City of Scottsdale

McDowell Sonoran Preserve

Ecological Resource Plan

Developed by the City of Scottsdale

and

EnviroSystems Management, Inc.

October

2024

CITY OF SCOTTSDALE MCDOWELL SONORAN PRESERVE

ECOLOGICAL RESOURCE PLAN

DEVELOPED BY THE CITY OF SCOTTSDALE
AND
ENVIROSYSTEMS MANAGEMENT, INC.

WITH
CONTRIBUTIONS FROM

THE MCDOWELL SONORAN PRESERVE COMMISSION, THE MCDOWELL SONORAN CONSERVANCY, ARIZONA GAME AND FISH DEPARTMENT, AND THE PUBLIC

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CITY OF SCOTTSDALE MCDOWELL SONORAN PRESERVE
3939 N. DRINKWATER BLVD
SCOTTSDALE, AZ 85251

scottsdaleaz.gov/preserve

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Executive Summary

The Ecological Resource Plan 2024 (ERP 2024) builds upon the 2016 Ecological Resource Plan (ERP 2016) developed for the City of Scottsdale's McDowell Sonoran Preserve (Preserve). As such, the ERP 2024 includes recommendations and guidance for scientific studies to evaluate and monitor ecological resources of the Preserve for the purpose of promoting the long-term health of the Preserve. The ERP 2024 recommends continued collection of data, assessment and additional analyses, and monitoring of ecological resources so that potential changes can be measured and reported to provide insight into adaptive management strategies tailored to the needs of the Preserve's ecological health, biodiversity, and sustainability.

ERP 2024 builds on baseline diversity and monitoring surveys, broadens to include data collection for other ecological indicators, and expands into metrics of abundance, composition, movement between and within habitat types, and habitat function and diversity. Historical records (archival data) may be used where appropriate to extend the time perspective of the studies. ERP 2024 provides a structure and process to understand current ecological conditions of the Preserve, identify potential resource areas of concern, and provide opportunities to observe future change and trends with statistically valid data. ERP 2024 incorporates reporting requirements for review of results to foster collaboration with stakeholders and the public to assess the status of the Preserve ecology and weigh management decisions for sustainability.

An Annual Report is recommended to provide a consolidated account of all study efforts and outcomes summarized for any given year. The information for the Annual Report will be generated from individual technical reports produced for specific studies and baseline monitoring. The Annual Report will be used to inform all stakeholders of the status of studies underway, results and conclusions for studies completed, and for public involvement and educational purposes. The annual report will be peer reviewed to help identify possible notable trends occurring in multiple studies and will serve as a basis to determine the frequency of the McDowell Sonoran Preserve Ecological Health Assessment.

The McDowell Sonoran Preserve Ecological Health Assessment will be produced periodically (three to five years, or as needed) to provide a comprehensive summary of results and conclusions of monitoring and studies completed within the Preserve. The overarching goal will be to convene a panel of experts and peer reviewers to come to consensus on the state of the ecological health of the Preserve and any notable trends worthy of further attention.
Budget considerations will need to be balanced with the proposed frequencies and priorities outlined in ERP 2024. ERP 2024 will serve as a tool for City Staff, the McDowell Sonoran Preserve Commission, and the City Council to make decisions about research priorities and is meant to be a dynamic document that will evolve over time based on results and conclusions from monitoring studies.

The McDowell Sonoran Preserve is a dynamic ecosystem and ERP 2024 provides a framework for measuring and understanding an ever-changing landscape. The Preserve is subject to past,

current, and future human and environmental impacts its sustainability for which the ERP 2024 lends guidance in the form of science, management, collaboration, and education.

I. McDowell Sonoran Preserve Description

A. Overview of the McDowell Sonoran Preserve Management Structure

The Preserve consists of over 30,580 acres of land and is home to well over 1,000 documented plants and animals, archaeological and historic artifacts, and unique geologic features. The Preserve is owned and operated by the City of Scottsdale (City) and managed through a partnership with the McDowell Sonoran Conservancy, a 501c3 nonprofit organization. Under this unique partnership the City owns, operates, and maintains the Preserve and the McDowell Sonoran Conservancy provides staff, citizen scientists, and stewards to aid the City in promoting, managing, and protecting the Preserve. The McDowell Sonoran Conservancy provides subject matter experts, research activities, and recommendations on management of natural resources within the Preserve.

A1. History and Background

Humans have occupied the greater Phoenix Valley including Scottsdale for approximately 9,000 years. In the mid-1800's Euro-American settlements moved in bringing cattle ranching, mineral prospecting and mining, and farming. The City of Scottsdale was founded in 1894 and incorporated in 1951; the effort to establish the Preserve began in 1991 with the formation of the McDowell Sonoran Land Trust, a 501c3 non-profit organization with the stated goal to preserve the lands in and around the McDowell Mountains. In 1995 and 2004, the Citizens of Scottsdale voted to approve sales taxes devoted to providing money for the acquisition of land for the Preserve within the Recommended Study Boundary (RSB). The RSB is a 34,000-acre geographic area where the City can use the above mentioned taxes to purchase land for inclusion in the Preserve and provide appropriate recreation trails and access areas. The citizens of Scottsdale continue to value the cultural heritage, unique desert habitat for various species of wildlife, educational opportunities, and opportunities for public recreation in a dense urban area.

As of 2024, the City has acquired or protected over 30,580 acres within the RSB (Figure 1). In most cases, the City has acquired lands in fee title, but in other cases the preserved land remains privately owned although protected by conservation easements, zoning designations, or other existing land use regulations.

The Preserve lies in central Arizona, in central and northern Scottsdale. Most of the Preserve can be described as palo verde-mixed cacti in the Arizona Upland Series of the Sonoran Desertscrub biome as described in Brown (1982). The Preserve received an annual average of 10.38 inches of precipitation between 1994 and 2022 (Flood Control District of Maricopa Official Precipitation Record, 2023). Elevations range from 1,690 feet above mean sea level (amsl) at the southern boundary to 4,059 feet amsl at East End Peak providing a wide array of habitats supporting diverse communities of flora and fauna throughout the Preserve.

The Preserve is within the City of Scottsdale corporate limits and is situated between Maricopa County's McDowell Mountain Regional Park (approximately 21,099 acres) and the Town of Fountain Hills Preserve (approximately 824 acres) both to the east, Tonto National Forest

(approximately 2.9 million acres) to the north, and urban Scottsdale/Phoenix to the south and west.

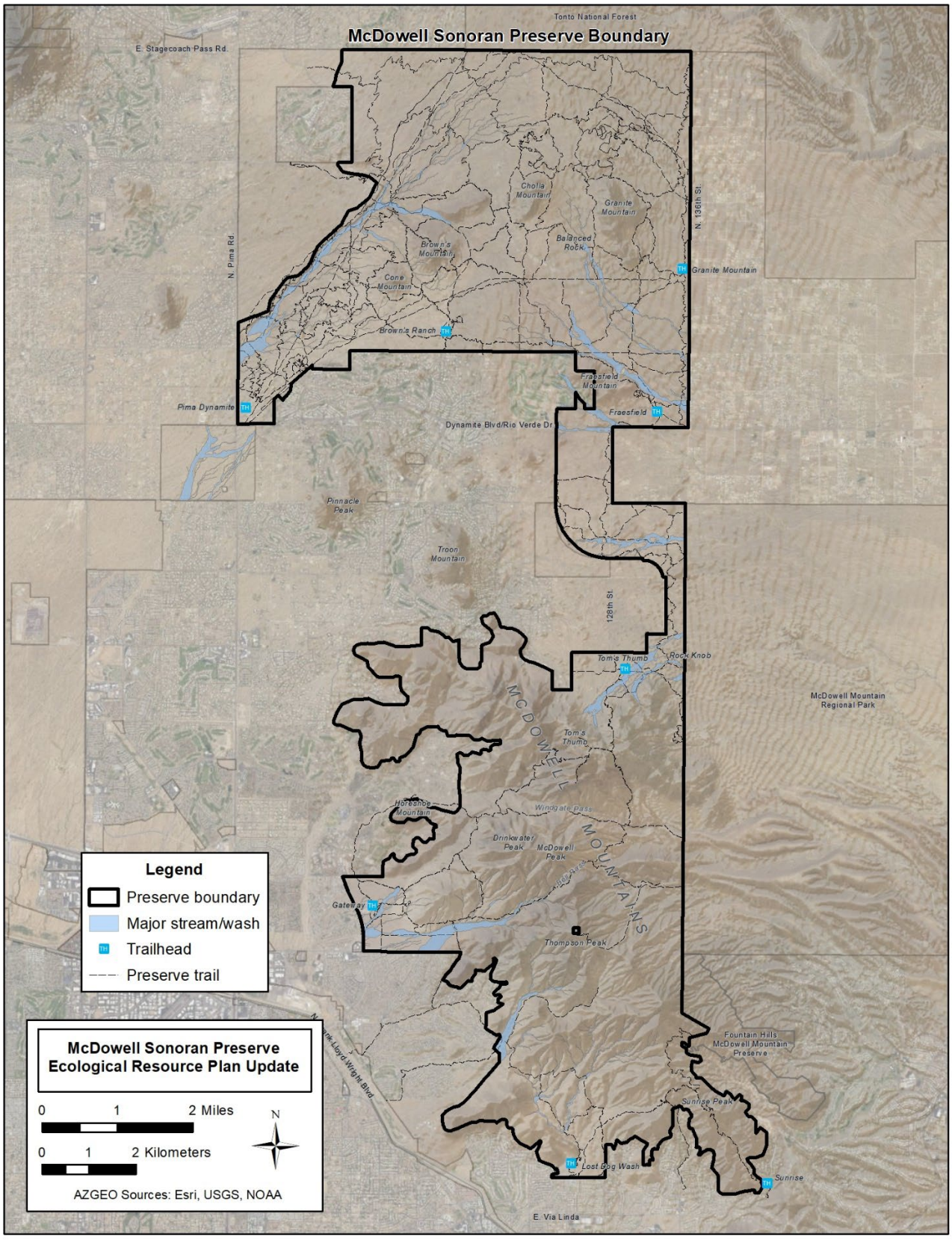

Figure 1. McDowell Sonoran Preserve.

The Preserve protects wildlife corridors that connect the Tonto National Forest and Maricopa County's McDowell Mountain Regional Park through areas that otherwise would be fragmented by various forms of urban development.

B. Purpose and Management Objectives of McDowell Sonoran Preserve

B1. Governing Structure

The City of Scottsdale is the landowner and manager of the Preserve. Its responsibilities include all land acquisition, trail and trailhead improvement planning, daily maintenance and operation, and public safety services. Management of the Preserve is carried out according to Chapter 21 of the Scottsdale Revised Code (S.R.C).

The stated purpose of the Preserve is described in S.R.C. Sec. 21-2:

> (a) The purpose of the McDowell Sonoran Preserve is to establish in perpetuity a preserve of Sonoran Desert and mountains to maintain scenic views, as a habitat for wildlife and desert plants; to protect archaeological and historical resources and sites, while providing appropriate public access for educational purposes; and to provide passive outdoor recreational opportunities for residents and visitors.
>
> (b) The preserve will be left in as pristine a state as possible to maintain for this and future generations, in perpetuity, a nearby natural desert refuge from the rigors of urban life.
>
> (c) The preserve will not contain traditional facilities or improvements associated with a public park but may contain facilities or improvements that the city determines are necessary or appropriate to support passive recreational activities.

The stated management objectives of the Preserve are described in S.R.C. Sec. 21-3:

(1) Preserve the local plants, wildlife, and natural resources to maintain the biological diversity and long-term sustainability of the area's ecology.
(2) Maintain scenic views to preserve the aesthetic values of the area for all to enjoy and for its contribution to the quality of life of the community.
(3) Protect historical and archaeological resources, such as petroglyph sites.
(4) Provide a superior opportunity for people to experience and enjoy the magnificent Sonoran Desert and mountains.
(5) Provide a variety of opportunities for passive outdoor recreation, such as hiking, wildlife viewing, mountain bicycling, horseback riding, and rock climbing.
(6) Support tourism in the community by providing public outdoor educational opportunities for visitors.
(7) Provide opportunities for education and research on the Sonoran Desert and mountains.
(8) Provide enough access areas of sufficient size and with adequate amenities for appropriate public access.

(9) Develop a non-paved public trail system for hiking, mountain biking, bicycling and horseback riding and link these trails, where appropriate, with other city and regional trails.
(10) Restore habitat in degraded areas of the preserve to its undisturbed condition, including diverse plant species and natural ecological processes.

B2. Community Conservation Values

The purpose and management objectives of the Preserve express the conservation values of the City of Scottsdale and its citizens. The conservation ethic emphasizes biological, ecological, social, cultural, and outdoor recreation values, and perpetuates preservation and sustainability of natural open space through science, education, and stewardship to assure protection of the Sonoran Desert and McDowell Mountains for this and future generations (McDowell Sonoran Conservancy, 2024).

B3. Public Education

Public education is a pillar of the City's Preserve management strategy. The Preserve Management Objectives in Chapter 21 of the Scottsdale Revised Code include providing opportunities for education and research on the Sonoran Desert and mountains. This objective is achieved through a wide variety of public education opportunities, many of which are provided by the McDowell Sonoran Conservancy. The McDowell Sonoran Conservancy delivers educational opportunities for residents and visitors including guided hikes and bike rides, public lectures, online content, youth education, and trail and trailhead ambassadors.

B4. Public Involvement

Public input and involvement are at the core of the City of Scottsdale. The Preserve was envisioned by the citizens, supported by the citizens, and exists because of the support of the citizens. The future of the Preserve will depend on involvement and support from the citizens. Citizen involvement is embodied in the McDowell Sonoran Preserve Commission, a seven-member advisory body that makes recommendations to the Scottsdale City Council on matters concerning the Preserve, and in the McDowell Sonoran Conservancy, the City's non-profit partner in the care and management of the Preserve. The McDowell Sonoran Conservancy was founded by advocates for the initial vision of the Preserve and continues to this day as a key element in the citizen support of the Preserve.

II. Status of Ecological Resources

A. Ecological Baseline

The baseline is the state at which the resource has been inventoried, measured, or described. A substantial baseline for diversity has been previously determined for numerous resources of the Preserve. Other metrics of abundance, reproductive success, composition, and habitat type and use have been measured to some extent for some species and form a degree of baseline conditions for these metrics. However, standard methods for data collection and analysis or established frequency of such investigations have not yet been put into place.

The ecological resources of the Preserve discussed in the 2016 ERP were based primarily on large-scale inventories of plant and wildlife completed between 2009-2014 giving an overall snapshot of the ecological resources present in the Preserve and providing the baseline condition of biodiversity. The *Flora and Fauna of the McDowell Sonoran Preserve* (2014) was the culmination of plant and animal field studies conducted over nearly three years. Additional studies and reports were completed by the McDowell Sonoran Conservancy with experts and partners on geological resources (Gootee et al., 2009; Gruber et al., 2010; Gootee and Gruber, 2015) and plant associations (Jones and Madera, 2014) during this time frame.

These data and reports provided insight into the ecological health of the Preserve. They are part of a databank of baseline information. The Principal Investigators of these inventories and reports concluded that the flora and fauna diversity are consistent with those in surrounding natural Arizona uplands, the multiple trophic levels present indicate a robust food web, and the Preserve was in healthy condition, given the historic use and proximity to urban development (ERP, 2015). Previous scientific studies conducted within the Preserve are listed in Appendix A.

Since 2016, scientific investigations represent more focused efforts on inventories and monitoring of certain groups of animals, habitat use and wildlife movement, assessing degraded lands and restoration, as well as identifying and treating invasive plant species. Formal and informal management plans have been developed to enhance recreation and implement strategies for resource protection.

A1. Role of Preserve Stewards – Citizen Science Model

Preserve steward volunteers working with the McDowell Sonoran Conservancy assist the City of Scottsdale with the maintenance and promotion of the Preserve by patrolling trails, greeting, and providing information to visitors, providing educational hikes and programs providing support for the Preserve staff, and aiding with scientific research.

Scientific investigations in the Preserve provide a unique opportunity for interested citizen scientists and Preserve stewards to collect baseline ecological data on conditions in the Preserve and to participate in on-going scientific studies. The on-going studies provide for both desktop level analysis of data and in-field observations of current on-the-ground conditions. The citizen science model connects citizens of all ages, abilities and interest levels with the operation, maintenance, and planning aspects of the Preserve. Connection to the Preserve has a multitude of benefits including better understanding of the natural and physical conditions in the Preserve, appreciation of the social and health benefits of Preserve management, and interest in maintaining the ecological and physical health of the Preserve.

The City, along with McDowell Sonoran Conservancy, agency land managers, experts from research and academic institutions, and countless hours from citizen scientists and stewards have developed a strong collaborative coalition and bank of scientific information dedicated to the health and sustainability of the Preserve.

B. Preserve Management Plans

The Preserve is operated according to the purpose, goals, and objectives of Chapter 21 of the Scottsdale Revised Code. The following management plans and policies have been developed for management of specific resources within the Preserve in accordance with Chapter 21. Management plans are incorporated into the 2024 ERP to provide comprehensive, consistent, and integrated management.

B1. Wildland Fire and Fuel

The City's Community Services Department and the Scottsdale Fire Department work closely with a variety of partner agencies on the planning and implementation of wildland fire and fuel reduction projects in strategic areas throughout the City, particularly in the areas within and surrounding the Preserve. Priorities for fuel reduction projects are continually evaluated and prioritized to have the greatest impact for preventing and slowing the spread of wildfires.

B2. Invasive Plants

The City Community Services Department partners with McDowell Sonoran Conservancy to identify, plan, prioritize, and implement invasive plant management, particularly for Fountain Grass and Buffelgrass (*Pennisetum* spp.). Each year, the City and the McDowell Sonoran Conservancy work together to update the Invasive Pennisetum Species Strategic Plan and identify priority areas to targeted treatments.

B3. Cultural Resources

The City has a Cultural Resource Master Plan (CRMP) approved by the City Council in 2016. The CRMP provides guidance for the management of cultural resources within the Preserve and establishes an ethic of conservation archaeology. The CRMP promotes the protection and interpretation of cultural resources in the Preserve for present and future generations and encourages a sense of resource stewardship among the City's constituency. Former land uses have left their mark upon the Preserve and can be recognized from historical records, archaeological sites, and ecofacts, which may have influenced current conditions.

B4. Public Trailhead Access Areas

The City has a plan for public trailhead access areas known as the Access Areas Report. This plan prescribes the location of public trailheads and the amenities included at each trailhead. This plan was created in 1999 and updated in 2010. Since that time, much of the proposed work identified in the plan has been completed.

B5. Shared-use Non-motorized Trails

The locations of trails in the Preserve are dictated by the Preserve Trails Plan. First created in the late 1990's, the trails plan shows the locations of trails in the Preserve. In 2013, the City implemented a planning process for the trails in the northern region of the Preserve, which resulted in the creation of the Phase 2C and Phase 3 Trails Plans.

B6. Rock Climbing Plan

Rock climbing in the Preserve is managed according to the Conceptual Rock Climbing Plan which documents the locations of the rock crags in the Preserve where rock climbing is permitted, and

the climbing access routes used to connect from the main trails to the crags. The plan also includes the policy by which rock climbing is managed in the Preserve.

III. Ecological Resource Studies and Analyses

The purpose of the ERP 2024 is to provide a structure and process for understanding and monitoring of ecological conditions, sustain the health of the Preserve, identify potential areas of concern, and to provide statistically valid data analysis to observe trends. It builds upon past and ongoing baseline diversity and monitoring surveys, broadens to include data collection for other resource indicators of biodiversity, and expands into the areas of abundance, composition, movement between and within habitat types, and habitat function and diversity. All studies implemented under ERP 2024 will be designed to collect current data with replicable scientific methods to allow for statistical evaluation of results.

Budget considerations will need to be balanced with the proposed frequencies and priorities outlined in ERP 2024. ERP 2024 will serve as a tool for City Staff, the McDowell Sonoran Preserve Commission, and the City Council to make decisions about research priorities and is meant to be a dynamic document that will evolve over time based on results and conclusions from monitoring studies. Given budget constraints, careful consideration should be taken to assure that research priorities focus on data related to trends in ecological health which can be used to inform the Adaptive Management process.

The ERP 2024 Objectives serve to guide long-term management for the ecological health and sustainability of the Preserve. These Objectives will be reflected in the scope of work directives to be developed for each resource study.

- **M**onitor ecological health to develop databases for statistical analysis.
- **E**valuate species density, diversity, distribution, and movement to contribute to long-term monitoring data.
- **C**reate consistency in methods over time and across projects to produce comparable data for analysis.
- **P**ursue trend analyses to detect change over time.
- **D**etect invasive species (plant or animal) to identify preventative strategies for containing population spread.
- **O**bserve atmospheric data and incorporate into each scientific study, as well as in a broader Preserve-wide context that may be impacting trends.
- **I**dentify evidence of current and historic human impact and encroachment to manage risk and identify research opportunities.
- **A**pply new and emerging technologies when appropriate to enhance, refine, and increase efficiency for long-term monitoring.

- **S**ummarize findings on a consistent basis to evaluate Preserve health.
- **G**enerate adaptive management strategies and options when research analysis indicates action may be needed.

Implementation of the ERP 2024 studies will be carried out through the City procurement process. As such, any qualified agency, non-profit institution, university, or private or public organization with the required expertise could be eligible. In addition, elements of the ERP could be carried out through means such as University graduates pursuing research as part of advanced degrees could propose studies consistent with Preserve goals and ERP 2024 objectives.

Indicator Species and Baseline Data

Indicator species are those whose status reflects or predicts the condition of the environment where they are found. The strategy of using indicator species is derived from the concept that ecological health is integrated over, or reflected by, the current status or trends (short- or long-term patterns of change) in the diversity, abundance, reproductive success, or growth rate of species living in that environment (Ahmed et al., 2016).

Studies of selected flora and fauna species diversity were completed from 2010 to 2013, with subsequent studies capturing diversity for birds, butterflies, and bats. These investigations largely form the baseline of flora and fauna diversity of the Preserve. Moving forward, long-term monitoring of diversity will be partnered with additional data collection for baseline establishment including density, productivity, distribution, population health, and habitat type, use, and wildlife movement.

Study Frequencies

Research frequencies should be such that data is statistically significant to detect change in a period of time that the adaptive management process can respond to it. The frequencies discussed in the resource studies are only suggested guidelines. Suggested frequencies provide flexibility for refined decisions to be made during the creation of the specific research designs and recognize the limitations of available funding. Frequency categories of Low, Medium, and High have been developed for each resource study. Additionally, it is anticipated that study initiation for the various resources will be implemented on a staggered basis depending on funding and staffing.

Atmospheric Data

Atmospheric data should be collected in performance of individual studies as well as on a Preserve-wide basis, if possible. Atmospheric data is important for evaluating site conditions and the influence atmospheric conditions may have on interpreting study results. Atmospheric data consist of several measurements that may include temperature, precipitation, relative humidity, dewpoint, windspeed and direction, air pressure, aspect (exposure), cloud cover, and solar radiation. Some data may require special equipment. However, most data can be collected relatively easily and are routinely part of scientific studies.

Human Impact

Impacts of humans on the natural environment should be evaluated, where appropriate, as part of the proposed scientific research studies and analysis. Human impacts can include human factors such as changes in climate (e.g., urban heat islands), habitat loss and fragmentation, pollution and contamination, disease outbreaks, human encroachment (wildland-urban interface), introduction and spread of invasive plant and animal species, and wildfire.

Ecological Evaluation and Management Process

An ecological evaluation and management process will be used to assess the Preserve's ecological health. This process incorporates the standards of ERP 2024's reporting requirements and stakeholder's involvement along with scheduled studies and/or monitoring adapted from Mau-Crimmins, et al., 2005 (Figure 2). Resource studies have been recommended in consultation with the City of Scottsdale, McDowell Sonoran Preserve Commission, Arizona Game and Fish Department (AGFD), and the McDowell Sonoran Conservancy. The intent is to measure and assess biological diversity, density and productivity in multiple trophic levels and habitats to be used as benchmarks of ecological health. Trend analyses and detection of change can be used to identify causes that may be attributed to natural variances, abiotic factors, human impact, or combination thereof. Information ascertained may then trigger further investigations and subsequent management decisions. It is anticipated investigations, and monitoring will be adjusted and refined over time as the data indicate.

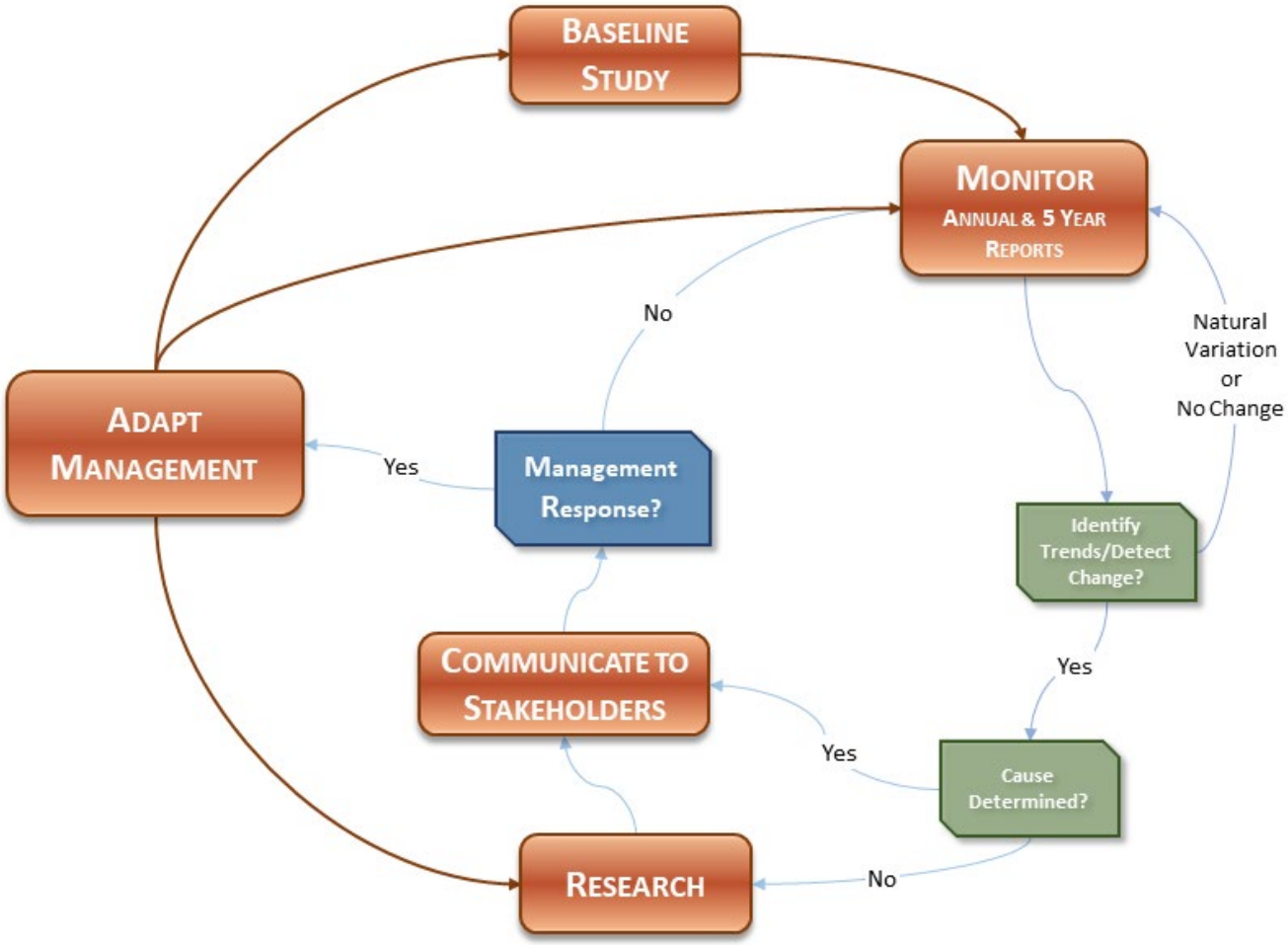

Figure 2. Ecological Evaluation and Management Process.

Within ERP 2024, resource studies have been assigned tiers (T1 or T2) to aid in the prioritization of research projects.

Tier Definitions:

- T1 – Prioritized studies based ecological metrics of diversity, density, habitat type and function to measure and monitor resources to track changes and evaluate impacts.
- T2 – To be studied on an as needed basis, based on trends that may be determined through T1 studies.

The following sections are broken down by resource of study and the metrics being evaluated with the tier level for that metric (T1 or T2). Metric driven standardized study methods are available and have been in use by researchers in multiple disciplines for decades. These methods can then be followed to collect comparable data for long-term monitoring efforts and trend analyses into the future. General forms of data collection, monitoring frequency, and thresholds are included under each metric as guidance. Field investigations may be scheduled for initiation

over a three to five-year period dependent on availability of principal investigators, citizen scientists, contractors, and funding.

The ERP 2024 Objectives, study metrics, frequency, and thresholds provide the framework for study regimens that result in a cohesive approach to methodology, data collection, analysis, documentation, and adaptive management for the Preserve.

A. Flora

A1. Vegetation

Vegetation and biomass provide insights into an environment's overall health, climate conditions, nutrient availability, and carbon cycle dynamics. Research has shown composition of the vegetation, and the properties of its environment are related. At present the environmental conditions can be estimated in the field from the floristic composition with regard to differences both in the combination of plant species and in their relative biomass production (de Boer, 1983).

Metrics

Species diversity, density, percent cover, composition, and dominance. (T1)

Baseline

- A baseline for diversity is established.
- A baseline for plant density, percent cover, composition, and dominance to be established.

Course of Action

- Permanent and random transects or quadrat plots.

Monitoring Frequency

- Low – Every 5 years.
- Medium – Every - 3 years. (Suggested)
- High – Every 2 years.

Thresholds

- Trend analysis indicates a significant change in diversity, density, percent cover, or shifts in composition and dominance.

❖ Vegetative biomass. (T1)

Baseline

- A baseline for productivity to be established.

Course of Action

- Production plots or transects.

Monitoring Frequency

- Low - Every 10 years. Suggested for thorough process
- Medium – Every 5 years. If simplified process is showing areas of concern
- High – Every 2 years. Suggested for simplified process

Thresholds

- Trend analysis indicates a significant change in vegetative productivity.

Background

Original plant inventories and plant association mapping occurred from 2011 to 2013 (McDowell Sonoran Conservancy, 2014).

A2. Phenology

Plant-pollinator interactions are a critical component of a healthy plant community and a healthy ecosystem. These interactions may be impacted by many factors, including potential phenological mismatches that may disrupt the timing of successful pollination. Environmental variables influence both when plants flower and when insects pollinate, and if those variables change, so might the timing of each species. If those changes do not track each other, plants and pollinators may not be active at the same time, potentially causing problems to both groups (Solga, et al., 2014).

Metrics

❖ Phenology of key Sonoran Desert plants and associated pollinators. (T1)

Baseline

- A baseline for phenology is established.

Course of Action

- Monitor at previously established locations.

Monitoring Frequency

- Low – Every 1-2 years
- Medium - Monthly to quarterly (Suggested)
- High – Weekly (with support of other funds)

Thresholds

- Trend analysis indicates significant change in phenophases.

Background

Since 2017, the McDowell Sonoran Conservancy has been collecting phenological data at three sites in the Preserve at least twice a week throughout the year. Citizen scientists monitor six plant and one bird species: saguaro, buckhorn cholla, jojoba, soap tree yucca, desert senna, and velvet mesquite, barrel cactus, and ocotillo, and the white-winged dove, which has a close association with the saguaro cactus.

A3. Saguaro Cactus

Saguaro cacti are only found in the Sonoran Desert. As a desert indicator species, they play a very important role in the ecosystem by providing shelter, food, and nesting sites for many animals (USGSa, 2024). A symbol of the Sonoran Desert with a life span of 150-175 years, saguaro cactus not only play an ecological role, they also have important spiritual and cultural value to many communities, including Tribes.

Metrics

❖ Growth and health of saguaro cactus. (T1)

Baseline

- A baseline to be established for the saguaro cactus.

Course of Action

- Study plots to age and measure height, numbers and length of arms, new growth, recruitment, and inspect for signs of stress, disease, loss of arms, and collapse. Note the presence of nurse plants.
- Photograph individual saguaros and nurse plants, if present.

Monitoring Frequency

- Monitor height, number of arms, new growth, recruitment.
  - Low – Every 8 years
  - Medium – Every 6 years (Suggested)
  - High- Every 5 years
- Monitor signs of stress, disease, loss of arms, collapse, and photograph.
  - Low – Every 8 years
  - Medium – Every 5 years (Suggested)
  - High- Every 3 years

Thresholds

- Trend analysis indicates a significant change in growth, health, and recruitment of saguaro cactus.

Background

Study plots and transects for Saguaros have been occurring since 2023 in the area of the Preserve impacted by the Diamond Fire.

B. Fauna

B1. Game Species

The population estimates conducted by AGFD provide valuable long-term monitoring of predator and prey populations within the Preserve. Predator-prey relationships maintain ecosystem stability by regulating population sizes of both predators and prey, influencing the flow of energy through food webs, and shaping the structure of ecological communities (Glen and Dickman, 2014).

Metrics

❖ Population estimates for mule deer and javelina, and other medium to large mammals such as coyotes, bobcats, and mountain lions. (T1 – Mule Deer/Javelina – T2 - others)

Baseline

- A baseline is established.

Course of Action

- Continue AGFD aerial game species count.

Monitoring Frequency

- Low – 3 years
- Medium – 2 years
- High - Annual (Suggested, but could be backed off to medium or low if no notable changes are being detected)

Thresholds

- Trend analysis indicates significant changes in game species populations.

Background

In partnership with the City of Scottsdale, the AGFD has been completing aerial game species counts to estimate population status annually from 2013 to present.

B2. Bats

Bats provide several ecosystem services, and hence reflect the status of the plant populations on which they feed and pollinate as well as the productivity of insect communities. Bat populations are affected by a wide range of stressors that affect many other taxa. Bats are excellent indicators of human-induced changes in climate and habitat quality. Many bats fulfill vital ecosystem services and changes in bat populations often reflect features of habitat deterioration. Bat populations show responses to environmental stressors ranging from alterations in habitat quality to climate change (Jones, et al., 2009).

Metrics

❖ Preserve-wide diversity, relative abundance, composition, and distribution of bat species. Detection of white-nose syndrome. (T1)

Baseline

- A baseline to be established.

Course of Action

- Preserve-wide acoustic monitoring, emergence counts, and mist netting.
- Locate additional roosts.

Monitoring Frequency

- Low – 5 years
- Medium – Every 1-2 years (Suggested)
- High - annually

Thresholds

- Presence of white-nose syndrome detected.
- Trend analysis indicates significant changes in abundance and/or diversity in the Preserve.

❖ Density and productivity of Townsend's big-eared bat maternity roost. (T1)

Baseline

- A baseline for the maternity roost is established.

Course of Action

- Roost activity logger, acoustic monitoring, emergence counts, and/or mist netting.

Monitoring Frequency

- Low – 2-3 years
- Medium – Annually (Suggested)
- High – Monthly

Thresholds

- Presence of white-nose syndrome detected.
- Trend analysis indicates a significant decline in Townsend's big-eared bat density, productivity, and activity.

❖ Maternity roost microclimate conditions. (T1)

Baseline

- A baseline for the maternity roost microclimate to be established.

Course of Action

- Microclimate measurements for temperature and humidity.

Monitoring Frequency

- Low – 2-3 years
- Medium – Annually (Suggested)
- High - Monthly

Thresholds

- Trend analysis indicates a significant change in microclimate conditions.

Background

Long-term monitoring performed by the McDowell Sonoran Conservancy within the Preserve has been ongoing since 2017. Thirteen species of bats have been identified and a maternity roost for the Townsend's big-eared bat has been discovered.

B3. Pollinators

Pollinators link the fate of many other species scattered over large landscapes. Monitoring key Preserve locations of these species to determine stability of their habitat will ensure ability to respond if conditions markedly deteriorate. Invasive plant species can also out compete native species upon which these pollinators depend, and many of the flowering plants these pollinators visit are suffering low seed set due to pollen decline (Desert Museum, 2024).

Metrics

❖ Butterfly species diversity and relative abundance. (T1)

Baseline

- A baseline for diversity is established.

Course of Action

- Continue butterfly monitoring.

Monitoring Frequency

- Low – 1-2 years
- Medium – twice per year (Suggested)
- High – monthly to quarterly

Thresholds

- Trend analysis indicates a significant decrease in diversity and relative abundance of butterfly species.

Diversity of other pollinators including bees (including invasives), wasps, and moths. (T1)

Baseline

- No baseline data is collected regarding other pollinators.

Course of Action

- Inventory and monitoring.

Monitoring Frequency

- Low – 1-2 years
- Medium – twice per year (Suggested)
- High – monthly to quarterly

Thresholds

Trend analysis indicates a significant decrease in diversity of other pollinators.

Background

The McDowell Sonoran Conservancy has conducted annual Fall butterfly counts at six sites since 2014. In 2017, an annual Spring count was added at the same sites to better assess seasonal variances. Fifty-nine butterfly species have been identified.

B4. Birds – Migratory, Raptor, Nocturnal, and Sensitive Species

Birds have been used as bioindicators for many reasons, including: (1) their ecology is well understood; (2) the links among bird communities, vegetal associations, and territory has been clearly demonstrated; (3) they cover different levels of the ecological pyramid in every environment; (4) they are easily detected, thus, allowing rapid data collection not only on presence/absence but also on abundance (Padoa-Schioppa, et al., 2006).

Metrics

❖ Diversity and density for diurnal species. Diversity and relative abundance for nocturnal species. (T1 – certain key species and T2 option for others)

Baseline

- A baseline for diurnal and nocturnal diversity is established.

Course of Action

- Diurnal and nocturnal point count surveys.

Monitoring Frequency - Diurnal

- Low – 2-3 years
- Medium – Annually (Suggested)
- High -3 times per year

Monitoring Frequency - Nocturnal

- Low – 3-4 years
- Medium – 1-2 years (Suggested)
- High - Annually

Thresholds

- Trend analysis indicates a significant decrease in diversity, diurnal density, or nocturnal relative abundance.

❖ Raptor nest status. (T1)

Baseline

- A baseline for raptor nests to be established.

Course of Action

- Field surveys to identify active nests, species, and fledgling numbers, if present.
- Map nest locations.

Monitoring Frequency

- Low – 6-8 years
- Medium – 4-5 years (Suggested)
- High -2-3 years

Thresholds

- Trend analysis indicates a significant change in raptor nest status.

Background

In 2018, the McDowell Sonoran Conservancy annual bird monitoring was increased to a total of nine diurnal and two nocturnal survey routes. Diurnal sites are surveyed three times per year to capture seasonal fluctuation; nocturnal sites are surveyed once in late May. At least 190 species of birds have been recorded.

B5. Arthropods (ground-dwelling)

Arthropods are important components of the ecosystem that occupy vital positions in food webs, changing population, and communities. Arthropods play multiple roles in the ecosystem such as herbivores, decomposers, predators, parasites, seed dispersers, and pollinators. The peculiar characteristics of arthropods such as small body size, high diversity, increased reproductive capacity, easy sampling, make them suitable for environmental biomonitoring. For these reasons, arthropods are used as biological indicators to monitor and assess the impacts on the ecosystem (Medhi, et al., 2021).

Metrics

❖ Diversity, density, and composition (including invasives) between wildland-urban interface and natural area habitats. (T1)

Baseline

- The diversity and density baseline is present for arthropod studies.

Course of Action

- Pitfall traps.

Monitoring Frequency

- Low – 1-2 years (Suggested)
- Medium – 2 times a year
- High – 4 times a year - CAP LTER protocol (Subject to funding availability or outside sources)

Thresholds

- Trend analysis indicates a significant change in diversity, density, and composition (including invasives) between wildland-urban interface and natural area habitats.

Background

Since 2012, the McDowell Sonoran Conservancy has been conducting research by collecting ground-dwelling arthropods at regular intervals at sites throughout the Preserve. The sampling design pairs sites in the interior of the Preserve to sites near the urban edge for comparison. The diversity of arthropods in the Preserve is high, with over 300 unique taxa identified. The Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) program has been assisting identification species of arthropods collected by the Preserve.

B6. Talussnails

The Phoenix talussnail is a mollusk species being considered for Endangered Species Act listing as either threatened or endangered by the U.S. Fish and Wildlife Service in 2025-2026. Invasive and feral populations of brown garden snails and decollate snails may be found within the wildland-urban interface and natural area habitats. These introduced snails may impact the native talussnails through competition, predation, and exposure to new parasites. More comprehensive survey work is needed to document the presence of these snails within rocky habitats and along trails.

Metrics

- Diversity, density, and composition (including invasives) between wildland-urban interface and natural area habitats. (T1)

  Baseline

  - A baseline to be established.

  Course of Action

  - Locate talussnail populations among rocky hillsides and along trails.

  Monitoring Frequency

  - Low – Every 5 years
  - Medium – Every 3 years
  - High – Every 1-2 years (Suggested)

  Thresholds

  - Trend analysis indicates a significant change in diversity, density, and composition (including invasives) between wildland-urban interface and natural area habitats.

Background

AGFD has a couple records of native Phoenix talussnails within the Preserve (Waters, 2011). Use AGFD survey protocol (Sorensen, 2022) and AGFD can provide training to Preserve staff and citizen scientists on how to conduct talussnail surveys and using iNaturalist app to record new observations.

B6. Amphibians and Reptiles

Herpetofauna constitute an important part of the food web. They serve as prey for many animals, including mammals, birds, and other herpetofauna. As predators, they consume insects and other invertebrates, and species such as mice and rats. Amphibians are indicators of wetland ecosystem health. They are sensitive to a variety of threats due to their permeable skin and complex life histories, thus, can serve as early indicators of ecosystem change when monitored over time (Baril, et al., 2019).

Metrics

❖ Diversity and relative abundance of Amphibians. (T1)

Baseline

- A baseline for diversity is established.

Course of Action

- Inventory and monitoring.

Monitoring Frequency

- Low – Every 3-5 years
- Medium – Every 3 years (Suggested)
- High – Every 1-2 years

Thresholds

- Detection of presence of chytrid fungus and/or invasive bullfrogs. Trend analysis indicates a significant decrease in amphibian diversity and relative abundance.

❖ Diversity and relative abundance of Reptiles. (T1)

Baseline

- A baseline is established.

Course of Action

- Occupancy monitoring plots.

Monitoring Frequency

- Low – 3 times per year for 2 years
- Medium – 2 times per year for 3 years (Suggested)
- High – 3 times per year for 4 years

Thresholds

- Trend analysis indicates a significant decrease in reptile diversity and relative abundance.

❖ Sonoran Desert tortoise density, reproduction, and population health. (T1)
(tortoise movement is identified under Section D below)

Baseline

- A baseline for long-term monitoring plots to be established.

Course of Action

- Long-term monitoring plots.

Monitoring Frequency

- Low – 3 times a year for 2 years
- Medium – 2 times a year for 3 years (Suggested)
- High – 3 times a year for 5 years

Thresholds

- Detection of presence of Upper Respiratory Tract Disease (URTD).
- Trend analysis indicates a significant decrease in Sonoran Desert tortoise density, reproduction, and population health.

Background

Original amphibian and reptile surveys were conducted between March 2011 and November 2013 (Weber, et al., 2016). Two hundred individual amphibians and reptiles were documented including 34 species in 11 families and 29 genera (3 species of amphibians, 31 species of reptiles; 1 species of tortoise, 13 species of lizards, and 17 species of snakes).

In 2016, amphibian inventories of species presence and relative abundance were conducted during the rainy season. In 2019, these efforts increased to include weekly monitoring from July through September to assess species phenology (timing of emergence, reproduction, metamorphosis,) and in relation to water availability. Five species of toads were documented including the Great Plains toad, red-spotted toad, Couch's spadefoot, Sonoran Desert toad and Woodhouse's toad (Jessie Dwyer, personal communication, May 29, 2024).

C. Water and Riparian Areas

Riparian areas and desert springs face numerous challenges, including groundwater pumping, drought, increasing temperatures, and invasive species. In addition, there is a lack of information on the exact number of springs, their locations, condition, and the species that depend on them (Drake, et al., 2016).

Metrics

- Perennial, intermittent, and ephemeral (including man-made) surface water classification, vegetation composition, and faunal diversity and relative abundance. (T1)

  Baseline

  - A baseline to be established.

  Course of Action

  - Riparian vegetation inventory (including invasives), extent, canopy cover, and vertical volume.
  - Wet/dry mapping and measurement of spring(s) flow, and water presence and depth or if absent.
  - Faunal survey (including invasives).

  Monitoring Frequency

  - Riparian vegetation inventory (including invasives), extent, canopy cover, and vertical volume.
    - Low – Every 6-8 years
    - Medium – Every 4-5 years (Suggested)
    - High- Every 2-3 years
  - Wet/dry mapping, water presence and depth and spring flow measurement. Include observation of invasive bullfrogs, if present.
    - Low – Every 2 years
    - Medium – Annually
    - High – Twice per year - spring/fall (Suggested)
  - Faunal surveys
    - Low – 6-8 years

- Medium – 4-5 years (Suggested)
- High -2-3 years

Thresholds

- Loss of one or more water features or reduction of classification status.
- Trend analysis indicates a significant decrease in riparian vegetation, extent, canopy cover, or vertical volume.
- Trend analysis indicates a significant decrease in faunal diversity and relative abundance.

❖ Water Quality (T1)

Baseline

- A baseline to be established.

Course of Action

- Sampling and analysis for pesticides and other toxins.
- Sample for presence of chytrid fungus.

Monitoring Frequency

- Low – Every 3 years
- Medium – Every 2 years
- High – Annually (Suggested)

Thresholds

- Prescence of pesticides or other toxins in excess of Environmental Protection Agency standards.
- Presence of chytrid fungus.

❖ Groundwater levels (T1)

Baseline

- A baseline to be established.

Course of Action

- Obtain current and historic Arizona Department of Water Resources Groundwater Site Inventory records on Preserve.

Monitoring Frequency

- Low –Every 3 years
- Medium – Every 2 years
- High – Annually (Suggested)

Thresholds

- Trend analysis indicates a significant reduction in groundwater level in the Preserve.

Background

In *The Flora and Fauna of Scottsdale's McDowell Sonoran Preserve* (2014), riparian and water resources on the Preserve were characterized as scarce. Limited surface water sources include one perennial spring, several small intermittent water sources, and a series of older wildlife water

catchments and old stock tanks. Little is known about these resources, particularly riparian habitat, species composition, and wildlife diversity that may exist.

D. Habitat Connectivity and Movement Corridors

Habitat connectivity is critical for maintaining healthy populations, as it promotes biological diversity through the exchange of genes (i.e., reproduction) and allows animals to respond in the face of environmental changes. Understanding the factors that connect and influence the distribution of a species is important for predicting how these animals will respond to disruptions in the environment and developing plans to limit potential impacts (Damschen and Brodie, 2024).

Metrics

❖ A) Movement of mule deer, javelina, mountain lions, desert tortoise, and small to medium-sized predator and prey species between northern, central (including gooseneck), southern regions of the Preserve and adjacent habitat (T1); B) Habitat use of washes as movement corridors; primary and secondary. (T1)

Baseline

- Camera trapping baseline is established for target species for Preserve regional movement.
- Camera trapping to be established with deployment near washes.
- Radio telemetry baseline is established for mule deer and desert tortoise. Radio telemetry baseline to be established for mountain lions.

Course of Action

- Radio telemetry of mule deer, desert tortoise, and mountain lion.
- Health assessment of desert tortoises with radio transmitters.
- Wildlife camera traps.

Monitoring Frequency (collars are battery-life dependent)

➢ Mule deer deployment with 3-year collar-life
- Low – Redeploy every 8 years (Suggested)
- Medium – Redeploy every 6 years
- High – Redeploy every 5 years

➢ Desert tortoise deployment with 2-year collar-life
- Low – Redeploy every 5 years (Suggested)
- Medium – Redeploy every 7 years
- High - Redeploy continuously for 10 years

➢ Mountain lion deployment with 3–5-year collar-life
- Low – Redeploy every 10 years
- Medium – Redeploy every 8 years (Suggested)
- High – Redeploy every 5 years

➢ Camera trap analysis
- Low – 60-day period every 2 years

- Medium – 60-day period annually (Suggested)
- High – 60 period twice per year (spring/fall)

Thresholds

- Detection of URTD in desert tortoise.
- Trend analysis indicates significant changes in movement between northern, central (including gooseneck), southern regions of the Preserve and adjacent habitat.
- Trend analysis indicates significant changes in use of drainages as movement corridors.
- Trend analysis indicates changes in movement from human-related impediment within the Preserve.

❖ Wildlife mortality. (T2)

Baseline

- A baseline is established.

Course of Action

- Monitoring at major road crossings including within one mile of Rio Verde Drive in the Gooseneck Corridor area of the Preserve.

Monitoring Frequency

- Low – Every 7-8 years
- Medium – Every 5-6 years
- High- Every 4-5 years (Suggested)

Thresholds

- Trend analysis indicates a significant increase in wildlife mortality.

Background

In 2024, 60 cameras were deployed in the Preserve as part of the long-term camera trap study taking place each spring/fall.

In 2016, the City, McDowell Sonoran Conservancy, and AGFD initiated a mule deer telemetry project and produced a subsequent report entitled *Mule Deer Corridor and Habitat Use in the McDowell Sonoran Preserve* which tracked mule deer movements on the Preserve through the deployment of radio collars. This study investigated habitat use by mule deer in relation to trail use.

McDowell Sonoran Preserve Corridor Viability Project (2020) monitored wildlife populations and assessed the viability of the Preserve's Gooseneck Corridor. Twenty-six remote wildlife cameras were placed throughout the Preserve between 2017 – 2019. Species of mountain lion, mule deer, and medium-sized carnivores were found across all regions of the Preserve. This document suggests every region of the Preserve provides the needed resources for these species to survive and reproduce.

In 2012, the City partnered with AGFD to conduct a wildlife mortality study to document wildlife movements and roadway mortality in the Gooseneck Corridor area of the Preserve. This work

produced a report entitled *Identification of Wildlife Road Mortality Hotspots and Wildlife Activity Patterns within the Scottsdale McDowell Sonoran Preserve Wildlife Linkage* (Grandmaison, 2012).

E. Soil/Geology

Biological soil crusts (biocrusts) are commonly found on the soil surface in arid and semi-arid ecosystems. Biocrusts can consist of mosses, cyanobacteria, lichens, algae, and microfungi, and they strongly interact with the soil. These organisms, depending on the specific biocrust, are important to the functioning of ecosystems and to the organization of plant and soil communities. Biocrusts are essential for reclaiming a disturbed area to a functioning ecosystem (USGSb, 2024).

Metrics

❖ Soil biocrust degradation, soil erosion, and loss of vegetative cover and diversity (i.e., from trail use, trailheads, urban interface, other). (T1)

Baseline

- A baseline is established for trail use.
- A baseline to be established for biocrust degradation, soil erosion, and loss of vegetative cover and diversity for trailheads, urban interface, other.

Course of Action

- Trail degradation study.
- Broaden trail degradation study to include other recreation/urban interface locations.

Monitoring Frequency

- Low – 6-8 years
- Medium – 4-5 years (Suggested)
- High -2-3 years

Thresholds

- Trend analysis indicates significant increases in soil biocrust degradation, soil erosion, and loss of vegetative cover and diversity from trail use, trailheads, urban interface, and other.

❖ Degraded lands mapping in Preserve. (T1)

Baseline

- A baseline is established.

Course of Action

- Re-map degraded lands on Preserve.

Monitoring Frequency

- Low –Every 8 years
- Medium –Every 5 years (Suggested)
- High –Every 3 years

Thresholds

- Trend analysis indicates significant increases in degraded lands in the Preserve.

❖ Integrity of unique geologic features, especially near developed areas. (T2)

Baseline

- A baseline is established.

Course of Action

- Survey.

Monitoring Frequency

- Low – every 5 years
- Medium – every 2-3 years
- High – twice per year (Suggested)

Thresholds

- Damage/loss of integrity.

Background

In 2018, the McDowell Sonoran Conservancy and several contributors published an article entitled, the Comparison of Trailside Degradation across a Gradient of Trail Use in the Sonoran Desert in the *Journal of Environmental Management* (Rowe, et al. 2018). This article provided a comprehensive analysis of impacts to soils and biocrust on multiple levels in relation to trail use in the Preserve. In addition, a degraded lands map of the Preserve was prepared by the McDowell Sonoran Conservancy.

Geological resources have been extensively researched, inventoried, and documented throughout the Preserve (Gootee et al., 2009; Gruber et al., 2010; Gootee and Gruber, 2015).

IV. Adaptive Management Process and Recommendations

The adaptive management process has been defined in multiple ways by many natural resource scientists, institutions, educators, and managers. In general, it is a highly iterative process based on learning and refining. There is usually some uncertainty about management outcomes that through continual research and learning helps refine the management efforts and goals. Adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. The steps include stakeholder involvement, management objectives, management alternatives, predictive models, monitoring plans, decision making, monitoring responses to management, assessment, and adjustment to management actions. An adaptive approach actively engages stakeholders in phases of a project, facilitating mutual learning and reinforcing the commitment to learning-based management (Williams, et al., 2009).

The approach to adaptive management recognizes the inherent variability of natural systems, capitalizes upon change and improvement in data gathering and analysis techniques, and treats actions in an experimental framework in which learning becomes an inherent objective and alternative hypotheses are evaluated. It is basically a mechanism for continuous improvement based on what has been learned through monitoring and evaluation of management actions. Adaptive management is designed to bring new information immediately into new management direction (Salafsky et al., 2001). An adaptive management program can also help to anticipate and resolve uncertainty related to individual species, the effect of conservation measures and/or changes in environmental conditions.

A. Annual Report

An Annual Report will be produced that summarizes all studies and monitoring conducted each year and their results. The purpose of the Annual Reports is to make available a consolidated account of all scientific efforts and outcomes summarized for any given year. The information for the Annual Report will be generated from individual technical reports produced for specific investigations and baseline monitoring. Technical reports will present objectives, methods, results, and conclusions that can then be summarized, incorporated by reference, or included as appendices to the Annual Report. The requirement of technical reports should be included in all studies and monitoring activities requested and funded by the City on the Preserve. The Annual Report can then be used to inform all stakeholders of the status of studies underway, present results and conclusions for studies completed, and for public involvement and educational purposes. The Annual Report will be peer reviewed and will serve as a basis to determine the frequency of the McDowell Sonoran Preserve Ecological Health Assessment.

B. McDowell Sonoran Preserve Ecological Health Assessment

The McDowell Sonoran Preserve Ecological Health Assessment will be produced periodically (three to five years, or as needed) to provide a comprehensive summary of results and conclusions of monitoring and investigations completed within the Preserve. Information should include any trend analyses or other statistical validation of data in such a manner as to evaluate individual parameters and elements, thresholds, and the overall ecosystem health of the Preserve.

The overarching goal will be to convene a panel of experts and peer reviewers to come to consensus on the state of the ecological health of the Preserve. It is anticipated that other information and concepts will be put forth regarding resource management, environmental and climatic factors, topics of investigation, emerging technologies, and sustainability to take the Preserve into the future.

Budget considerations will need to be balanced with the proposed frequencies and priorities outlined in ERP 2024. ERP 2024 will serve as a tool for City Staff, the McDowell Sonoran Preserve Commission, and the City Council to make decisions about research priorities and is meant to be a dynamic document that will evolve over time based on results and conclusions from monitoring studies.

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APPENDIX A

Previous Scientific Studies

Previous Scientific Studies

Report Name	Study Dates	Frequency	Location	References
McDowell Mtn Limestone	2009	1×	Entire Preserve	Gootee et al., 2009
Lost Dog Geologic Survey	2010	1×	Lost Dog Wash	Gruber et al., 2010
Flora and Fauna of the Preserve	2010-2013	1×	Entire Preserve	McDowell Sonoran Conservancy, 2014
Past Restoration	2010-2018	1×	Eight Study Sites	Rowe et al., 2020
Herpetofauna of the Preserve	2011-2013 March-Nov	Monthly for 10 Mo/Yr	Nine Survey Areas	Weber et al., 2016
Biotic Communities of the MSP	2011-2014	1×	Entire Preserve	Jones, 2014
Wildlife Road Mortality Hotspots	2012-2013	1×	Wildlife Linkage Area	Grandmaison, 2012
Ground Dwelling Arthropods	2012-2013	Quarterly	Ten Transects	Earl, 2013
Vegetation of the Preserve	2014	1×	Entire Preserve	Jones and Hull, 2014
Plant Associations with Scottsdale's Preserve (Map)	2014	1×	Entire Preserve	Jones and Madera, 2014
Butterfly Survey Status	2014-2022	Biannual Spring and Fall	Six Locations	Rutowski et al., 2022
Milky Quartz Vein	2015	1×	Two Study Areas	Gootee and Gruber, 2015
Mule Deer Corridor and Habitat Use in the Preserve	2016-2018	Annually	Entire Preserve	Sprague et al., 2019
Preserve Corridor Viability Project	2017-2019	1×	Wildlife Linkage Area	McDowell Sonoran Conservancy, 2020
Trail Impact Study	2018	1×	Nine Trail Segments	Rowe, 2018
Degraded Lands Mapping	2018	1×	10 Sections	Rowe et al., 2021
Biological Invasions – Fountain Grass Removal	2018-2021	1×	Entire Preserve	Rowe et al., 2022
Geology Field Guide	2019	1×	Entire Preserve	Stotnicki and Gruber, 2019
Bunchgrasses of the Preserve	2019	1×	Entire Preserve	Jones, 2019
Biological Invasions – Buffelgrass Removal	2019-2022	1×	36 Sites	Rowe et al., 2023
Invasive Pennisetum Species Strategic Plan 2022-2027	2022	1×	Entire Preserve	City of Scottsdale and McDowell Sonoran Conservancy, 2022
Butterfly Diversity	2024			Rowe et al., 2024
Sensitivity of Arthropods	2024			Uhey et al., 2024