Chapter 11

Science-Based Management of Public Lands in Southern Nevada

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Introduction

Landmark legislation provides guiding principles for land management planning in southern Nevada and the rest of the United States. Such legislation includes, but is not limited to, the Forest Service Organic Administration Act of 1897 (16 U.S.C. 473-478, 479-482 and 551), National Park Service Organic Act of 1916 (U.S.C. Title 16, Secs. 1-4), Wilderness Act 1964 (P.L.88-577), National Environmental Policy Act of 1969 (P.L 91-190), Endangered Species Act of 1973 (P.L. 91-205), National Forest Management Act of 1976 (P.L. 94-588), and Federal Land Policy and Management Act of 1976 (P.L. 94-579). The acts establishing congressionally designated areas within southern Nevada, such as Lake Mead National Recreation Area, Spring Mountains National Recreation Area, and Desert National Wildlife Refuge, also contain guidelines for the management of these lands. These documents variously require preservation of natural and cultural resources and wilderness character, protection of species, and prevention of undesirable environmental effects from land management actions. These requirements must be met while allowing for multiple "uses" of certain public lands (e.g. recreation, ranching, resource extraction, renewable energy development, etc.) to the degree that they do not threaten preservation, protection, and prevention goals. Many considerations come into play in the development and implementation of land management plans and actions. The planning process requires a balancing act that sometimes pits one need or priority against another. When priorities align, management actions can have multiple benefits. In some cases, specific priorities can trump other needs and priorities and receive disproportionate consideration. Overall, the management of public lands is a very complicated and sometimes contentious process.

Science provides an objective way to help weigh quantifiable information and draw conclusions about the effects of past and potential future land management policies, decisions, and actions. When effectively integrated into adaptive management, science-based information can reduce uncertainties, increase knowledge, and improve decision making. However, the specific science information needed for effective management is often lacking or difficult to access or interpret. Science is typically reported in scientific journals as discrete units describing individual studies with other scientists as the primary audience. Translations of these studies and syntheses of multiple studies into formats that can be readily used in land management planning efforts are often lacking. Identifying and articulating the highest priority science and research needs is one of the primary purposes of the Southern Nevada Agency Partnership (SNAP; http://www.SNAP.gov) Science and Research Team (Chapter 1; Turner and others 2009). The SNAP Science and Research Strategy (Strategy) calls for a synthesis report to be written every 5 years summarizing the state of knowledge, information gaps, and management implications of scientific information as it relates to the SNAP Strategy goals (Turner and others

2009). This General Technical Report serves as the first SNAP Science and Research Synthesis Report (Synthesis Report) commissioned by the Science and Research Team. The Synthesis Report is mostly based on information from the peer-reviewed scientific literature, and is itself peer reviewed and constitutes a new contribution to the scientific literature. This final chapter addresses Sub-goal 2.3, which is to manage current and future authorized southern Nevada land uses in a manner that balances public need and ecosystem sustainability, and Sub-goal 2.5, which is to promote an effective conservation education and interpretation program to improve the quality of resources and enhance public use and enjoyment of southern Nevada public lands. It summarizes information from the previous chapters on what scientific information is known currently and what remains largely unknown, and it discusses how science can be used to make future management decisions that balances public needs and ecosystem sustainability.

Current Scientific Understanding and Information Needs

Ecosystem stressors associated with human activities, wild horse and burro and livestock grazing, and altered fire regimes have been the traditional focus of land managers in southern Nevada. Concerns about invasive species emerged during the 1990s, and perhaps even greater concerns regarding climate change, energy development, and water development arose during the 2000s. The current challenge is to understand how to manage these many, and often interacting, stressors to maintain ecosystem sustainability. This task is more daunting today than it was only a few decades ago because of the rapidly expanding human population, the increase in the number of stressors of significant concern, and the need to address both public access and resource issues on Nevada's public lands.

The effect of climate change on ecosystem sustainability is perhaps the greatest unknown stressor with respect to current management planning in southern Nevada. The science is clear that anthropogenic caused climate change is occurring on a global scale and that longer and more intense droughts and increased temperatures are becoming increasingly more likely in the deserts of southwestern North America (Chapter 2). However, the precise nature of these changes are not yet known and the scaled-down predictions necessary for determining the most effective management actions have yet to be developed. Also, it is not clear how these conditions will interact with other ecosystem stressors that land managers can potentially control.

The current state of science can help tease out some of the most significant stressors threating ecosystem sustainability in southern Nevada (Chapter 2). However, there is much more that remains unknown regarding these stressors and potential ecosystem responses. The sections that follow summarize these primary knowns and unknowns, and suggest research priorities for the major management topics in southern Nevada.

Water and Water Use

The hydrology of southern Nevada is characterized by regionally limited recharge areas within mountain ranges, and interbasin flow from adjacent regions. Discharge occurs through seeps and springs, evapotranspiration, subsurface flow out of the region, and pumping (Chapter 3). The Colorado River (Lake Mead) and its tributaries (the Muddy and Virgin Rivers), along with Las Vegas Wash, form the major fluvial systems in the area. Although recharge from precipitation can vary widely among years, large subsurface aquifers historically buffered interannual fluctuations in ground water levels across much of southern Nevada. This means that the discharge from springs and seeps

was maintained for long periods of time, supporting locally endemic species and their habitat (Chapter 6). Accelerated rates of ground water pumping during recent decades now affects discharge patterns threatening spring and seep ecosystems, and projected increases in pumping may pose even greater ecosystem threats in the future.

In order to effectively manage water resources in southern Nevada, it is important to understand future patterns of ground water recharge. Predictions of a warmer climate, potentially higher evapotranspiration rates, and more variable precipitation could dramatically alter ground water dynamics. An understanding of these potential future scenarios is critical to ensure that current planning decisions related to ground water pumping and water use do not adversely impact ground water resources or otherwise cause significant and potentially irreversible environmental degradation. (See Chapter 3 for a detailed discussion of information needs related to water and water use in southern Nevada.)

Invasive Species

The concern associated with invasive species on wildlands in southern Nevada gained prominence following President Clinton's Executive Order 13112 in 1999 and the development of a national strategy for management of this ecosystem stressor. At that time, the science to support this mandate was not very extensive, as invasion biology had only emerged as a major branch of ecology during the 1980s. During the past few decades there has been a tremendous amount of new information generated regarding biological invasions worldwide.

In southern Nevada it is now clear that the main invasive plants of concern in upland areas are annual species, especially red brome (*Bromus rubens*) and Mediterranean splitgrass (*Schismus* spp.), which are associated with altered fire regimes. Riparian areas are most threatened by perennial plants, especially Tamarisk (*Tamarix* spp.), which can compete with native plants, degrade wildlife habitat, and potentially alter hydrologic and fire regimes. Aquatic plants are not yet recognized as major threats to the degree that their invasive analogs in terrestrial ecosystems are. However, there are a few poised to invade southern Nevada that could become aquatic ecosystem transformers, including Eurasian water-milfoil (*Myriophyllum spicatum*) and giant salvinia (*Salvinia molesta*).

Various non-native terrestrial animals are also of significant management concern in southern Nevada, ranging from ants, dogs, and cats, to free-roaming cows and equids (Chapter 4). The effects of species like ants and dogs and cats are related primarily to competition with or predation on native species, but habitat alteration by cows and equids is also a major concern. Non-native aquatic animals range from the quagga mussel (*Dreissena rostriformis*), American bullfrog (*Rana catesbeiana*), red swamp crayfish (*Procambarus clarkia*), to various fish species. Threats from these species include altered food web dynamics and predation on native species.

Perhaps one of the most significant unknowns relates to the ability to accurately predict future patterns of spread for existing invasives, establishment and spread of new invasives, and the relative and cumulative threats posed by all invasive species in southern Nevada. This information, and an understanding of the feasibility for controlling the different species, is critical for prioritizing management actions among the plethora of non-native and potentially invasive species in this region. (See Chapter 4 for a detailed discussion of information needs related to invasive species management in southern Nevada.)

Fire History, Effects, and Management

It is generally understood that fire has been infrequent in most of southern Nevada since the last ice age, which ended approximately 10,000 years ago (Chapter 5). What is less recognized is that some landscapes have continuously experienced at least moderate fire frequencies during this time period. These include sagebrush, piñon-juniper, and mixed conifer ecosystems, and in these areas fire may be an important ecosystem process. However, the vast majority of the current southern Nevada landscape is dominated by blackbrush and lower elevation vegetation types that did not support frequent fire historically and where large and/or frequent fires are ecosystem stressors. Key fire management messages that can be derived from current science are that (1) potential effects of fire should be evaluated in the context of ecosystem type, fire behavior characteristics, and site-specific characteristics (e.g. fire history); (2) fire suppression is ultimately the most effective way to manage fire at middle and lower elevation where fire was historically infrequent, but wildland fire use or fire surrogates may be appropriate under certain circumstances at higher elevations; and (3) the post-fire rehabilitation/restoration tools that are currently being used at middle to lower elevations appear to be ineffective or poorly evaluated (Chapter 5).

Information is needed on both long-term ramifications of fire in middle and upper elevation vegetation types (i.e., blackbrush and above), and post-fire management of lower elevation vegetation types dominated by creosotebush (*Larrea tridentata*) and saltbush (*Atriplex* spp.). In all future fire studies, the potential influence of climate change should be considered to place the results in the context of climate projections for the next decades through the end of the current century. (See Chapter 5 for a detailed discussion of information needs related to fire history, effects, and management in southern Nevada.)

Species of Conservation Concern

Aside from the desert tortoise, which has been studied more than any other species in southern Nevada, relatively little is known about the life history characteristics and specific habitat requirements of most species in this region (Chapter 6). This includes the species covered under the Clark County Multiple Species Habitat Conservation Plan. Research has often focused on mitigation strategies to protect sensitive species without a full understanding of the life history and ecophysiological constraints on the species and the stressors that are causing their declining status.

With so many unknowns associated with the many species of concern in southern Nevada, it is a challenge to prioritize which species should be the focus of scientific research and which questions should be addressed. The default is often to focus on species that agencies have specific legal requirements to protect (e.g., Federally listed). Development of effective conservation plans requires an understanding of the life history characteristics, habitat requirements, and specific stressors affecting the listed species. These plans may initially lack the desired level of detail. However, critical information needs can be identified in the planning process and new research projects coupled with habitat and population monitoring can be used to develop an effective adaptive management program. (See Chapter 6 for a detailed discussion of information needs related to species of conservation of concern in southern Nevada.)

Maintaining and Restoring Sustainable Ecosystems

The overarching objective for land managers in southern Nevada is to maintain and restore sustainable ecosystems that are resilient to disturbance and resistant to invasion (Chapter 7). The ecosystems types within southern Nevada differ significantly in both their environmental characteristics and dominant stressors and, consequently, in their resilience to disturbance and resistance to invasive species. In order for restoration and management strategies to be effective, they must account for these differences. A useful decision support framework based on ecosystem resilience and resistance distinguishes among (1) protection from current and future stressors; (2) preventive management actions designed to increase resilience and resistance of areas with declining ecological conditions; and (3) restoration activities following disturbance or other ecosystem degradation (table 7.1). This framework allows for customized guidelines for each of the major ecosystems types in southern Nevada (table 7.2). An integrated and consistent assessment of southern Nevada ecosystems and their relative resilience and resistance can be used to prioritize management and restoration activities using this framework. Monitoring programs designed to track ecosystem changes in response to both stressors and management actions can be used to increase understanding of ecosystem resilience and resistance, realign restoration and management approaches, and implement adaptive management.

Cross-cutting information needs for restoration and management of southern Nevada's diverse ecosystems include a better understanding of the factors that determine resilience and resistance and of the interacting effects of the region's stressors. They also include knowledge of the environmental conditions required for establishment and persistence of native plant species and methods for their restoration. (See Chapter 7 for a detailed discussion of information needs related to maintaining and restoring sustainable ecosystems in southern Nevada.)

Human Interactions with the Environment Through Time and Preserving Heritage Resources

Southern Nevada has been continuously inhabited by humans at least since the end of the last ice age (Chapter 8). This period marks the shift from a more mesic and temperate climate to the more arid desert climate that exists today. During most of the post ice age Holocene (i.e., the last 12,000 years), human occupation was characterized by small nomadic bands that migrated seasonally following resources needed for subsistence. During the last few thousand years, larger settlements emerged that were associated with a move towards more agricultural societies in the riverine bottomlands. The first Europeans travelled to southern Nevada in the late 1700s, and by the middle 1850s settlers were steadily migrating into the region along the Old Spanish Trail (later the Mormon Road) and displacing Native Americans from their agricultural, foraging, and hunting lands. Settlers also brought with them horses and livestock that were having significant effects on the landscape as early as the 1800s, and these stock animals have been continuously present on through to the present (Chapter 2).

Population levels moved upward with the construction of Hoover Dam in the 1930s, but really increased substantially during the past few decades resulting in urban sprawl, increased development within public lands, and increased visitation to remote areas of southern Nevada (Chapter 9). This has resulted in the loss of cultural sites through development, looting, and vandalism. Public education, law enforcement, and monitoring of cultural sites are widely recognized as ways to minimize damage to these sites. However, agency resources are generally insufficient to address all of these needs.

The major remaining information gap is the limited extent of archeological survey coverage; only 7 percent of Southern Nevada has been surveyed, primarily within the Las Vegas Valley and associated with development projects (Chapter 8). A complete survey for the region is not realistic, but additional targeted surveys that expand and improve the sample of lands examined would go a long way towards improving the baseline information in the region. More comprehensive links between archeological sites and their environmental settings would increase understanding of potential interactions between humans and ecosystem conditions. Also, continued research is needed to evaluate the effectiveness of public education and outreach, volunteer site monitoring, and law enforcement programs in achieving the objectives of reducing damage to and loss of cultural sites. (See Chapters 8 and 9 for a detailed discussion of information needs related to human interactions with the environment through time and preserving heritage resources in southern Nevada.)

Recreation Use on Federal Lands

The vast majority of lands are open to human use in southern Nevada. The burgeoning human population is increasing the use of these lands for recreational purposes, creating a very difficult challenge for Federal land managers (Chapter 10). Also, the human population is becoming more urban and multi-cultural, resulting in potential changes in recreational patterns that will require flexibility in current management approaches. To plan for these changes, land managers need information about how these changing demographics may affect the types and patterns of recreational use of public lands. (See Chapter 10 for a detailed discussion of information needs related to recreation use on Federal lands in southern Nevada.)

The Role of Science in Land Management

Management that balances public need and ecosystem sustainability is informed by the science information in this Synthesis Report. The goal of ecosystem sustainability has its origins in legislation mentioned at the beginning of this chapter, and subsequent national policies that call for natural resources, and by inference the ecosystem processes that sustain them, to be preserved unimpaired for future generations. However, land managers must balance the goal of ecosystem sustainability with other goals derived from other laws and national policies associated with recreation, resource extraction, and other land uses that collectively constitute the land management context of southern Nevada. Although science often plays a major role in the initial legislation and policy development and can form the foundation of initial planning goals and objectives, subsequent science produced through targeted research studies and monitoring for status and trend of resources has the greatest influence on deciding when a management response is warranted or when established management objectives may need to be modified (fig. 11.1).

Objectives should be written with specific science-based, objective, and measurable standards in mind, for example, allowing livestock grazing up to a limit of x percent vegetation biomass consumption based on a sliding scale that takes into account recent climatic conditions and other potential interacting stressors. Objective standards greatly simplify the process of monitoring and decision making because they are relatively unambiguous (fig. 11.1). The problem is that science is often insufficient to justify specific standards, and therefore standards are based on general scientific theory and are relatively subjective, for example, allowing grazing practices that do not negatively affect the health, productivity, and diversity of plant communities, which is subjective and hard to monitor. Subjective standards require more complicated monitoring and generally make decision making more difficult and controversial.

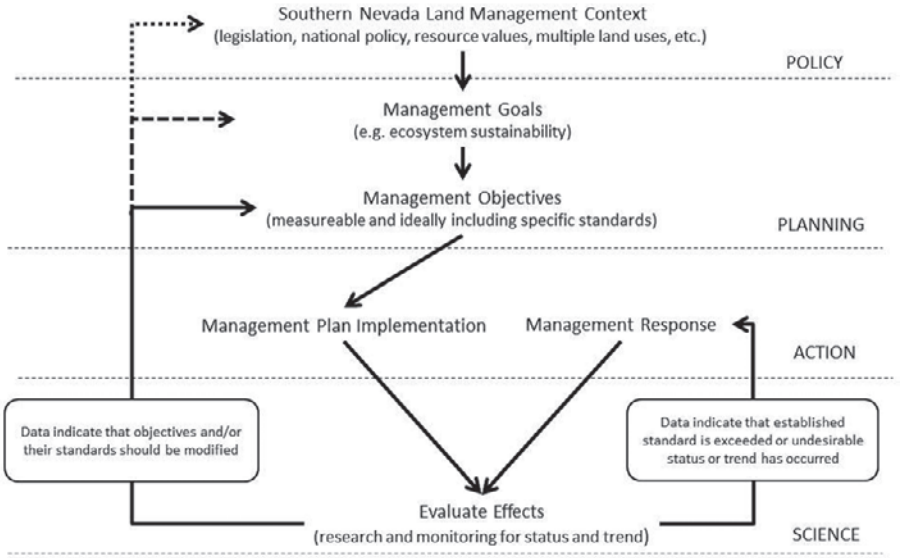

Figure 11.1—The role of science in the management of Federal lands in southern Nevada

Once management plans are implemented, monitoring plans that are specifically coupled with management objectives can help land managers monitor the status and trend of their ecosystem resources and determine if management responses or modifications of management objectives are warranted (fig. 11.1). With the advent of the information age and ability to archive and share data remotely, there has been a move towards more standardized monitoring methods to facilitate large scale analyses across multiple land management agency units. However, these standard methods are often not ideally suited for evaluating management objectives that are designed for smaller landscapes and their local land management contexts. Land managers must understand these potential limitations and choose their monitoring and data management methods carefully to ensure that they will give them the scientific information necessary to effectively evaluate their management objectives and management actions.

The Role of Science in Education

This Synthesis Report serves as an outreach document to inform stakeholders and the general public about the major ecosystem stressors, and natural, cultural, and recreational resources in southern Nevada. It also provides valuable information on management alternatives.

An educated populace makes it easier for land managers to communicate science-based management with the public, and should ultimately streamline the approval processes for land management plans. As mentioned above, science information is often written by scientists for scientists and science products are often not ideal for communication with the general public. There is, therefore, a need for science-based objective summaries of key land management topics that clearly distinguish between what is scientifically known and what is more generally derived from professional opinion and cultural influences. The mode of information delivery should also be varied to capture a wide range of audiences (e.g. print, radio, television, websites, and social media).

Reference

Turner, K.; LaVoie, A.M.; Ronning, C.J.; Sharp, R.M.; Palmer, C.J.; Miller, J.M. 2009. SNAP Science and Research Strategy (Strategy). Southern Nevada Agency Partnership. Online: http://snap.gov/upload/SNAP-S-R-Strategy-2009r.pdf. [2011, April 6].