of vegetations gaps > 25 cm, shrub height (cm), and number of non-noxious species. With a standard Type I error rate of $\alpha = 0.05$ and a specified power of 0.80 (the standard accepted power for statistical analyses which equals a Type II error rate $\beta = 0.20$), required sample sizes to detect the 10-year 10% decline ranged from ~ 4 to 62 plots (Figure C3). Because of the high number of plots to detect change in shrub height compared to the other variables, 35 plots are expected sufficient for detecting a 10-year 10% decline in the other four metrics and represent a reasonable tradeoff between statistical power and efficient sampling. Because these power analyses were conducted on AIM data from across Clark County, after three years of sampling, a new power analysis using data from the BCCE only may result in fewer plots necessary for sampling, assuming higher vegetation homogeneity among plots within the BCCE compared to the entirety of Clark County.

Figure C3. Sample Sizes Required to Detect a 10% Decline in Five Vegetation Variables



Vertical solid line represents standard accepted power of 0.80 (i.e. Type II error rate of 0.20). Horizontal dashed lines represent sample sizes where the respective power curve reaches power = 0.80.

2.2.4 Statistical Analysis

Vegetation data should be analyzed for trends or stasis using appropriate statistical techniques, in particular via regression modeling appropriate for the distributions of each vegetation variable (Herrick et al. 2009).

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Attachment C1

Summary of Monitoring Methods for 78 MSHCP-Covered Species and 17 Species Proposed for Coverage Under Permit Amendment

Summary of Monitoring Methods for 78 MSHCP-Covered Species and 17 Species Proposed for Coverage Under Permit Amendment

Common Name	Scientific Name	Monitored[a]	MSHCP-Covered?	Monitoring Method
Birds				
Yellow billed cuckoo	*Coccyzus americanus*	Yes	Current	Protocol survey[b]
Southwestern willow flycatcher	*Empidonax traillii extimus*	Yes	Current	Protocol survey[c]
American peregrine falcon	*Falco peregrinus anatum*	Yes	Current	Point count
Blue grosbeak	*Guiraca caerulea*	Yes	Current	Point count
Phainopepla	*Phainopepla nitens*	Yes	Current	Point count
Summer tanager	*Piranga rubra*	Yes	Current	Point count
Vermillion flycatcher	*Pyrocephalus rubinus*	Yes	Current	Point count
Arizona Bell's vireo	*Vireo bellii arizonae*	Yes	Current	Point count
Golden eagle	*Aquila chrysaetos*	Yes	Proposed	Point count
Western burrowing owl	*Athene cunicularia hypugea*	Yes	Proposed	Point count
Gilded flicker	*Colaptes chrysoides*	Yes	Proposed	Point count
Loggerhead shrike	*Lanius ludovicianus*	Yes	Proposed	Point count
Ridgway's rail	*Rallus obsoletus yumanensis*	Yes	Proposed	Point count
Bendire's thrasher	*Toxostoma bendirei*	Yes	Proposed	Point count
Le Conte's thrasher	*Toxostoma lecontei*	Yes	Proposed	Point count
Mammals				
Silver haired bat	*Lasionycteris noctivagans*	Yes	Current	Passive acoustic
Long eared myotis	*Myotis evotis*	Yes	Current	Passive acoustic
Long legged myotis	*Myotis volans*	Yes	Current	Passive acoustic
Palmer's chipmunk	*Neotamias palmeri*	No	Current	-
Desert pocket mouse	*Chaetodipus penicillatus sobrinus*	No	Proposed	-
Townsend's big-eared bat	*Corynorhinus townsendii*	Yes	Proposed	Passive acoustic
Spotted bat	*Euderma maculatum*	Yes	Proposed	Passive acoustic
Amphibians				
Relict leopard frog	*Rana onca*	No	Current	-
Reptiles				
Glossy snake	*Arizona elegans*	No	Current	-
Banded gecko	*Coleonyx variegatus*	No	Current	-
Sidewinder	*Crotalus cerastes*	No	Current	-
Speckled rattlesnake	*Crotalus mitchellii*	No	Current	-
Mojave green rattlesnake	*Crotalus scutulatus scutulatus*	No	Current	-
Great Basin collared lizard	*Crotaphytus bicinctores*	Yes	Current	Occupancy survey
Desert iguana	*Dipsosaurus dorsalis*	Yes	Current	Occupancy survey
Large spotted leopard lizard	*Gambelia wislizenii wislizenii*	Yes	Current	Occupancy survey
Desert tortoise	*Gopherus agassizii*	Yes	Current	Occupancy survey
California kingsnake	*Lampropeltis getulus californiae*	No	Current	-
Western leaf nosed snake	*Phyllorhynchus decurtatus*	No	Current	-

Common Name	Scientific Name	Monitored[a]	MSHCP-Covered?	Monitoring Method
Western red tailed skink	*Plestiodon gilberti rubricaudatus*	No	Current	-
Western long nosed snake	*Rhinocheilus lecontei lecontei*	No	Current	-
Sonoran lyre snake	*Trimorphodon biscutatus lambda*	No	Current	-
Banded Gila monster	*Heloderma suspectum cinctum*	No	Proposed	-
Invertebrates				
Spring Mountains acastus checkerspot	*Chlosyne acastus robusta*	No	Current	-
Dark blue butterfly	*Euphilotes ancilla purpura*	No	Current	-
Morand's checkerspot butterfly	*Euphydryas anicia morandi*	No	Current	-
Spring Mountains comma skipper	*Hesperia colorado mojavensis*	No	Current	-
Spring Mountains icariodes blue	*Icaricia icarioides austinorum*	No	Current	-
Mt. Charleston blue butterfly	*Icaricia shasta charlestonensis*	No	Current	-
Nevada admiral	*Limenitis weidemeyerii nevadae*	No	Current	-
Spring Mountains springsnail	*Pyrgulopsis deaconi*	No	Current	-
Southeast Nevada springsnail	*Pyrgulopsis turbatrix*	No	Current	-
Carole's silverspot butterfly	*Speyeria zerene carolae*	No	Current	-
Monarch butterfly	*Danaus plexippus*	No	Proposed	-
Mojave poppy bee	*Perdita meconis*	No	Proposed	-
Plants				
No common name	*Anacolia menziesii*	No[d]	Current	-
Rough angelica	*Angelica scabrida*	No[d]	Current	-
Charleston pussytoes	*Antennaria soliceps*	No[d]	Current	-
Sticky ringstem	*Anulocaulis leiosolenus*	Yes	Current	Three-tiered[e]
Las Vegas bearpoppy	*Arctomecon californica*	Yes	Current	Three-tiered
White bearpoppy	*Arctomecon merriamii*	Yes	Current	Three-tiered
Rosy king sandwort	*Arenaria kingii* ssp. *rosea*	No[d]	Current	-
Clokey milkvetch	*Astragalus aequalis*	No[d]	Current	-
Threecorner milkvetch	*Astragalus geyeri* var. *triquetrus*	Yes	Current	Three-tiered
Clokey eggvetch	*Astragalus oophorus* var. *clokeyanus*	No[d]	Current	-
Spring Mountains milkvetch	*Astragalus remotus*	No[d]	Current	-
Alkali mariposa lily	*Calochortus striatus*	No[d]	Current	-
Clokey paintbrush	*Castelleja martinii* var. *clokeyi*	No[d]	Current	-
Clokey thistle	*Cirsium clokeyi*	No[d]	Current	-
No common name	*Claopodium whippleanum*	No[d]	Current	-

Common Name	Scientific Name	Monitored[a]	MSHCP-Covered?	Monitoring Method
Blue Diamond cholla	*Cylindropuntia multigeniculata*	No[d]	Current	-
No common name	*Dicranoweisia crispula*	No[d]	Current	-
Jaeger whitlowgrass	*Draba jaegeri*	No[d]	Current	-
Charleston draba	*Draba paucifructa*	No[d]	Current	-
Inch high fleabane	*Erigeron uncialis* ssp. *conjugans*	No[d]	Current	-
Forked (Pahrump Valley) buckwheat	*Eriogonum bifurcatum*	No[d]	Current	-
Sticky buckwheat	*Eriogonum viscidulum*	No[d]	Current	-
Clokey greasebush	*Glossopetalon clokeyi*	No[d]	Current	-
Smooth pungent (dwarf) greasebush	*Glossopetalon pungens* var. *glabrum*	No[d]	Current	-
Pungent dwarf greasebush	*Glosspetalon pungens* var. *pungens*	No[d]	Current	-
Red Rock Canyon aster	*Ionactis caelestis*	No[d]	Current	-
Hidden ivesia	*Ivesia cryptocaulis*	No[d]	Current	-
Jaeger ivesia	*Ivesia jaegeri*	No[d]	Current	-
Hitchcock bladderpod	*Lesquerella hitchcockii*	No[d]	Current	-
Charleston pinewood lousewort	*Pedicularis semibarbata* var. *charlestonensis*	No[d]	Current	-
White margined beardtongue	*Penstemon albomarginatus*	No[d]	Current	-
Charleston beardtongue	*Penstemon leiophyllus* var. *keckii*	No[d]	Current	-
Jaeger beardtongue	*Penstemon thompsoneae* var. *jaegeri*	No[d]	Current	-
Parish's phacelia	*Phacelia parishii*	No[d]	Current	-
Clokey mountain sage	*Salvia dorrii* var. *clokeyi*	No[d]	Current	-
Clokey catchfly	*Silene clokeyi*	No[d]	Current	-
Charleston tansy	*Sphaeromeria compacta*	No[d]	Current	-
Charleston kittentails	*Synthyris ranunculina*	No[d]	Current	-
No common name	*Syntrichia princeps*	No[d]	Current	-
Charleston grounddaisy	*Townsendia jonesii* var. *tumulosa*	No[d]	Current	-
Limestone violet	*Viola purpurea* var. *charlestonensis*	No[d]	Current	-
Silverleaf sunray	*Enceliopsis argophylla*	No[d]	Proposed	
Las Vegas buckwheat	*Eriogonum corymbosum var. nilesii*	No[d]	Proposed	
St. George blue-eyed grass	*Sisyrinchium radicatum*	No[d]	Proposed	-
Eastern Joshua tree	*Yucca jaegeriana*	No[f]	Proposed	-

[a]Some species not monitored because they do not occur on private land within Clark County or are too rare or cryptic to be monitored.

[b]See 'Halterman et al. (2016) A natural history summary and survey protocol for the Western distinct population segment of the yellow-billed cuckoo: US Fish and Wildlife techniques and methods. Sacramento, California.' for survey protocol

[c]See 'Sogge et al. (2010) A natural history summary and survey protocol for the southwestern willow flycatcher. US Department of the Interior, US Geological Survey.' for survey protocol details.

Common Name	Scientific Name	Monitored[a]	MSHCP-Covered?	Monitoring Method

[d]These species should be monitored using the three-tiered approach, pending indentification of extant populations. See Appendix C for discussion.

[e]See 'Bangle et al. (2010) Inventory, research and monitoring for covered plant species. Project Report 2005-NPS-535-P.' for survey method details.

[f]Populations known but no monitoring methods described because not currently MSHCP-covered.

Attachment C2
CWHR Habitat Reports for Covered Species

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
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SPECIES INFORMATION REPORT FOR: BLUE GROSBEAK

(Passerina caerulea)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B476 CNDDB ID: ABPBX63010

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: CARDINALIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Distant Migrator

SPECIAL STATUS:

No Special Status

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
AMADOR	Summer
BUTTE	Summer
CALAVERAS	Summer
COLUSA	Summer
CONTRA COSTA	Summer
EL DORADO	Summer
FRESNO	Summer
GLENN	Summer
IMPERIAL	Summer
INYO	Summer
KERN	Summer
KINGS	Summer
LOS ANGELES	Summer
MADERA	Summer
MARIPOSA	Summer
MERCED	Summer
MONO	Summer
MONTEREY	Summer
NEVADA	Summer
ORANGE	Summer
PLACER	Summer
RIVERSIDE	Summer
SACRAMENTO	Summer
SAN BENITO	Summer
SAN BERNARDINO	Summer
SAN DIEGO	Summer
SAN JOAQUIN	Summer
SAN LUIS OBISPO	Summer
SANTA BARBARA	Summer
SHASTA	Summer
SOLANO	Summer
STANISLAUS	Summer
SUTTER	Summer

TEHAMA	Summer
TULARE	Summer
TUOLUMNE	Summer
VENTURA	Summer
YOLO	Summer
YUBA	Summer
DFG REGION	
NORTHERN	Summer
NORTH CENTRAL	Summer
BAY DELTA	Summer
CENTRAL	Summer
SOUTH COAST	Summer
INLAND DESERTS	Summer
HYDROLOGIC REGION	
NORTH COAST	Summer
SACRAMENTO RIVER	Summer
TULARE LAKE	Summer
SAN JOAQUIN	Summer
SAN FRANCISCO BAY	Summer
CENTRAL COAST	Summer
SOUTH COAST	Summer
NORTH LAHONTAN	Summer
SOUTH LAHONTAN	Summer
COLORADO RIVER	Summer
NATIONAL FOREST	
ANGELES	Summer
CLEVELAND	Summer
EL DORADO	Summer
INYO	Summer
KLAMATH	Summer
LAKE TAHOE BASIN	Summer
LASSEN	Summer
LOS PADRES	Summer
MENDOCINO	Summer
PLUMAS	Summer
SAN BERNARDINO	Summer
SEQUOIA	Summer
SHASTA-TRINITY	Summer
SIERRA	Summer
STANISLAUS	Summer
TAHOE	Summer
TOIYABE	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
ANNUAL GRASSLAND	Summer				
		1S Short Herb Sparse			high
		1P Short Herb Open			high
		1M Short Herb Moderate			high
		1D Short Herb Dense			high
		2S Tall Herb Sparse			high
		2P Tall Herb Open			high
		2M Tall Herb Moderate		med	high
		2D Tall Herb Dense		med	high
DECIDUOUS ORCHARD	Summer				

		2 Young Trees		med	high
		3 Mature Trees		med	high
DESERT RIPARIAN	Summer				
		1 Seedling Tree/Shrub		med	high
		2S Small Tree/Shrub Sparse	med	med	high
		2P Small Tree/Shrub Open	med	med	high
		2M Small Tree/Shrub Moderate	high	high	high
		2D Small Tree/Shrub Dense	high	high	high
		3S Medium Tree/Shrub Sparse	med	med	high
		3P Medium Tree/Shrub Open	med	med	high
		3M Medium Tree/Shrub Moderate	high	high	high
		3D Medium Tree/Shrub Dense	high	high	high
		4S Large Tree Sparse	low	low	med
		4P Large Tree Open	low	low	med
EUCALYPTUS	Summer				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open		low	low
		2M Sapling Tree Moderate		low	low
		2D Sapling Tree Dense		low	low
IRRIGATED GRAIN CROPS	Summer				
		No Size or Stage Data		med	high
IRRIGATED HAYFIELD	Summer				
		No Size or Stage Data		med	high
IRRIGATED ROW AND FIELD CROPS	Summer				
		No Size or Stage Data		med	high
MONTANE RIPARIAN	Summer				
		1 Seedling Tree		low	med
		2S Sapling Tree Sparse	low	low	med
		2P Sapling Tree Open	low	low	med
		2M Sapling Tree Moderate	med	med	med
		2D Sapling Tree Dense	med	med	med
		3S Pole Tree Sparse	low	low	med
		3P Pole Tree Open	low	low	med
		3M Pole Tree Moderate	med	med	med
		3D Pole Tree Dense	med	med	med
		4S Small Tree Sparse	low	low	med
		4P Small Tree Open	low	low	med
		4M Small Tree Moderate	med	med	med
		4D Small Tree Dense	med	med	med
		5S Medium/Large Tree Sparse		low	low
		5P Medium/Large Tree Open		low	low
PALM OASIS	Summer				
		1 Seedling Tree		med	med
		2S Small Tree Sparse		med	high
		2P Small Tree Open		med	high
		3S Large Tree Sparse		med	high
		3P Large Tree Open		med	high
VALLEY FOOTHILL RIPARIAN	Summer				
		1 Seedling Tree	med	med	high

2S Sapling Tree Sparse	med	med	high
2P Sapling Tree Open	med	med	high
2M Sapling Tree Moderate	high	high	high
2D Sapling Tree Dense	high	high	high
3S Pole Tree Sparse	med	med	high
3P Pole Tree Open	med	med	high
3M Pole Tree Moderate	high	high	high
3D Pole Tree Dense	high	high	high
4S Small Tree Sparse	med	med	high
4P Small Tree Open	med	med	high
4M Small Tree Moderate	high	high	high
4D Small Tree Dense	high	high	high
5S Medium/Large Tree Sparse	low	med	med
5P Medium/Large Tree Open	low	med	med
5M Medium/Large Tree Moderate	low	low	low
5D Medium/Large Tree Dense	low	low	low

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - TERRESTRIAL			essential
INVERTEBRATES			essential
HABITAT EDGE ELEMENTS			
SHRUB/AGRICULTURE	secondary	secondary	secondary
SHRUB/GRASS	secondary	secondary	secondary
LIVE VEGETATIVE COVER			
LAYER - HERBACEOUS		preferred	secondary
LAYER - SHRUB	secondary	secondary	secondary
LAYER - TREE	preferred	secondary	preferred
RIPARIAN INCLUSION	secondary	secondary	secondary
TREES - HARDWOOD	preferred	preferred	preferred
VEGETATIVE DIET ELEMENTS			
FRUITS			preferred
GRAIN			preferred
SEEDS			preferred

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SPECIES INFORMATION REPORT FOR: VERMILION FLYCATCHER

(Pyrocephalus rubinus)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B324 CNDDB ID: ABPAE36010

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: TYRANNIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Non-Migrator

SPECIAL STATUS:

species-level status California Species of Special Concern

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
IMPERIAL	Summer
INYO	Summer
KERN	Summer
LOS ANGELES	Summer
ORANGE	Summer
RIVERSIDE	Summer
SAN BERNARDINO	Summer
SAN DIEGO	Summer
SANTA BARBARA	Summer
DFG REGION	
CENTRAL	Summer
SOUTH COAST	Summer
INLAND DESERTS	Summer
HYDROLOGIC REGION	
TULARE LAKE	Summer
CENTRAL COAST	Summer
SOUTH COAST	Summer
SOUTH LAHONTAN	Summer
COLORADO RIVER	Summer
NATIONAL FOREST	
ANGELES	Summer
CLEVELAND	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
DESERT RIPARIAN	Yearlong				
		1 Seedling Tree/Shrub		high	high
		2S Small Tree/Shrub Sparse	med	high	high
		2P Small Tree/Shrub Open	med	high	high
		2M Small Tree/Shrub Moderate	med	high	high
		2D Small Tree/Shrub Dense	med	high	high
		3S Medium Tree/Shrub Sparse	high	high	high
		3P Medium Tree/Shrub Open	high	high	high
		3M Medium Tree/Shrub Moderate	high	high	high
		3D Medium Tree/Shrub Dense	high	high	high
		4S Large Tree Sparse	high	high	high
		4P Large Tree Open	high	high	high
		4M Large Tree Moderate	high	high	high
		4D Large Tree Dense	high	high	high
IRRIGATED GRAIN CROPS	Yearlong				
		No Size or Stage Data		low	high
IRRIGATED HAYFIELD	Yearlong				
		No Size or Stage Data		low	high

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - FLYING			secondary
INSECTS - TERRESTRIAL			preferred
INVERTEBRATES			essential
AQUATIC ELEMENTS			
PONDS			preferred
RIVERS			preferred
WATER			secondary
HABITAT EDGE ELEMENTS			
SHRUB/AGRICULTURE		preferred	preferred
SHRUB/GRASS		preferred	preferred
SHRUB/WATER	secondary	preferred	preferred
TREE/AGRICULTURE	secondary	preferred	preferred
TREE/GRASS		preferred	secondary
TREE/WATER	secondary	preferred	secondary
HUMAN ELEMENTS			
FENCES		preferred	preferred
WATER - CREATED BODY			preferred
LIVE VEGETATIVE COVER			
LAYER - SHRUB		secondary	preferred
LAYER - TREE	preferred	secondary	
RIPARIAN INCLUSION	secondary	secondary	secondary
TREES - HARDWOOD	preferred	preferred	preferred

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SPECIES INFORMATION REPORT FOR: YELLOW-BILLED CUCKOO

(Coccyzus americanus)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B259 CNDDB ID: ABNRB02020

TAXONOMY:

Class: AVES Order: CUCULIFORMES
Family: CUCULIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Distant Migrator

SPECIAL STATUS:

subspp.occidentalis

California Endangered
Federal Proposed Threatend
BLM Sensitive
Forest Service Sensitive

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
BUTTE	Summer
COLUSA	Summer
GLENN	Summer
IMPERIAL	Summer
INYO	Summer
KERN	Summer
LAKE	Summer
ORANGE	Summer
PLACER	Summer
RIVERSIDE	Summer
SAN BERNARDINO	Summer
SAN DIEGO	Summer
SUTTER	Summer
TEHAMA	Summer
YUBA	Summer
DFG REGION	
NORTHERN	Summer
NORTH CENTRAL	Summer
BAY DELTA	Summer
CENTRAL	Summer
SOUTH COAST	Summer
INLAND DESERTS	Summer
HYDROLOGIC REGION	
NORTH COAST	Summer
SACRAMENTO RIVER	Summer

TULARE LAKE	Summer
SOUTH COAST	Summer
NORTH LAHONTAN	Summer
SOUTH LAHONTAN	Summer
COLORADO RIVER	Summer
NATIONAL FOREST	
CLEVELAND	Summer
EL DORADO	Summer
INYO	Summer
KLAMATH	Summer
LAKE TAHOE BASIN	Summer
LASSEN	Summer
LOS PADRES	Summer
MENDOCINO	Summer
PLUMAS	Summer
SAN BERNARDINO	Summer
SEQUOIA	Summer
SHASTA-TRINITY	Summer
TAHOE	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
DECIDUOUS ORCHARD	Summer				
		3 Mature Trees	high	med	med
DESERT RIPARIAN	Summer				
		1 Seedling Tree/Shrub	low	low	high
		2P Small Tree/Shrub Open	med	med	high
		2M Small Tree/Shrub Moderate	high	high	high
		2D Small Tree/Shrub Dense	high	high	high
		3P Medium Tree/Shrub Open	med	med	high
		3M Medium Tree/Shrub Moderate	high	high	high
		3D Medium Tree/Shrub Dense	high	high	high
		4P Large Tree Open	med	med	high
		4M Large Tree Moderate	high	high	high
		4D Large Tree Dense	high	high	high
VALLEY FOOTHILL RIPARIAN	Summer				
		2S Sapling Tree Sparse		low	med
		2P Sapling Tree Open		low	med
		2M Sapling Tree Moderate	low	low	high
		2D Sapling Tree Dense	low	low	high
		3S Pole Tree Sparse	low	low	med
		3P Pole Tree Open	low	low	med
		3M Pole Tree Moderate	high	med	high
		3D Pole Tree Dense	high	med	high
		4S Small Tree Sparse	med	med	med
		4P Small Tree Open	low	med	high
		4M Small Tree Moderate	high	high	high
		4D Small Tree Dense	high	high	high
		5S Medium/Large Tree Sparse	med	med	med
		5P Medium/Large Tree Open	med	med	high
		5M Medium/Large Tree Moderate	high	high	high
		5D Medium/Large Tree Dense	high	high	high

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
AMPHIBIANS			preferred
INSECTS - TERRESTRIAL			essential
INVERTEBRATES			essential
REPTILES			preferred
HABITAT EDGE ELEMENTS			
TREE/SHRUB	secondary	secondary	secondary
TREE/WATER	secondary	secondary	secondary
LIVE VEGETATIVE COVER			
LAYER - SHRUB		preferred	preferred
LAYER - TREE	secondary	secondary	secondary
RIPARIAN INCLUSION	secondary	secondary	secondary
TREES - HARDWOOD	secondary	preferred	secondary
VEGETATIVE DIET ELEMENTS			
FRUITS			preferred

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SPECIES INFORMATION REPORT FOR: SUMMER TANAGER

(Piranga rubra)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B469 CNDDB ID: ABPBX45030

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: CARDINALIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Distant Migrator

SPECIAL STATUS:

species-level status: California Species of Special Concern

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
IMPERIAL	Summer
INYO	Summer
KERN	Summer
LOS ANGELES	Summer
RIVERSIDE	Summer
SAN BERNARDINO	Summer
SAN DIEGO	Summer
DFG REGION	
CENTRAL	Summer
SOUTH COAST	Summer
INLAND DESERTS	Summer
HYDROLOGIC REGION	
TULARE LAKE	Summer
SOUTH COAST	Summer
SOUTH LAHONTAN	Summer
COLORADO RIVER	Summer
NATIONAL FOREST	
ANGELES	Summer
SEQUOIA	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING

DESERT RIPARIAN	Summer				
		3S Medium Tree/Shrub Sparse		low	high
		3P Medium Tree/Shrub Open	med	med	high
		3M Medium Tree/Shrub Moderate	high	high	high
		3D Medium Tree/Shrub Dense	high	high	high
		4S Large Tree Sparse	med	med	high
		4P Large Tree Open	med	med	high
		4M Large Tree Moderate	high	high	high
		4D Large Tree Dense	high	high	high
DESERT WASH	Migrant				
		3S Medium Tree/Shrub Sparse		low	med
		3P Medium Tree/Shrub Open		med	med
		3M Medium Tree/Shrub Moderate		med	med
		3D Medium Tree/Shrub Dense		med	med
		4S Large Tree Sparse		med	med
		4P Large Tree Open		med	med
		4M Large Tree Moderate		med	med
		4D Large Tree Dense		med	med
PALM OASIS	Migrant				
		2S Small Tree Sparse		low	med
		2P Small Tree Open		low	med
		2M Small Tree Moderate		med	med
		2D Small Tree Dense		med	med
		3S Large Tree Sparse		med	med
		3P Large Tree Open		med	med
		3M Large Tree Moderate		med	med
		3D Large Tree Dense		med	med
VALLEY FOOTHILL RIPARIAN	Summer				
		1 Seedling Tree			low
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open		low	low
		2M Sapling Tree Moderate		low	low
		2D Sapling Tree Dense		low	low
		3S Pole Tree Sparse	low	low	med
		3P Pole Tree Open	low	low	med
		3M Pole Tree Moderate	med	med	med
		3D Pole Tree Dense	med	med	med
		4S Small Tree Sparse	low	low	med
		4P Small Tree Open	med	med	high
		4M Small Tree Moderate	high	high	high
		4D Small Tree Dense	high	high	high
		5S Medium/Large Tree Sparse	low	low	med
		5P Medium/Large Tree Open	med	med	high
		5M Medium/Large Tree Moderate	high	high	high
		5D Medium/Large Tree Dense	high	high	high

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - FLYING			secondary
INSECTS - TERRESTRIAL			secondary
INVERTEBRATES			essential
HABITAT EDGE ELEMENTS			
TREE/SHRUB	preferred	preferred	preferred

TREE/WATER	secondary	secondary	secondary
LIVE VEGETATIVE COVER			
RIPARIAN INCLUSION	secondary	secondary	secondary
TREES - HARDWOOD	secondary	secondary	secondary
VEGETATIVE DIET ELEMENTS			
FRUITS			preferred

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SPECIES INFORMATION REPORT FOR: BELL'S VIREO

(Vireo bellii)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B413 CNDDB ID: ABPBW01110

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: VIREONIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Distant Migrator

SPECIAL STATUS:

subspp.arizonae	California Endangered BLM Sensitive
subspp.pusillus	Federal Endangered California Endangered

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
INYO	Summer
LOS ANGELES	Summer
MONTEREY	Summer
ORANGE	Summer
RIVERSIDE	Summer
SAN BERNARDINO	Summer
SAN DIEGO	Summer
SAN LUIS OBISPO	Summer
SANTA BARBARA	Summer
VENTURA	Summer
DFG REGION	
BAY DELTA	Summer
CENTRAL	Summer
SOUTH COAST	Summer
INLAND DESERTS	Summer
HYDROLOGIC REGION	
CENTRAL COAST	Summer
SOUTH COAST	Summer
SOUTH LAHONTAN	Summer
COLORADO RIVER	Summer
NATIONAL FOREST	
ANGELES	Summer

CLEVELAND	Summer
INYO	Summer
LOS PADRES	Summer
SAN BERNARDINO	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
DESERT RIPARIAN	Summer				
		1 Seedling Tree/Shrub		low	high
		2P Small Tree/Shrub Open	high	high	high
		2M Small Tree/Shrub Moderate	high	high	high
		2D Small Tree/Shrub Dense	high	high	high
		3P Medium Tree/Shrub Open	med	med	high
		3M Medium Tree/Shrub Moderate	med	med	high
		3D Medium Tree/Shrub Dense	high	high	high
		4P Large Tree Open	med	med	high
		4M Large Tree Moderate	med	med	high
		4D Large Tree Dense	high	high	high
VALLEY FOOTHILL RIPARIAN	Summer				
		1 Seedling Tree		low	high
		2P Sapling Tree Open	high	high	high
		2M Sapling Tree Moderate	high	high	high
		2D Sapling Tree Dense	high	high	high
		3P Pole Tree Open	med	med	high
		3M Pole Tree Moderate	med	med	high
		3D Pole Tree Dense	high	high	high
		4P Small Tree Open	med	med	high
		4M Small Tree Moderate	med	med	high
		4D Small Tree Dense	high	high	high

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - TERRESTRIAL			essential
INVERTEBRATES			essential
HABITAT EDGE ELEMENTS			
SHRUB/WATER	secondary	secondary	secondary
TREE/SHRUB	preferred	preferred	preferred
TREE/WATER	secondary	secondary	secondary
LIVE VEGETATIVE COVER			
LAYER - SHRUB	preferred	preferred	preferred
RIPARIAN INCLUSION	essential	secondary	secondary
VEGETATIVE DIET ELEMENTS			
FRUITS			preferred

CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM
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SPECIES INFORMATION REPORT FOR: WILLOW FLYCATCHER

(Empidonax traillii)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B315 CNDDB ID: ABPAE33040

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: TYRANNIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Distant Migrator

SPECIAL STATUS:

species-level status	California Endangered Forest Service Sensitive
subspp. brewsteri	California Endangered Forest Service Sensitive
subspp.extimus	Federal Endangered California Endangered Forest Service Sensitive

LOCATION INFORMATION

LOCATION COUNTY	SEASON
ALPINE	Summer
AMADOR	Summer
BUTTE	Summer
CALAVERAS	Summer
EL DORADO	Summer
FRESNO	Summer
INYO	Summer
KERN	Summer
LASSEN	Summer
MADERA	Summer
MARIPOSA	Summer
MONO	Summer
NEVADA	Summer
PLACER	Summer
PLUMAS	Summer
SAN DIEGO	Yearlong
SANTA BARBARA	Summer
SHASTA	Summer
SIERRA	Summer
TEHAMA	Summer
TRINITY	Summer
TULARE	Summer
TUOLUMNE	Summer
VENTURA	Summer

DFG REGION	
NORTHERN	Summer
NORTH CENTRAL	Summer
CENTRAL	Summer
SOUTH COAST	Yearlong
INLAND DESERTS	Summer
HYDROLOGIC REGION	
NORTH COAST	Summer
SACRAMENTO RIVER	Summer
TULARE LAKE	Summer
SAN JOAQUIN	Summer
CENTRAL COAST	Summer
SOUTH COAST	Yearlong
NORTH LAHONTAN	Summer
SOUTH LAHONTAN	Summer
NATIONAL FOREST	
EL DORADO	Summer
INYO	Summer
LAKE TAHOE BASIN	Summer
LASSEN	Summer
PLUMAS	Summer
SEQUOIA	Summer
SHASTA-TRINITY	Summer
SIERRA	Summer
STANISLAUS	Summer
TAHOE	Summer
TOIYABE	Summer

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
DESERT RIPARIAN	Migrant				
		1 Seedling Tree/Shrub		high	high
		2S Small Tree/Shrub Sparse		high	high
		2P Small Tree/Shrub Open		high	high
		2M Small Tree/Shrub Moderate		high	high
		2D Small Tree/Shrub Dense		high	high
		3S Medium Tree/Shrub Sparse		high	high
		3P Medium Tree/Shrub Open		high	high
		3M Medium Tree/Shrub Moderate		high	high
		3D Medium Tree/Shrub Dense		high	high
		4S Large Tree Sparse		high	high
		4P Large Tree Open		high	high
		4M Large Tree Moderate		high	high
		4D Large Tree Dense		high	high
EUCALYPTUS	Migrant				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open		low	low
		2M Sapling Tree Moderate		low	low
		2D Sapling Tree Dense		low	low
		3S Pole Tree Sparse		low	low
		3P Pole Tree Open		low	low
		3M Pole Tree Moderate		low	low
		3D Pole Tree Dense		low	low

		4S Small Tree Sparse		low	low
		4P Small Tree Open		low	low
		4M Small Tree Moderate		low	low
		4D Small Tree Dense		low	low
		5S Medium/Large Tree Sparse		low	low
		5P Medium/Large Tree Open		low	low
		5M Medium/Large Tree Moderate		low	low
		5D Medium/Large Tree Dense		low	low
MONTANE RIPARIAN	Summer				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open	low	med	high
		2M Sapling Tree Moderate	med	high	high
		2D Sapling Tree Dense	high	high	high
		3S Pole Tree Sparse	low	high	high
		3P Pole Tree Open	low	high	high
		3M Pole Tree Moderate	med	high	high
		3D Pole Tree Dense	high	high	high
		4S Small Tree Sparse	low	high	high
		4P Small Tree Open	low	high	high
		4M Small Tree Moderate	high	high	high
		4D Small Tree Dense	high	high	high
VALLEY FOOTHILL RIPARIAN	Summer				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open	low	med	high
		2M Sapling Tree Moderate	med	high	high
		2D Sapling Tree Dense	high	high	high
		3S Pole Tree Sparse	low	high	high
		3P Pole Tree Open	low	high	high
		3M Pole Tree Moderate	med	high	high
		3D Pole Tree Dense	high	high	high
		4S Small Tree Sparse	low	high	high
		4P Small Tree Open	low	high	high
		4M Small Tree Moderate	high	high	high
		4D Small Tree Dense	high	high	high
		5S Medium/Large Tree Sparse	low	low	low
		5P Medium/Large Tree Open	low	low	low
		5M Medium/Large Tree Moderate	low	low	low
		5D Medium/Large Tree Dense	low	low	low
WET MEADOW	Summer				
		1S Short Herb Sparse		low	high
		1P Short Herb Open		low	high
		1M Short Herb Moderate		low	high
		1D Short Herb Dense		low	high
		2S Tall Herb Sparse		low	high
		2P Tall Herb Open		low	high
		2M Tall Herb Moderate		low	high
		2D Tall Herb Dense		low	high

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - FLYING			essential
INVERTEBRATES			essential

HABITAT EDGE ELEMENTS			
SHRUB/GRASS	preferred	secondary	secondary
SHRUB/WATER		preferred	preferred
TREE/GRASS	preferred	secondary	secondary
TREE/WATER		secondary	preferred
LIVE VEGETATIVE COVER			
LAYER - SHRUB	secondary	secondary	preferred
RIPARIAN INCLUSION	secondary	preferred	preferred

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SPECIES INFORMATION REPORT FOR: PHAINOPEPLA

(Phainopepla nitens)

ACTIVITY/STATUS INFORMATION

IDENTIFICATION:

CWHR ID: B408 CNDDB ID: ABPBP03010

TAXONOMY:

Class: AVES Order: PASSERIFORMES
Family: PTILOGONATIDAE

LIFE HISTORY ATTRIBUTES:

Daily Activity: Diurnal Seasonal Activity: Yearlong Migration: Local Migrator

SPECIAL STATUS:

No Special Status

LOCATION INFORMATION

LOCATION	SEASON
COUNTY	
ALAMEDA	Yearlong
AMADOR	Yearlong
BUTTE	Yearlong
CALAVERAS	Yearlong
COLUSA	Yearlong
CONTRA COSTA	Yearlong
EL DORADO	Yearlong
FRESNO	Yearlong
GLENN	Yearlong
IMPERIAL	Yearlong
INYO	Yearlong
KERN	Yearlong
LAKE	Yearlong
LOS ANGELES	Yearlong
MADERA	Yearlong
MARIPOSA	Yearlong
MERCED	Yearlong
MONO	Yearlong
MONTEREY	Yearlong
NAPA	Yearlong
NEVADA	Yearlong
ORANGE	Yearlong
PLACER	Yearlong
RIVERSIDE	Yearlong
SACRAMENTO	Yearlong
SAN BENITO	Yearlong
SAN BERNARDINO	Yearlong
SAN DIEGO	Yearlong
SAN JOAQUIN	Yearlong
SAN LUIS OBISPO	Yearlong
SAN MATEO	Summer
SANTA BARBARA	Yearlong
SANTA CLARA	Yearlong

SANTA CRUZ	Yearlong
SHASTA	Yearlong
SOLANO	Yearlong
STANISLAUS	Yearlong
SUTTER	Yearlong
TEHAMA	Yearlong
TULARE	Yearlong
TUOLUMNE	Yearlong
VENTURA	Yearlong
YOLO	Yearlong
YUBA	Yearlong

DFG REGION

NORTHERN	Yearlong
NORTH CENTRAL	Yearlong
BAY DELTA	Yearlong
CENTRAL	Yearlong
SOUTH COAST	Yearlong
INLAND DESERTS	Yearlong

HYDROLOGIC REGION

NORTH COAST	Yearlong
SACRAMENTO RIVER	Yearlong
TULARE LAKE	Yearlong
SAN JOAQUIN	Yearlong
SAN FRANCISCO BAY	Yearlong
CENTRAL COAST	Yearlong
SOUTH COAST	Yearlong
NORTH LAHONTAN	Yearlong
SOUTH LAHONTAN	Yearlong
COLORADO RIVER	Yearlong

NATIONAL FOREST

ANGELES	Yearlong
CLEVELAND	Yearlong
EL DORADO	Yearlong
INYO	Yearlong
KLAMATH	Yearlong
LAKE TAHOE BASIN	Yearlong
LASSEN	Yearlong
LOS PADRES	Yearlong
MENDOCINO	Yearlong
PLUMAS	Yearlong
SAN BERNARDINO	Yearlong
SEQUOIA	Yearlong
SHASTA-TRINITY	Yearlong
SIERRA	Yearlong
STANISLAUS	Yearlong
TAHOE	Yearlong
TOIYABE	Yearlong

HABITAT SUITABILITY INFORMATION

HABITAT	SEASON	SIZE/AGE CLASS	REPRO	COVER	FEEDING
BLUE OAK-FOOTHILL PINE	Yearlong				
		2S Sapling Tree Sparse	low	med	high
		2P Sapling Tree Open	low	med	high
		3S Pole Tree Sparse	med	high	high
		3P Pole Tree Open	med	high	high
		4S Small Tree Sparse	high	high	high

		4P Small Tree Open	high	high	high
		5S Medium/Large Tree Sparse	med	med	high
		5P Medium/Large Tree Open	med	med	high
BLUE OAK WOODLAND	Yearlong				
		2S Sapling Tree Sparse	low	med	high
		2P Sapling Tree Open	low	med	high
		3S Pole Tree Sparse	med	high	high
		3P Pole Tree Open	med	high	high
		4S Small Tree Sparse	high	high	high
		4P Small Tree Open	high	high	high
		5S Medium/Large Tree Sparse	med	med	high
		5P Medium/Large Tree Open	med	med	high
CHAMISE-REDSHANK CHAPARRAL	Yearlong				
		2P Young Shrub Open		low	low
		2M Young Shrub Moderate		low	low
		2D Young Shrub Dense		low	low
		3P Mature Shrub Open		low	low
		3M Mature Shrub Moderate		low	low
		3D Mature Shrub Dense		low	low
		4P Decadent Shrub Open		low	low
		4M Decadent Shrub Moderate		low	low
		4D Decadent Shrub Dense		low	low
COASTAL OAK WOODLAND	Yearlong				
		2S Sapling Tree Sparse	low	med	high
		2P Sapling Tree Open	low	med	high
		3S Pole Tree Sparse	med	high	high
		3P Pole Tree Open	med	high	high
		4S Small Tree Sparse	high	high	high
		4P Small Tree Open	high	high	high
		5S Medium/Large Tree Sparse	med	med	high
		5P Medium/Large Tree Open	med	med	high
DESERT RIPARIAN	Yearlong				
		2S Small Tree/Shrub Sparse	med	med	med
		2P Small Tree/Shrub Open	med	med	med
		2M Small Tree/Shrub Moderate	med	med	med
		3S Medium Tree/Shrub Sparse	high	high	high
		3P Medium Tree/Shrub Open	high	high	high
		3M Medium Tree/Shrub Moderate	med	med	med
		4S Large Tree Sparse	high	high	high
		4P Large Tree Open	high	high	high
		4M Large Tree Moderate	med	med	med
DESERT WASH	Yearlong				
		2S Small Tree/Shrub Sparse	med	med	med
		2P Small Tree/Shrub Open	med	med	med
		2M Small Tree/Shrub Moderate	med	med	med
		3S Medium Tree/Shrub Sparse	high	high	high
		3P Medium Tree/Shrub Open	high	high	high
		3M Medium Tree/Shrub Moderate	med	med	med
		4S Large Tree Sparse	high	high	high
		4P Large Tree Open	high	high	high
		4M Large Tree Moderate	med	med	med
EUCALYPTUS	Yearlong				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse		low	low

		2P Sapling Tree Open		low	low
		2M Sapling Tree Moderate		low	low
		2D Sapling Tree Dense		low	low
		3S Pole Tree Sparse		low	low
		3P Pole Tree Open		low	low
		3M Pole Tree Moderate		low	low
		3D Pole Tree Dense		low	low
		4S Small Tree Sparse		low	low
		4P Small Tree Open		low	low
		4M Small Tree Moderate		low	low
		4D Small Tree Dense		low	low
		5S Medium/Large Tree Sparse		low	low
		5P Medium/Large Tree Open		low	low
		5M Medium/Large Tree Moderate		low	low
		5D Medium/Large Tree Dense		low	low
JUNIPER	Summer				
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open		low	low
		3S Pole Tree Sparse		low	low
		3P Pole Tree Open		low	low
		4S Small Tree Sparse		low	low
		4P Small Tree Open		low	low
		5S Medium/Large Tree Sparse		low	low
		5P Medium/Large Tree Open		low	low
MIXED CHAPARRAL	Yearlong				
		1 Seedling Shrub		low	low
		2S Young Shrub Sparse		low	low
		2P Young Shrub Open		low	low
		2M Young Shrub Moderate		low	low
		2D Young Shrub Dense		low	low
		3S Mature Shrub Sparse		low	low
		3P Mature Shrub Open		low	low
		3M Mature Shrub Moderate		low	low
		3D Mature Shrub Dense		low	low
		4S Decadent Shrub Sparse		low	low
		4P Decadent Shrub Open		low	low
		4M Decadent Shrub Moderate		low	low
		4D Decadent Shrub Dense		low	low
MONTANE HARDWOOD	Yearlong				
		2S Sapling Tree Sparse	low	low	low
		2P Sapling Tree Open	low	low	low
		2M Sapling Tree Moderate	low	low	low
		3S Pole Tree Sparse	med	med	med
		3P Pole Tree Open	med	med	med
		3M Pole Tree Moderate	low	low	low
		4S Small Tree Sparse	med	med	med
		4P Small Tree Open	med	med	med
		4M Small Tree Moderate	low	low	low
		5S Medium/Large Tree Sparse	med	med	med
		5P Medium/Large Tree Open	med	med	med
		5M Medium/Large Tree Moderate	low	low	low
PALM OASIS	Yearlong				
		2S Small Tree Sparse	high	high	high
		2P Small Tree Open	high	high	high
		2M Small Tree Moderate	med	med	med
		3S Large Tree Sparse	high	high	high
		3P Large Tree Open	high	high	high
		3M Large Tree Moderate	med	med	med

PINYON-JUNIPER	Summer				
		2S Sapling Tree Sparse		low	low
		2P Sapling Tree Open		low	low
		3S Pole Tree Sparse		low	low
		3P Pole Tree Open		low	low
		4S Small Tree Sparse		low	low
		4P Small Tree Open		low	low
		5S Medium/Large Tree Sparse		low	low
		5P Medium/Large Tree Open		low	low
URBAN	Yearlong				
		No Size or Stage Data	high	high	high
VALLEY FOOTHILL RIPARIAN	Yearlong				
		1 Seedling Tree		low	low
		2S Sapling Tree Sparse	low	low	low
		2P Sapling Tree Open	low	low	low
		2M Sapling Tree Moderate	low	low	low
		2D Sapling Tree Dense	low	low	low
		3S Pole Tree Sparse	low	low	low
		3P Pole Tree Open	low	low	low
		3M Pole Tree Moderate	low	low	low
		3D Pole Tree Dense	low	low	low
		4S Small Tree Sparse	low	low	low
		4P Small Tree Open	low	low	low
		4M Small Tree Moderate	low	low	low
		4D Small Tree Dense	low	low	low
		5S Medium/Large Tree Sparse	low	low	low
		5P Medium/Large Tree Open	low	low	low
		5M Medium/Large Tree Moderate	low	low	low
		5D Medium/Large Tree Dense	low	low	low
VALLEY OAK WOODLAND	Yearlong				
		2S Sapling Tree Sparse	low	med	high
		2P Sapling Tree Open	low	med	high
		3S Pole Tree Sparse	med	high	high
		3P Pole Tree Open	med	high	high
		4S Small Tree Sparse	high	high	high
		4P Small Tree Open	high	high	high
		5S Medium/Large Tree Sparse	med	med	high
		5P Medium/Large Tree Open	med	med	high
VINEYARD	Yearlong				
		No Size or Stage Data		med	med

ELEMENT INFORMATION

ELEMENT	REPRO	COVER	FEEDING
ANIMAL DIET ELEMENTS			
INSECTS - FLYING			essential
INVERTEBRATES			essential
HABITAT EDGE ELEMENTS			
SHRUB/GRASS	preferred	preferred	preferred
TREE/GRASS	preferred	preferred	preferred
TREE/SHRUB	secondary	secondary	

LIVE VEGETATIVE COVER			
LAYER - SHRUB	preferred		secondary
LAYER - TREE	preferred	preferred	preferred
RIPARIAN INCLUSION	secondary	secondary	secondary
TREES - HARDWOOD	preferred	preferred	preferred
VEGETATIVE DIET ELEMENTS			
BERRIES			secondary
FRUITS			secondary

Attachment C3
CWRH Habitat Element Checklist

CWHR HABITAT ELEMENT CHECKLIST

Indicate which elements are present inside (I) and/or nearby but outside (O) of the study area in sufficient quantity and quality to support presence of a particular wildlife species. You may exclude elements (E) that are absent from the study area if excluded elements number less than the elements that are present.

	ACORNS - Fruit of an oak		LAYER, HERBACEOUS >10% herb. understory		SNAG, LARGE (ROTTEN) >30" dbh
	ALGAE - Any algae other than kelp		LAYER, SHRUB >10% shrub understory		SNAG, LARGE, (SOUND) >30" dbh
	AMPHIBIANS - Frogs, Toads, etc.		LAYER, TREE >10% subcanopy trees		SNAG, MEDIUM (ROTTEN) 15-30" dbh
	AQUATICS, EMERGENT		LICHENS		SNAG, MEDIUM (SOUND) 15-30" dbh
	AQUATICS, SUBMERGED		LITHIC - Rock scatter <10" diam.		SNAG, SMALL (ROTTEN) <15" dbh
	BANK - Cut, hollow or lake border		LITTER - Residue <1" in diam.		SNAG, SMALL (SOUND) <15" dbh
	BARREN - Devoid of veg. within veg. area		LOG, LARGE (HOLLOW) >20" diam.		SOIL, AERATED - Well drained
	BERRIES - Small, pulpy fruit		LOG, LARGE (ROTTEN) >20" diam.		SOIL, FRIABLE - Easily crumbled
	BIRDS, LARGE - > 450g (1lb)		LOG, LARGE (SOUND) >20" diam.		SOIL, GRAVELLY - Gravel .8-3" diam.
	BIRDS, MED. - 110-450g (4oz-1lb) lb1111111)		LOG, MEDIUM (HOLLOW) 10-20" diam		SOIL, ORGANIC - > 20% organic matter (wght.)
	BIRDS, SMALL - < 110g (4oz)		LOG, MEDIUM (ROTTEN) 10-20" diam.		SOIL, SALINE - Alkaline soils/veg.
	BOGS - Low-lying, residue rich areas		LOG, MEDIUM (SOUND) 10-20" diam.		SOIL, SANDY - Sand .05-2mm diam.
	BRUSH PILE - >1m high, >=15m^2 basal area		MAMMALS, LARGE - > 2270g (5lb.)		SPRINGS-Freshwater springs, seeps
	BUILDINGS - Houses, sheds, etc.		MAMMALS, MED. - 110-2270g (4oz-5lb)		SPRINGS, HOT
	BURROW - Excavation made by animal		MAMMALS, SMALL - < 110g (4oz)		SPRINGS, MINERAL
	CAMPGROUND		MOSS - Bryophytes		STEEP SLOPE-Slopes > 50%
	CARRION - Any dead animal matter		MUD FLATS- contiguous with water body		STREAMS, INTERMITTENT
	CAVE - Natural chamber open to surface		NECTAR		STREAMS, PERMANENT
	CLIFF - Steep, vertical overhanging face		NEST BOX - Constructed nesting cavity		STUMP (ROTTEN)-snag<3m (10') high
	CONES - From gymnosperm trees		NEST PLATFORM - Const. large platform		STUMP (SOUND)-snag<3m (10') high
	DUFF - Non-structured decaying matter		NEST ISLAND - Man-made nesting island		TALUS-Slope from rock accumulation
	DUMP - Sanitary landfill		NUTS - Hard-shelled, dry fruit.		TIDEPOOLS
	EGGS - Any bird or reptile eggs		PACK STATION - with assoc. human use		TRANSMISSION LINES
	FENCES - Any type		PONDS - Permanent, <2ha (5 acres) surf. area		TREE LEAVES
	FERN - Spore-forming plants with fronds		REPTILES		TREE, BROKEN LIVE TOP >11" dbh
	FISH		RIPARIAN INCLUSION - Riparian veg. (small)		TREE, W/ CAVITIES
	FLOWERS		RIVERS - Perm., >6m (20') wide in dry season		TREE, W/ LOOSE BARK
	FORBS - Herbaceous dicotyledons		ROCK - Outcrop >10" diam.		TREE/AGRICULTURE - Interface
	FRUITS - Pulpy fruit		ROOTS		TREE/GRASS - Interface
	FUNGI - Mushrooms, molds, etc.		SALT PONDS - Saline ponds		TREE/SHRUB - Interface
	GRAIN - A single, hard cereal seed		SAND DUNE		TREE/WATER - Interface
	GRAMINOIDS - Grass-like plants		SAP		TREES, FIR - *Abies sp.* >11" dbh
	GRASS/AGRICULTURE - Interface		SEEDS - Other than listed above		TREES, HARDWOOD - >11" dbh
	GRASS/WATER - Interface		SHRUB/AGRICULTURE- Interface		TREES, PINE - *Pinus sp.* > 11" dbh
	INSECTS, FLYING - Insect eaten in air		SHRUB/GRASS - Interface		VERNAL POOLS
	INSECTS, TERRESTRIAL		SHRUB/WATER - Interface		WATER - Any source of free water
	INVERTEBRATES		SHRUBS - Woody plants, not trees		WATER, FAST - Unsilted; >2ft/sec. flows
	INVERTEBRATES, AQUATIC		SLASH, LARGE (ROTTEN) Residue 3-10" diam.		WATER, CREATED BODY - Guzzler, well, etc.
	JETTY - Rock/concrete extending into water		SLASH, LARGE (HOLLOW) Residue 3-10" diam.		WATER, SLOW - Some silt.; flows < .5ft/sec.
	KELP - Large, coarse, brown algae		SLASH, LARGE (SOUND) Residue 3-10" diam.		WATER/AGRICULTURE- Interface
	LAKES - Permanent > 2ha (5 acres)		SLASH, SMALL Residue 1-3" diameter		WHARF

☐ MINE - excavated for minerals

Attachment C4
Qualitative Indicator Evaluation Sheet

Evaluation Sheet (Front)

Aerial Photo:_____

Management Unit:_____ State:_____ Office:_____ Range/Ecol. Site Code:_____
(Allotment or pasture)

Ecological Site Name:_____ Soil Map Unit/Component Name:_____

Observers:_____ Date:_____

Location (description):_____

T. ____ R. _____ or _____N. Lat. Or UTM E_____m Position by GPS? Y / N
UTM Zone___, Datum___

Sec. _____, _____ _____W. Long. N_____m Photos taken? Y / N

Size of evaluation area:_____

Composition (Indicators 10 and 12) based on:__Annual Production, __Cover Produced During Current Year or __Biomass

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Soil/site verification:

Range/Ecol. Site Descr., Soil Surv., and/or Ecol. Ref. Area:
Surface texture _____
Depth: very shallow __, shallow __, moderate __, deep __
Type and depth of diagnostic horizons:
1. _____ 3. _____
2. _____ 4. _____
Surf. Efferv.: none __, v. slight __, slight __, strong __, violent __

Parent material _____ Slope _____% Elevation _____ft.

Average annual precipitation _____inches

Evaluation Area:
Surface texture _____
Depth: very shallow __, shallow __, moderate __, deep __
Type and depth of diagnostic horizons:
1. _____ 3. _____
2. _____ 4. _____
Surf. Efferv.: none __, v. slight __, slight __, strong __, violent __

Topographic position _____ Aspect _____

Seasonal distribution _____

Recent weather (last 2 years) (1) drought _____, (2) normal _____, or (3) wet _____.

Wildlife use, livestock use (intensity and season of allotted use), and recent disturbances:

_____
_____
_____
_____

Off-site influences on evaluation area:

_____
_____
_____
_____

Criteria used to select this particular evaluation area as REPRESENTATIVE (specific info. and factors considered; degree of "representativeness")

_____
_____
_____
_____

Other remarks (continue on back if necessary)

_____
_____
_____
_____

Reference: (1) Reference Sheet:_____; Author:_____; Creation Date:_____
or (2) Other (e.g., name and date of ecological site description; locations of ecological reference area(s))_____

Evaluation Sheet (Back)

Departure from Expected	**Code**	**Instructions for Evaluation Sheet, Page 2**
None to Slight	N-S	(1) Assign 17 indicator ratings. If indicator not present, rate None to Slight.
Slight to Moderate	S-M	(2) In the three grids below, write the indicator number in the appropriate column for each indicator that is applicable to the attribute.
Moderate	M	(3) Assign overall rating for each attribute based on preponderance of evidence.
Moderate to Extreme	M-E	(4) Justify each attribute rating in writing.
Extreme to Total	E-T	

Indicator	Rating	Comments
1. Rills	S H	
2. Water-flow Patterns	S H	
3. Pedestals and/or terracettes	S H	
4. Bare ground _____%	S H	
5. Gullies	S H	
6. Wind-scoured, blowouts, and/or deposition areas	S	
7. Litter movement	S	
8. Soil surface resistance to erosion	S H B	
9. Soil surface loss or degradation	S H B	
10. Plant community composition and distribution relative to infiltration	H	
11. Compaction layer	S H B	
12. Functional/structional groups	B	
13. Plant mortality/decadence	B	
14. Litter amount	H B	
15. Annual production	B	
16. Invasive plants	B	
17. Reproductive capability of perennial plants	B	

Attribute Rating Justification
Soil & Site Stability:

E-T	M-E	M	S-M	N-S

S (10 indicators):
Soil & Site Stability
Rating: _____

Attribute Rating Justification
Hydrologic Function:

E-T	M-E	M	S-M	N-S

H (10 indicators):
Hydrologic Function
Rating: _____

Attribute Rating Justification
Biotic Integrity:

E-T	M-E	M	S-M	N-S

B (9 indicators):
Biotic Integrity
Rating: _____

Appendix D
AMMP Revision Documentation Table

Appendix D – AMMP Revision Documentation Table

Version No.	Date	Summary of Revisions	Rationale for Revisions	Revision Made/Approved By
2.0	10/31/22 (Draft), 2/2/23 (Final)	Revised BGOs to adhere to USFWS 'SMART' principles	Updated the BGOs to better match USFWS guidance	Revisions made by Science Advisor Panel (Alta Science & Engineering), Approved by Scott Cambrin (Senior Biologist, DCP) 1/25/23
		Added monitoring methods for desert upland and riparian habitat	Updated previous 'placeholder' language	
		Added monitoring methods for covered plant species	Updated previous 'placeholder' language	
		Revised monitoring methods for species based on current scientific knowledge and existing site-specific data	Updated to incorporate best available science	
		Added species proposed to be covered under permit amendment so that baseline monitoring can be started now, for species detectable using existing methods and surveys	Collect baseline data for some proposed species as feasible	
		Revised the adaptive management to remove targets and apply triggers more broadly to BGOs, species, and habitats	Targets were previously undefinable or unachievable; the primary focus is on knowing when species are faring poorly	
		Formatting and editorial changes throughout	Basic editorial improvements	