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Utilizing Ecological Connectivity in California Desert Wilderness Preservation

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Utilizing Ecological Connectivity Concepts in Californian Desert Wilderness Preservation

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ABSTRACT

The Wilderness Act of 1964 gave the federal land management agencies—the National Park Service, United States Forest Service, U.S Fish and Wildlife Service, and Bureau of Land Management—the authority to identify, propose, and manage lands as wilderness. Wilderness, once approved by Congress for inclusion in the National Wilderness Preservation System, is offered the highest form of land preservation in the nation. However, the wilderness identification process used by the implementing agencies is based on a half-century old statute with an aging definition of wilderness. While designated wilderness can protect the plant and wildlife communities within its borders from direct anthropogenic impacts, climate change and habitat fragmentation threaten the ability of these populations to persist long term. To better preserve plant and wildlife communities within wilderness, and thus preserve the fundamental character of wilderness itself, the wilderness identification process must be expanded to ensure new areas are selected based on ecological significance, in addition to the historic concepts instated by the Wilderness Act. In particular, the need for a reformed wilderness designation process is pronounced in the California desert region, where an increasingly fragmented landscape and demand for renewable energy infrastructure in the region poses a threat to ecosystems both within and outside of wilderness boundaries. Conservation planners have studied the benefits of ecological connectivity across larger landscapes, and well-connected preserve systems are more successful in maintaining ecosystem function, species persistence, and biological and genetic diversity. Prioritization of ecological connectivity by federal land management agencies would contribute to a more resilient National Wilderness Preservation System and the protection of the unique ecosystems and biodiversity found in the California desert region.

Utilizing Ecological Connectivity Concepts in Californian Desert Wilderness Preservation

1 – INTRODUCTION

"*If future generations are to remember us with gratitude rather than contempt, we must leave them something more than the miracles of technology. We must leave them a glimpse of the world as it was in the beginning*" *– President Lyndon Johnson, 1964*

1.1 The National Wilderness Preservation System

The United States (U.S.) contains over 2 billion acres of land, including some of the most diverse contiguous landscapes on Earth and over 565 unique ecosystem types (Wilderness Institute, et al., 2015; Dietz et al., 2015). However, in less than 500 years, much of this land has been extensively developed and stripped of its natural state, making wildlands increasingly rare and more difficult to protect (Wilderness Institute, et al., 2015). However, the fast-paced development and increase in motorized travel throughout the 1950s and 1960s also brought about a widespread concern among American citizens for the dwindling potential for wild and free lands to remain as such (Wilderness Institute, et al., 2015). This conservation movement was fueled by devastating events such as the damming of the Hetch Hetchy Valley in Yosemite National Park, as well as success stories such as the abandonment of the Echo Park Dam in Dinosaur National Monument. The existing federal land protections under the authorities of the National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), and Bureau of Land Management (BLM) provided valuable recreation, wildlife protection, timber production, grazing land, and other important economic and ecological functions. Even these protected areas were still not free from the threat of infrastructure development, and it became apparent that a more restrictive preservation system was needed.

The first draft of what would become the Wilderness Act was written in 1956 by Howard Zahniser, the one-time executive director of the Wilderness Society, in cooperation with the National Parks Association, Sierra Club, National Wildlife Federation, and Wildlife Management Institute (Jones, 2013). Nine years of negotiation and 65 failed bills later, the Wilderness Act was signed into law by President Lyndon Johnson (Jones, 2013). The Wilderness Act created the National Wilderness Preservation System (NWPS), a collection of federal lands that have unique securities, including protections from new roads, nonrenewable

resource extraction, and other development. The first legal concept of wilderness was defined by the Wilderness Act, which states:

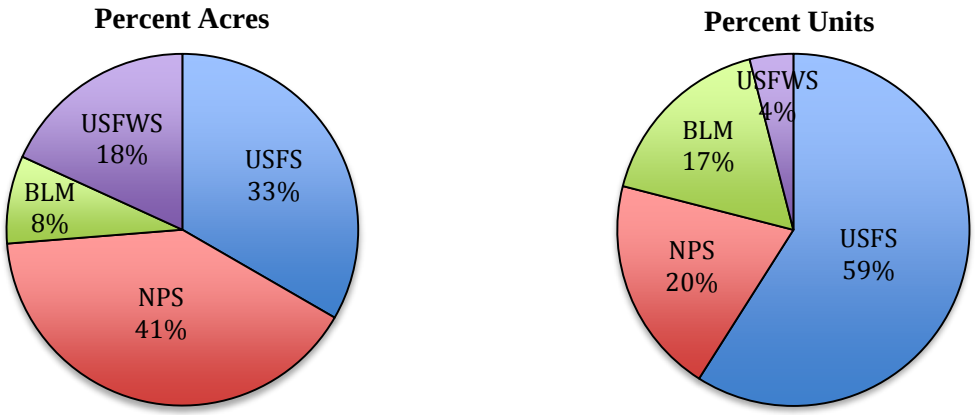
> "*A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which:*
>
> *(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;*
> *(2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation;*
> *(3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and*
> (4) *may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.*" (Wilderness Act, 1964)

The Wilderness Act immediately designated over 9.1 million acres of roadless land under the management of the USFS as wilderness areas and provided guidelines for which the four administering agencies—the NPS, USFWS, USFS, and BLM—can evaluate lands for designation. It ordered these agencies—hereinafter referred to collectively as the "wilderness agencies" or the "administering agencies"—to begin a decades-long study of their lands to identify new wilderness that would fit the bill. Once identified, all proposed wilderness areas must be approved by Congress before receiving the protection.

The Wilderness Act imposes some of the most restrictive management constraints found in existing environmental law. The NWPS is the highest level of federal land conservation in the U.S., providing protection from commercial enterprise, road-building, and motorized equipment. Thus, wilderness areas are protected from anthropogenic disturbances such as grazing, logging, mining, agriculture, off-road motor vehicles, and more, with the exception of some existing rights and other provisions discussed in the Wilderness Act. No permanent roads or motorized equipment, except for the minimum required for agency operations, are permitted in wilderness areas (Wilderness Act, 1964). This detail is often referred to as the "exception clause" of the

Wilderness Act, which was left purposefully vague and open to interpretation by the administering agencies and continues to be an important driver for how the Act is implemented today.

Today, over 50 years following the Wilderness Act, 765 wilderness areas are included in the NWPS (Dietz et al., 2015). This covers over 109 million acres—almost thirteen percent—of federal land[1] (Dietz et al., 2015; Wilderness Institute, et al., 2015). Of the four administering agencies, the NPS is responsible for the most acreage, while the USFS contains the most wilderness areas by unit (Wilderness Institute, et al., 2015). The percent of total NWPS acreage managed by each agency and the percent of total wilderness areas (units) within the NWPS managed by each agency are depicted in Figure 1: NWPS by Agency. Though the NWPS indeed protects a significant amount of land, the NWPS covers only about 2.7 percent of the contiguous U.S., underrepresenting the ecological diversity of the U.S. as a whole (Wilderness Institute, et al., 2015; Dietz et al., 2015).



Source: Dietz et al., 2015; Wilderness Institute, et al., 2015

Figure 1: NWPS by Agency

[11] This includes wilderness lands within Alaska.

Restrictive as the Wilderness Act is, in practice, its implementation varies widely. This is in part is due to the fact that there are four different administering agencies with the authority to interpret the Act as they see fit. Each of the wilderness agencies has individual histories, missions, and governing standards that contribute to the significant variation of management strategies utilized within their jurisdiction. The exception clause of the prohibited uses section of the Wilderness Act states, "except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act" (Wilderness Act, 1964). This clause is largely responsible for the divergence in management practices on wilderness land among the administering agencies as it gives the agencies the power to allow an otherwise prohibited use if they find it necessary to meet minimum requirements. In addition, the Wilderness Act did not provide any definition of a permanent road, causing fluctuating opinions from each agency over the use of management roads in wilderness areas. The definition of wilderness itself, as defined in the Act, provides a narrow interpretation of wilderness that is not consistent with modern conservation concepts that prioritize biodiversity and ecological function. To help set the stage, further discussion on each wilderness agency and their identification of wilderness and management approaches is provided in Chapter 2.

1.2 Overview: The Californian Desert Region

The southwestern U.S.—Arizona, California, Colorado, Nevada, New Mexico, and Utah—contains a myriad of topography and landscape conditions—mountains, valleys, plateau, canyons, and plains—that affect the region's climate. Natural fluctuations in the climate of the almost 700,000-square-mile region causes periods of drought, flooding, heat waves, cold snaps, heavy snowfall, severe winds, intense storms, and severe air quality conditions (Garfin et al., 2013). The region has the most extensive arid and semi-arid climates in the U.S. including the Mojave and Sonoran Deserts of Southern California and Arizona. These two deserts contain the hottest and driest areas in the U.S. and contain an extensive network of reserve areas (Garfin et al., 2013). The Mojave and Sonoran Deserts support a high diversity of plants and wildlife, from the pinyon pine (*Pinus quadrifolia*) and creosote bush (*Larrea tridentate*) communities to the desert riparian species found in desert washes. Though the Mojave and Sonoran Deserts cover Southern California, Arizona, and a small portion of Southern Nevada, for purposes of this paper, only the Californian portion of the two deserts are considered. This region has been

identified as some of the most ecologically intact areas in the state of California (Penrod et al., 2012).

The BLM is responsible for the majority of wilderness in the California desert region, though the NPS and USFS also manage wilderness in the region. The Mojave Desert contains a large area of conserved land at various levels of preservation; approximately 80 percent of the Mojave Desert is managed by the BLM. Less than 20 percent of the area within the Mojave Desert is privately owned and unprotected; however, extensive urban sprawl has caused habitat loss and fragmentation with wide-reaching effects (Spencer et al., 2010). The Sonoran Desert, which is generally the land area south of the Mojave Desert, also includes a high concentration of areas with various levels of protections (Spencer et al., 2010). Like the Mojave Desert, the BLM is also the largest land manager by acre in the Sonoran Desert. Highways that divide the desert, renewable energy infrastructure, and other stressors pose a significant threat to ecosystems and wildlife of the region. Despite the relatively low human populations found in these areas, urban sprawl, off-road motorized vehicle use, grazing, and mining cause long-lasting impacts to the desert vegetation and wildlife communities. Particularly, human encroachment has taken its toll on state and federally listed threatened and endangered species in these southwestern deserts, such as the desert tortoise (*Gopherus agassizi*), Mohave ground squirrel (*Spermophilus mohavensis*), and desert bighorn sheep (*Ovis Canadensis nelsonii*) (Spencer et al., 2010).

While the Mojave and Sonoran Deserts contain large concentrations of intact, protected areas, not all protections offer the same benefits as wilderness. Increasing recreational use and growing demand for renewable energy infrastructure within the region, the multiple-use management goals of the non-wilderness preserves (i.e., national parks, non-wilderness BLM land, Department of Defense land) will not protect the fragile and slow-to-recover desert ecosystems (Spencer et al., 2010). As a result of the California Energy and Air Pollution Act of 2015, California must increase renewable energy production and sale to 50 percent of its entire energy portfolio by 2030. The vast scale of renewable energy infrastructure development, which includes wind and solar power plants and associated transmission facilities, are likely to reduce available habitat connectivity, change essential ecosystem function, and reduce or eradicate opportunities for species to shift ranges and distributions in response to climate change (Penrod et al., 2012). Impacts result not only from the construction of these types of infrastructure, but

also from permanent maintenance roads that forever scar the landscape and adversely affect the wilderness character of the surrounding lands. As the BLM—the largest land manager in the southwestern desert region—is facing increasing pressure to approve renewable energy infrastructure projects, the need to extend wilderness designations and the legal protections of the Wilderness Act to these lands is as great as ever. In addition, heightening the protections within these areas to create large, connected areas of wilderness will provide for a more resilient approach to wilderness preservation in these deserts.

1.3 Research Objectives

This paper explores the past and present implementation of the Wilderness Act, focusing largely on the designation process by the wilderness agencies – in particular, the BLM. While the NWPS is a proactive conservation tool that has been successful in preserving areas that would have otherwise been impacted by human activity and development, its definition of wilderness lacks a firm requirement for broad-scale ecological function. The Wilderness Act itself contains an outdated approach to preservation by relying on a definition that favors areas with "wow factors" such as dense, sprawling vegetation or spectacular geography, but these areas don't always contain a fair representation of the threatened ecological systems within the U.S. (Dietz et al., 2015). Because ecological value is not a mandatory characteristic of a wilderness area, the administering agencies place varying importance on ecological or biodiversity values in recommending potential wilderness within their lands. Re-structuring the agencies' approach to the NWPS, by including designation criteria with a mandatory ecological component, could result in a more resilient, diverse wilderness system.

One of the most important and somewhat recent ecological concepts in conservation planning is that of ecological connectivity. Preserved systems that include larger areas connected across the greater landscape have been found to be better at maintaining ecosystem function, species persistence, and/or biodiversity than small and scattered preserved areas are (Tewksbury et al., 2002; Araújo et al., 2004; Hole et al., 2009; Baranyi et al., 2011). Ecological connections within preserved landscapes help maintain the essential ecological functions of populations' gene flow, migration, seed dispersal, and response to disturbances or changes in climate (Creech et al., 2014). Aligning the practices of ecological connectivity with wilderness planning may, in

particular, provide a more resilient wilderness preservation system for the California portion of the southwestern deserts, which are especially susceptible to the effects of human impacts.

While the NWPS and its implementation are evaluated to some extent as a whole, this paper aims to answer the following questions and sub-questions specifically related to the preservation of the California desert region:

1. How does implementation of the Wilderness Act differ among the administering agencies (i.e., what criteria are used to identify wilderness study areas, and subsequently, to recommend wilderness areas)?
2. How can incorporating and prioritizing ecological connectivity concepts in the agencies' wilderness eligibility processes benefit the preservation of desert ecosystems in California?
3. What additional recommendations or conclusions can be made with regards to unifying wilderness and ecological preservation?

To answer these research questions, relevant literature, including scientific studies, journal articles, legal reports, and public agency documentation was reviewed. Various past and recent legislation related to wilderness, California desert conservation, and renewable energy in California was also examined. This paper analyzes the literature review findings and ultimately presents recommendations for an enhanced wilderness planning process that would better preserve California desert ecosystems.

To provide an overview of how the Wilderness Act has evolved from legislation to application, Section 2: Administering the Wilderness Act discusses each of the administering agencies' histories, along with their past and present wilderness planning and management approaches. Section 3: Challenges to Wilderness in the California Deserts provides context for wilderness planning within the California desert region, including the current threats and challenges to preservation within the region. To analyze its usefulness in wilderness planning, past expert research on ecological connectivity has been synthesized, and the findings are explored in Section 4: Ecological Connectivity in Wilderness Preservation Planning. Section 4 also identifies benefits of ecological connectivity specifically to the California desert region. Section 5: Applying Ecological Connectivity to Wilderness discusses how ecological connectivity can fit

into future implementation of the Wilderness Act, describing recommendations for utilizing the concept to guide wilderness planning in the California desert region. The paper closes with Section 6: Conclusion and Recommendations, which gives a brief overview of the key points risen throughout the analysis.

2 – **ADMINISTERING THE WILDERNESS ACT**

In 1964, the Wilderness Act immediately designated 54 wilderness areas, containing approximately 9.1 million acres of national forest lands. Congress has the authority to add new areas to the NWPS, but the wilderness agencies are charged with reviewing federal lands for wilderness potential. Following 1964, well over 100 subsequent statutes[2] have been introduced; each address prohibited and permitted uses to some extent, though none amend the Wilderness Act (Gorte, 2011). The majority of the subsequent wilderness laws introduced have been to designate new wilderness, and all but three order the management of wilderness to be conducted in accordance with the Wilderness Act (Gorte, 2011).

The administrating agencies ordered with the task of wilderness review must identify lands and propose boundaries for Congress' consideration. Public and private interest organizations may also lobby for the inclusion of lands within the NWPS. While reviewing lands for inclusion in the NWPS, Congress must take into consideration the various interests involved in the land, taking years and often even decades to designate new wilderness (Wilderness Institute, et al., 2015). Figure 2: Wilderness Designation Process offers a simplified depiction of the steps included in the wilderness designation process.

The Wilderness Act and most of the early wilderness review statutes do not specifically address management of wilderness; the Wilderness Act only vaguely directs the agencies to protect the wilderness character of the designated areas (Gorte, 2011). Such efforts to identify wilderness are the USFS's Roadless Area Review and Evaluation (RARE) and the BLM's Wilderness Study Areas (WSAs), which are areas identified as potential wilderness. WSAs are temporarily subject to protections so as not to impair their suitability as wilderness until a conclusion is determined (Gorte, 2004). Therefore, the four administering agencies, their preexisting management policies, and their organizational structures largely influence the management of lands within the NWPS.

[2] As of February 2011, 132 wilderness statutes existed; however, since 2011, several additional wilderness statutes have been introduced, such as the 2015 California Desert Conservation and Recreation Act.

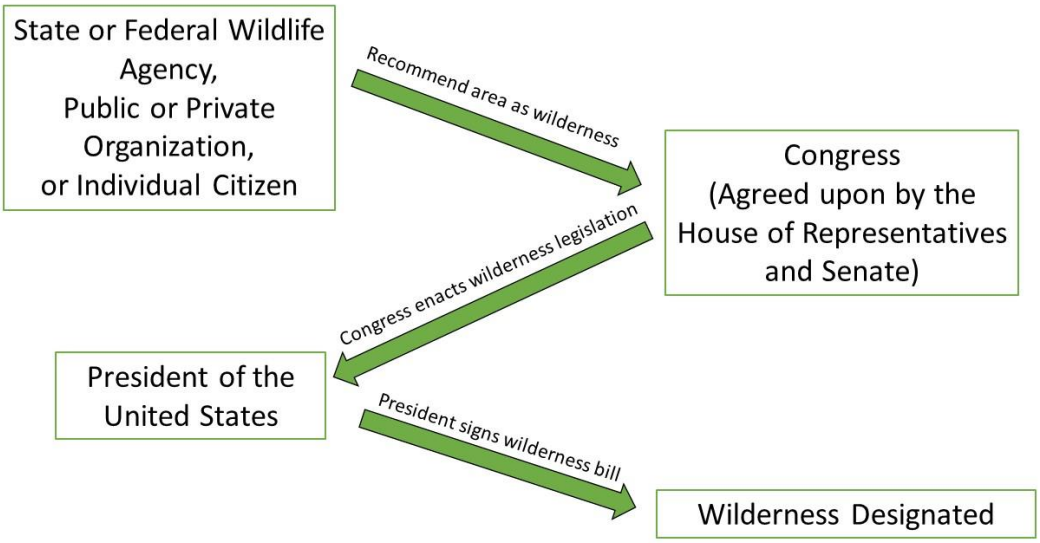


Figure 2: Wilderness Designation Process

Logistically, the NPS, USFWS, and BLM fall within the Department of the Interior (DOI), and the U.S. Department of Agriculture (USDA) manages the USFS. Two of these agencies—the NPS and USFWS—operate under "dominant use" statutes that favor recreation and fish and wildlife protection, respectively, over extractive land uses. In contrast, the other two agencies—the USFS and BLM—gain their authority from multiple use and sustained yield statutes that favor goals in both preservation and extractive uses (e.g., timber production, grazing, and/or mineral extraction) (Glicksman, 2014). In an attempt to unify the wilderness agencies' vision and implementation of the Wilderness Act, all four of the wilderness agencies operate a wilderness management-training center in Missoula, Montana. Nonetheless, the wilderness management approaches from agency to agency, and even within the agencies from wilderness area to wilderness area, can vary significantly. For example, many NPS wilderness areas prohibit hunting within its boundaries, while the USFS and BLM generally do not allow hunting in their wilderness (Gorte, 2011). The USFWS has also carried out active restoration activities within wilderness boundaries, operating under the exception clause of the Wilderness Act, while most of the wilderness agencies use a hands-off management approach.

2.1 Wilderness Identification by Agencies

The following subsections provide an overview of each wilderness agency, along with a description of their past and present wilderness planning and management approaches. The research presented looks at how each agency differs from one another, specifically in how they identify wilderness. Ultimately, this section will provide insight to where the wilderness agencies have room for improvement in their wilderness planning processes.

2.1.1 The NPS

The NPS's National Park System was created in 1916 upon adoption of the Organic Act to create a unified organization to operate the national parks and monuments already existing at the time (NPS, 2015a). Today, the NPS manages approximately 84 million acres of land, including national parks, monuments, battlefields, historical sites, recreation areas, seashores, and scenic rivers and trails (NPS, 2015a). With over 290 million visitors to the National Park System each year, the National Park System also includes an extensive network of roads and infrastructure, including visitor centers, lodging, food services, and gift shops (NPS, 2015a; Zellmer, 2014). National parks are delineated largely based on political and economic influences, with a primary goal of preserving lands for the enjoyment of the public (Zellmer, 2014; NPS, 2015a). As with wilderness areas, new national parks must be created by Congress; though recently, conservation partnerships and scenic easements have been used by the NPS to expand the system (Organic Act, 1916; Zellmer, 2014).

The NPS has a long history of building infrastructure within its parks in an attempt to make them conveniently accessible to an ever-growing number of visitors. Even its land management efforts in the past have focused on almost subduing nature, such as by fighting and preventing wildfires, eradicating predators such as wolves, and baiting and corralling bears and bison into sight of park visitors to provide entertainment and/or safe and benign recreation (Zellmer, 2014). In some cases, such as the Padre Island National Seashore, the NPS only have jurisdiction over the surface, while private mineral interests contain rights to the subsurface (Zellmer, 2014). To provide an example of the NPS's attitude towards visitorship, in 1956, the NPS's "Mission 66" began a ten-year program aiming to accommodate 80 million visitors by 1966, calling for more

development, utilities, and staffing within the National Park System. Today, the annual number of visitations has reached over three times the goal set by Mission 66 (Zellmer, 2014).

The undeveloped (backcountry) portions of national parks are subject to development and recreational impacts resulting from activities such as road building and off-road motorized vehicle use. Protections of backcountry within national parks are subject to administrative regulations that can change (NPS, 2015b); however, following the Wilderness Act, the NPS began a small but growing effort to locate and designate portions of the National Park System as wilderness. Some critics have claimed that the NPS's structure is biased against wilderness because wilderness management can interrupt normal visitor use and enjoyment of parks (Zellmer, 2014). Regardless of this potential obstacle, the NPS has been provided the highest wilderness acreage to the NWPS of any of the wilderness agencies. As of 2015, approximately 44 million acres of NPS lands have been added to the NWPS, providing these areas with more stringent and permanent protections that the Organic Act and NPS policies do not provide (NPS, 2015b). Still, many critics believe that the NPS's history of intensive recreational development and bias against restricted wilderness within the National Park System continues to affect the NPS's approach to wilderness management (Zellmer, 2014).

To evaluate an area's potential for wilderness designation, the NPS's wilderness eligibility criteria is comprised of each of the four parts of the Wilderness Act's wilderness definition. However, in addition to the primary definition criteria, other considerations are taken into account by the NPS. Such considerations include lands that have had heavy extractive uses in the past, but those past uses are currently unnoticeable or could potentially be restored. Existing rights or privileges, such mineral exploration, development, agricultural operations, are also not deal breakers for the NPS in considering lands. Another unique policy by the NPS is the fact that the use of motorized boats, snowmobiles, or aircraft does not make an area ineligible for inclusion as wilderness, as the extent to which these uses might impact wilderness and how they may be mitigated is considered (Wilderness Institute, et al., 2015).

The NPS's wilderness inventory process includes categorizing their lands into several potential wilderness types – from not yet assessed for wilderness potential to Congress-approved designated wilderness. The NPS's Management Policy #41 provides general strategies for the

management of NPS wilderness and applies to all eligible, study, proposed, and designated wilderness (NPS, 2006). Therefore, even wilderness that is eligible for but not yet designated as wilderness is managed so as to protect its wilderness characteristics. The NPS's wilderness designation process uses more wilderness status categories than any other of the wilderness agencies. The eight formal wilderness land statuses categorized by the NPS are as follows:

- *unassessed*: the area has not yet been assessed to determine if it is eligible for a wilderness study, or a previously determined ineligible area that requires reassessment;
- *assessed*: the area's eligibility has been assessed but the determination has not been formally approved;
- *eligible*: the area's eligibility has been approved by the NPS Director or the area has otherwise been selected for wilderness study;
- *proposed wilderness*: a formal wilderness study has been completed for the area but it has not been forwarded to the President of the U.S.;
- *transferrable wilderness inholdings*: private, state, tribal, or other non-federal lands within a designated wilderness that can be converted to wilderness without further congressional action once the land is acquired by the NPS;
- *proposed potential wilderness*: the area has met the qualifications of proposed wilderness and is adjacent to eligible, proposed, recommended, or designated wilderness;
- *designated potential wilderness*: the area has been designated as such by Congress because the area does not currently qualify for immediate designation due to a temporary nonconforming condition or use, but the NPS Secretary may designate it as wilderness once the appropriate conditions are met without further congressional action; and
- *designated wilderness*: the area has been designated by Congress as wilderness and signed into law by the President (NPS, 2013).

Of all the previously listed categories, the only permanent land status is designated wilderness. However, by managing all eligible or study wilderness as if it were already designated, the NPS precludes itself from beginning any activity or allowing any use that would disqualify the area as wilderness under the Wilderness Act's definition, or otherwise would diminish the area's wilderness characteristics. This is a common tool used by the wilderness agencies to ensure the area's protection throughout the lengthy designation process. The eligible, study, or proposed

wilderness is temporarily managed with this approach until Congress either designates the area as wilderness (in which the wilderness management is permanent) or releases the area from the eligible, study, or proposed designation (in which the area is returned to its prior management approach) (NPS, 2006).

2.1.2 The USFWS

The origins of the USFWS can be traced back to the Bureau of Fisheries and the Bureau of Biological Survey, which were both moved to the DOI and, in 1904, formed into the USFWS. The USFWS is responsible for administering several historic wildlife conservation statutes, including the Migratory Bird Treaty Act of 1918, the Marine Mammal Protection Act of 1972, and the Endangered Species Act of 1973. The National Wildlife Refuge System puts the USFWS's responsibilities beyond managing wildlife, making it a major federal land management agency (Zellmer, 2014). As wildlife refuges became popular recreation destinations, the National Wildlife Refuge System Administration Act of 1966 was passed to address this concern, requiring any recreation activities to be compatible with each refuges' major purpose. Even so, refuges continued to attract concerns over their management, and the 1997 Refuge Administration Improvement Act was enacted to create a more comprehensive and integrated management system of refuges as a whole (Zellmer, 2014).

The National Wildlife Refuge System (NWRS), administered by the USFWS, covers over 150 million acres, excluding its land protections within Alaska, and provides habitat to thousands species of birds, mammals, reptiles, amphibians, and fish (USFWS, 2014). Refuges within the system are designated as such by Congress or the president of the U.S. from already existing federal land managed by another agency, or otherwise are donated by private landowners (Zellmer, 2014). The USFWS manages more than 20 million acres of wilderness, of which approximately 90 percent is located in Alaska (USFWS, 2015). The USFWS perhaps has the most ecologically-inclined internal definition of wilderness characteristics, which includes, "providing environments for native plants and animals, including those threatened or endangered", as well as maintaining healthy watersheds and airsheds and serving as a benchmark for ecological studies (USWFS, 2008). Of course, the four tiers of wilderness as defined by the Wilderness Act are also a priority of the USFWS in identifying wilderness. The USFWS wilderness review and designation planning process includes three phases:

- inventory lands that meet the minimum requirements for wilderness (wilderness study areas (WSAs);
- study and evaluate the WSAs; and
- recommend WSAs for designation as wilderness.

All lands and waters managed by the USFWS are evaluated for wilderness eligibility, and reviews are conducted concurrently with the NWRS Comprehensive Conservation Planning (CCP) process (Wilderness Institute, et al., 2015). The USFWS must conduct wilderness reviews, implementing these three steps, at a minimum of every 15 years (USFWS, 2008). The following four statuses are assigned to land under evaluation by the USFWS:

- *wilderness study area*: area is being considered for wilderness recommendation
- *recommended wilderness*: area that the Director of the USFWS has recommended to the Secretary of the Interior for inclusion in the NWPS
- *proposed wilderness*: areas that the Secretary of the Interior has recommended to the President for inclusion in the NWPS
- *designated wilderness*: area designated as wilderness by law

Both proposed wilderness and designated wilderness are managed according to the Wilderness Act, though the protections granted to proposed wilderness are temporary.

The CCP process assists in meeting wilderness inventory goals by requiring reviews of NWRS lands covered by a CCP. Once land is designated as wilderness, the key principles listed in USFWS internal policies include accomplishing the Administration Act, Wilderness Act, and refuge system purposes for a variety of public benefits. Another key principle is to secure an "enduring" resource of wilderness, which USFWS policy states can be accomplished by maintaining and even restoring the biological integrity, diversity, environmental health, and wilderness character of designated wilderness (USFWS, 2008). This is especially unique to the USFWS, as other agencies have not made a priority of actively restoring or manipulating land to a natural state, or of biological integrity and diversity.

The USFWS is the only federal land management agency that dedicates its land management efforts to only wildlife; however, the lands vary greatly in size, origin, levels of previous

development, and USFWS control (Zellmer, 2014). While the USFWS is typically known as the wilderness agency with the highest emphasis on ecological and biological conservation, this does not necessarily align with the Wilderness Act's priorities, which lie primarily in providing natural conditions with little human interference. Biological conservation and wilderness preservation are often overlapping efforts, but due to the Wilderness Act's restrictions, a wilderness designation may interfere with USFWS efforts to actively manage wildlife populations and restore habitats (Zellmer, 2014) (USFWS, 2008).

2.1.3 The USFS

The USFS was created in 1905 to manage the nation's "forest reserves", which were originally created by the Forest Reserve Act of 1891 and would become national forests. The new USFS agency replaced the USDA's Bureau of Forestry, an organization whose roots can be traced back as far as 1881 to the Division of Forestry, which was created to assess the nation's forest conditions (Williams, 2005). The first several decades of the USFS focused on mapping national forests, providing and maintaining trail access, administering grazing permits, and protecting the forests from wildfire and unauthorized exploitation such as poaching and unauthorized timber and grazing operations (Williams, 2005). Today, the USFS's National Forest System (NFS) covers approximately 192.5 million acres of federal land (Gorte, 2006). The Multiple-Use Sustained-Yield Act of 1960 authorized the USDA to develop and manage the national forests' renewable resources for multiple uses while ensuring the continued productivity of timber, grazing land, watershed, wildlife, and outdoor recreation (Multiple-Use Sustained-Yield Act, 1960).

In 1964 the agency became the front-runner in wilderness management when the Wilderness Act immediately designated over 9.1 million acres of existing National Forest as wilderness (Gorte, 2011). Following 1964, the USFS began the RARE program to identify national forest lands with roadless tracts of at least 5,000 acres, and, therefore, would potentially qualify for designation as wilderness (Glicksman, 2014). The RARE effort identified 58 million acres of national forest lands but was abandoned in 1972 due to challenges of National Environmental Policy Act compliance (Gorte, 2011). The RARE II program, which began in 1977, identified an additional four million acres (Glicksman, 2014). Finally, a management plan adopted by the

USFS in 2001 identified 58.4 million acres of roadless area, covering approximately one-third of the NFS (Glicksman, 2014).

The USFS manages by far the most NWPS by unit—almost three times the units managed by the NPS—and is the second largest wilderness administer by acres. The success of the USFS in designating wilderness areas may be in part to the rugged and remote locations of their land, which discourages extractive uses due the impracticality and expense associated with the land and location (Glicksman, 2014). In addition, the qualities of forests generally also make the area better able to meet the qualifications of "solitude" that the Wilderness Act calls for due to abundance of trees and intervening topography.

To identify potential wilderness, the USFS assesses an area's wilderness characteristics, or the conditions of land that may qualify areas for consideration as designated wilderness according to the Wilderness Act's definition of wilderness (USFS, 2008). The four basic categories contained in this definition are considered in addition to an expanded USFS definition that adds the following characteristics to their inventory evaluations: size, natural, undeveloped, outstanding opportunities for solitude or primitive and unconfined recreation, special features and values, and manageability (USFS, 2008). Each criterion for wilderness is continually monitored in USFS lands to determine their potential for inclusion in the NWPS.

The USFS has been a leader in the wilderness agencies for measuring solitude, in particular. For example, the USFS classifies solitude within wilderness and potential wilderness into the following three categories:

- Type 1: high or medium use wilderness within more than 75 miles of travel corridors (e.g., hiking trails, navigable rivers, etc.) or low use wilderness with 100 miles or more of travel corridors;
- Type 2: high or medium use wilderness within between 1 and 75 miles of travel corridors or low use wilderness with between 1 and 100 miles of travel corridors;
- Type 3: No miles of travel corridor, regardless of wilderness size (USFS, 2014).

As previously mentioned, the USFS has somewhat relied on the concept of screening by vegetation or topography to assess solitude (Glicksman, 2014). However, USFS solitude

monitoring for potential wilderness also includes field monitors that count the total travel encounters (USFS, 2014). In addition, to monitor the ability to provide primitive and unconfined recreation, the USFS documents the conditions and development of trails or other travel corridors available (USFS, 2014).

2.1.4 The BLM

The BLM's roots can be traced back to the General Land Office, which was created in 1812, and the U.S. Grazing Service, which was created in 1934. The two agencies merged in 1946 to form the BLM with responsibilities in land disposal, range management, and minerals extraction (Gorte, 2006). It wasn't until the Federal Land Policy and Management Act (FLPMA) of 1976 that the agency's responsibilities were consolidated within one statute, and that the BLM became an administrator of wilderness lands. The BLM develops land use plans that guide the management of its public lands to protect natural resources while providing for non-natural uses such as human habitation, mineral development, energy infrastructure development, and more (California Energy Commission, 2014). The BLM manages approximately 261.5 million acres of federal land (Gorte, 2006). Approximately 31 million acres of this land is included in the BLM's National Conservation Lands in ten western states, including national monuments, conservation areas, wild and scenic rivers, scenic and historic trails, wilderness, and WSAs (BLM, 2015). Due to its large presence in the west, the BLM is the largest wilderness agency within the California desert region.

No public lands managed by the BLM were immediately elevated to wilderness by the Wilderness Act, as was the case with lands managed by the USFS. However, the FLPMA gave the BLM the responsibility of reviewing roadless areas of 5,000 acres or more that have the potential for wilderness designation. The FLPMA inventory initially identified approximately 23 million acres of land outside of Alaska that could qualify as WSAs, which critics claimed to be too low or incomprehensive (Glicksman, 2014) (Gorte, 2011). However, it is important to note that BLM lands may be more impacted by development and therefore are more incompatible with the required wilderness characteristics than other federal lands because BLM lands tend to have been and are more accessible to mineral and other extractive interests. Today, the BLM has identified approximately 12.6 million acres of WSAs and manages 222 separate wilderness areas

that encompass approximately 8.6 million acres; however, BLM wilderness equates to only approximately 3 percent of the BLM's entire land area (BLM, 2015).

BLM lands not designated as wilderness are analyzed for wilderness characteristics according to BLM Manual 6310. BLM Manual 6310 provides detailed direction on conducting inventories for wilderness characteristics. Lands that have or potentially have wilderness characteristics are documented, and these qualities must be considered when BLM land use decisions are made, as required by BLM Manual 6320. Wilderness characteristics inventories to identify the presence or absence of wilderness on BLM land are mandated by Section 201 of the FLPMA, and though no mandatory timelines have been instated, the inventories must be periodically updated (BLM, 2012a). The wilderness characteristic inventories will be updated when certain events or factors occur. An update could be required if the BLM identifies new information regarding resource conditions of an area that meet the minimum standards of wilderness characteristic; or if a project or undertaking that impact an area's wilderness characteristic is undergoing NEPA review (BLM, 2012a). The required wilderness characteristics for a potential BLM wilderness include the primary four eligibility criteria defined by the Wilderness Act. Congruent with the Wilderness Act language, the first three criteria (i.e., naturalness, size, and outstanding opportunities for solitude or primitive and unconfined recreation) are mandatory to qualify for potential wilderness (BLM, 2012a). The fourth optional criteria—supplemental values—is not mandatory but is nonetheless inventoried for areas that meet the first three criteria (BLM, 2012a).

Once an area is determined to meet the minimum eligibility criteria for wilderness characteristics, the BLM—true with its multiple use mandate—must consider both the impacts land uses on the potential wilderness area as well as the effects that a wilderness designation would have on the existing land uses within and adjacent to the area (BLM, 2012b). Key concerns that the BLM must consider are discussed in the BLM Manual 6320, which guides the wilderness land use planning process. The manual lists several considerations, including whether the land can be effectively managed by the BLM while still preserving the land's wilderness character, and also whether a wilderness designation would forgo resources and development potential that are not available elsewhere (BLM, 2012b). While the BLM attempts to avoid controversy over resource allocations or other economic interests that wilderness

designations would prohibit, it also has the authority to make land use decisions within its boundaries that would withdraw existing rights or land leases to better suit the wilderness character of the land (BLM, 2012b).

Adopting the USFS's criteria for solitude, the BLM has measured potential wilderness area's opportunity to provide solitude based on the concept of screening. Whereas forests do not lack in this concept due to rugged terrain with dense stands of trees, almost three-quarters of the BLM's land is characterized as scrubland; only approximately 10 percent of the public lands in the western U.S. contain forested land (Glicksman, 2014). While many wilderness enthusiasts believe that solitude may be found in the BLM's scrubland areas, the agency's past measure of solitude based on outstanding vegetative or topographic screening has precluded many areas from being eligible. Though the BLM has since reversed this policy to make clear that solitude may be found in areas without screening, its earlier adoption of the USFS's solitude-by-screening may account for its low number of established wilderness (Glicksman, 2014).

2.2 Wilderness Management and the Exception Clause

As previously discussed, wilderness offers the highest form of land preservation in the U.S. The Wilderness Act is particularly specific in what is allowed within wilderness boundaries; however, existing non-conforming uses or such uses necessary for agency management of the land are allowed in designated wilderness. In addition, as presented in the preceding sections, each agency charged with administering wilderness uses slightly varying practices and interpretations of allowed uses. However, wilderness offers protection from development—including transportation and energy infrastructure—that other preserved areas such as national parks, monuments, and forests do not provide.

Generally, no permanent human interference is allowed in wilderness areas. Nonetheless, the Wilderness Act's exception clause and subsequent wilderness statues allow for the use of otherwise prohibited activities (e.g., commercial enterprise, motorized vehicles, and permanent roads) for management and emergency purposes. In addition, the statute allows for measures to be taken for fire, insect, and disease control, "subject to such conditions as the Secretary deems desirable" (Wilderness Act, 1964). As such, agencies have used the power asserted by the exception clause to build roads for management purposes, control wildfires, continue the use of

motorized vehicles, allow livestock grazing and mineral prospecting, and develop water projects (Gorte, 2011). In addition, the Wilderness Act does not supersede state fish and wildlife activities; some wilderness statutes and management plans provide facilities and motorized access in support of the state fish and wildlife management activities within wilderness boundaries (Gorte, 2011).

Roads are often deemed necessary for management activities or emergency response by the wilderness agency, though these roads may also be used unofficially for recreation access. In some cases, wilderness agencies even stepped around the law's restriction on permanent roads in wilderness through the use of "cherry stems", which are roads within a non-wilderness buffer that run through an otherwise contiguous tract of wilderness. For example, the Inyo Mountains Wilderness, which is managed in part by the BLM and in part by the USFS, contains dirt access roads within its boundaries. These access roads, used by the USFS for management access, are identified as the neighboring Inyo National Forest; a buffer has been drawn around the roads, leaving a "cherry stem" of Inyo National Forest land within the greater Inyo Mountains Wilderness boundary.

Congress has generally been silent on the issue of distances between roads and wilderness boundaries, as well as on buffer zones between wilderness and nonconforming uses; however, subsequent wilderness bills have prohibited buffer zones from restricting uses on federal lands surrounding the wilderness (NPS, 2013) (Gorte, 2011). The first obvious statute to address buffer zones was an act of Congress to designate wilderness lands in the state of New Mexico in 1980, stating, "The fact that non-wilderness activities or uses can be seen or heard from areas within the wilderness shall not, of itself, preclude such activities or uses up to the boundary of the wilderness area" (Public Law 96-550). Almost identical language has been included in 30 other wilderness statutes following its introduction in 1980 (Gorte, 2011).

Nonconforming uses are also often built into the statutes that designate the wilderness themselves, likely a result of lobbying and conflicting interests that Congress must consider. For example, the California Desert Protection Act of 1994 included a condition for the BLM to authorize the construction of a space needle, if requested by the Secretary of the Navy, within the newly designated wilderness, if requested, and even provided for construction road right-of-way,

calling it a "nonwilderness road corridor" (Gorte, 2011). The space needle was never constructed, and the authorization for this nonconforming use has since expired. It is important to note that these compromises are almost impossible to avoid and may be a key component to the success and perseverance of the NWPS.

2.3 Summary of Existing Administration of Wilderness

New wilderness areas are only added to the NWPS when Congress approves an area that has been studied, reviewed, and proposed for wilderness by the administering agency. Each agency has its own process for inventorying and evaluating land for inclusion in the NWPS; however, they follow the same general steps according to the Wilderness Act and other wilderness statutes. Though each of the agencies use slightly different approaches and/or priorities in their wilderness review processes, they each comply with the Wilderness Act's four-prong definition of wilderness:

- the area is natural and not impacted by man;
- provides solitude or primitive and unconfined recreation;
- is of sufficient size; and
- may contain another important value.

Only the first three criteria in the definition are mandatory. Though the size requirement does provide some ecological connectivity benefits, the boundaries of wilderness are not required to be drawn according to ecosystem dynamics. Further, ecological value is only an optional criterion that seems almost an afterthought of the Wilderness Act's definition. While the success of conservation efforts are typically measured at least in part on how well ecological and biological diversity is represented in the protected network, this is not a defining factor in wilderness conservation under the Wilderness Act (Dietz et al., 2015). Wilderness itself is a fundamentally holistic concept, and the preservation of wilderness should place more weight on the area's importance in the greater environmental and geographical setting as a whole (USDA, 2005).

"Untrammeled by man" refers to land that has been allowed to "run free" without direct anthropogenic impact (USDA, 2005). This is a well-accepted definition of wilderness, and once

designated, is an important concept to preserve (e.g., allowing natural forest fires take their course; leaving landscapes unaided to naturally regenerate following a disturbance; leaving streams and rivers unaltered, allowing for a natural change in path through time). The same can be interpreted from the Wilderness Act's use of the term "natural", as according to the Act, the area must "generally appear to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable." Using the terms untrammeled and natural accomplish the very important and fundamental role of protecting wilderness from human control. However, while an untrammeled, natural setting is often the primary goal of conservation planners, its use in the wilderness eligibility screening process results in the exclusion of land that has been impacted in the past from being included in the NWPS.

Ecosystems in the southwestern deserts are slow to recover from natural and human disturbances and management efforts are often required to help move the system back to a natural state. Restoration efforts have the potential to re-establish degraded areas and make them available for wilderness designation if the area meets the other wilderness requirements. Regardless, the longer an area remains unprotected by a wilderness designation, the higher the risk for further encroachment and impact becomes. In addition, the processes for designating wilderness are based on a statute that is over 50 years old, and they do not incorporate now widely-accepted ecological conservation concepts. The Wilderness Act is fundamentally an aesthetic and recreation preservation tool; however, it has become key in not just protecting wilderness for human enjoyment, but also in protecting wilderness for the plant and wildlife species found within it. Because wilderness is the leading land preservation statute in the U.S., it is necessary to continue to improve and build upon the Wilderness Act's original purpose, "for human enjoyment." To do this, wilderness agencies must also prioritize tried and true ecological conservation concepts in their wilderness planning processes. The need for a reformed or re-strategized wilderness designation process may be greatest in the California desert region, where an increasingly fragmented landscape and growing demand for renewable energy infrastructure in the region poses a threat to ecosystems both within and outside of wilderness boundaries. Further discussion on the California desert region is provided in the following section.

3 – **CHALLENGES TO WILDERNESS IN THE CALIFORNIA DESERTS**

The California desert region boasts some of the most unique biodiversity and landscapes in the U.S. Consequently, this area receives significant attention from both conservationists and developers. The following subsections discuss the challenges that wilderness and other preservation efforts face in the California desert region. Namely, this discussion focuses on renewable energy development, as it is one of the most anticipated threats to biodiversity and species persistence in the region.

3.1 Wilderness within the California Desert Region

The California desert region—containing the Mojave and Sonoran deserts—contains a multitude of sensitive species and habitats. These deserts have been receiving increased attention by conservationists in recent years. The first modern-day advance in desert wilderness conservation came at the end of the 20th Century, with the passage of the California Desert Protection Act of 1994, which designated over 3.6 million acres of wilderness in California. It created 66 new wilderness areas and added land to three existing BLM wildernesses, as well as a new wilderness study area totaling in 11,200 acres. Recently, the proposed California Desert Conservation and Recreation Act (DCRA) of 2015 proposes to update the 1994 Act by providing for conservation, enhanced recreation opportunities, and development of renewable energy in the California Desert Conservation Area. This proposal includes over 200,000 acres of new BLM wilderness areas, adding over 95,000 acres to existing wilderness managed by the BLM, in addition to new NPS Wilderness and other lesser protections (DCRA, 2015).

Some of the state's most sensitive desert animals and critical populations of these species exist within wilderness areas of the California desert region. For example, the desert bighorn sheep, listed as endangered under the federal Endangered Species Act (ESA), are shy ungulates found throughout the California desert and mountain regions. The species is particularly susceptible to impacts resulting from human activity and land use encroachment (Campbell, 2001). Because they dwell in rocky, mountainous areas separated by large, relatively flat, swaths of desert, the desert bighorn sheep populations in the California desert region have been extensively fragmented by urban and infrastructure development (Creech et al, 2014). In addition, recreation has had an impact on desert bighorn sheep through increased presence of hikers and domestic

dogs brought along by hikers (Campbell, 2001; Longshore, 2013). The presence of hikers can have a substantial, but temporary impact on individual desert bighorn sheep's habitat selection and behavior similar to that natural predators would cause (Longshore, 2013). Roads within desert bighorn sheep habitat also trigger the flight response, as well as alter migration routes, pathways to water sources, and breeding territory (Campbell, 2001). The final major threat to desert bighorn sheep is livestock grazing – causing either direct competition for water and food or indirect changes in the landscape and vegetation composition (Campbell, 2001).

Desert bighorn sheep numbers in the southwestern deserts have been devastatingly affected by California's development over the last 70 years; their relative isolation and small population size makes desert bighorn sheep especially vulnerable to loss of genetic diversity and in-breeding, which is further exacerbated by habitat fragmentation (Creech et al., 2014). Between 30 and 80 percent of total desert bighorn sheep populations have been extirpated since the 1940s; within the Mojave Desert, an estimated almost 40 percent of desert bighorn sheep populations had disappeared by the end of the 20th Century (Clinton et al, 2004; Creech et al., 2014). The population declines and local extinctions are largely the result of land use encroachment and livestock competition for resources, as well as the spread of livestock disease (Clinton et al., 2004).

Listed as threatened under both the federal and state's ESAs, the desert tortoise is yet another sensitive species that, like the desert ecosystem itself, is particularly susceptible to human impacts. The desert tortoise is a small reptile—its shell ranges from 18 to 27 centimeters in length—with slow reproductive rates due to its relatively late age of sexual maturity (i.e., the tortoise reached sexual maturity in 13 to 20 years) (Averill-Murray et al., 2012). The desert tortoise is extremely sensitive to habitat fragmentation, especially fragmentation that results from transportation corridors (Penrod et al., 2012). Road kill in particular is a large threat, as roads directly fragment and restrict movement among individuals and populations alike. In the California desert region, the species, like the desert bighorn sheep, is becoming more and more isolated from one another and suffering a genetic diversity losses due to inbreeding (Penrod et al., 2012). The conservation and success of this species is largely dependent on protected areas and conservation efforts, and the quality of desert tortoise habitat even in preserved areas can be affected by neighboring land uses (Averill-Murray et al., 2013). While historically, more than

150 desert tortoises per square kilometer existed in some areas, by 1990, declines of over 20 percent within local populations—and up to 90 percent of adult females in some populations—were recorded (Averill-Murray et al., 2012).

The Mohave ground squirrel, listed as "threatened" under the California ESA and "endangered" under the federal ESA, is also vulnerable to habitat loss and fragmentation, as well as off-road vehicle use and agricultural operations (Penrod et al., 2012). The species, found only in the western Mojave Desert, resides in flat, open desert scrub and woodland communities, as well as desert washes and sand dunes, and is dependent on water availability for reproduction and population abundance (Penrod et al., 2012). Though some abundant populations exist sporadically throughout the region, the populations are geographically isolated; therefore, habitat fragmentation has led to population decline and genetic diversity loss (Penrod et al, 2012). Potential threats include urban and rural development and transportation and energy infrastructure development within its range. In particular, the California desert region's renewable infrastructure demand has the potential to further fragment, degrade, and reduce Mohave ground squirrel habitat.

3.2 Threats to California Desert Preservation: Renewable Energy Movement

Desert ecosystems are particularly fragile, and impacts resulting from habitat fragmentation, urban development, motorized recreation, and other anthropogenic disturbances are long-lasting, with natural restoration processes taking decades or more. The California desert region, though far less populated than the California coastal regions, supports many land uses, including preserves, military uses, agriculture, mining, and tourism (California Energy Commission et al., 2014). It is also a region that is traversed by many state and inter-state highways. One of the main causes of regional declines in native species is habitat fragmentation; the once undeveloped desert landscape is now crisscrossed by barriers to wildlife that evolved with the ability to move freely across the region (Penrod et al., 2012). Though the region has many anthropogenic pressures that affect the success of preservation planning, natural habitats and species within the southwestern deserts are especially vulnerable to infrastructure impacts as the state races towards its goals in renewable energy. The desert region is appealing to renewable energy development prospectors because it offers some of the best conditions for generating solar, wind, and geothermal electricity in the world (California Energy Commission et al., 2014). However,

renewable energy development may conflict with wilderness in the arid ecosystems of the region, which contain high biodiversity and concentrations of sensitive species that are already stressed by climactic and anthropogenic changes (Lovich and Ennen, 2011).

In a movement to curb carbon emissions, renewable energy in the U.S. is being developed at an unprecedented rate to reduce the use of fossil fuel combustion in energy production. In September 2015, the Clean Energy and Pollution Reduction Act of 2015, or Senate Bill (SB) 350, was enacted, establishing a new set of objectives in clean energy, clean air, and pollution reduction for 2030 and beyond. The act requires the amount of electricity generated and sold from renewable energy resources to be increased to 50 percent of the state's entire energy portfolio by December 31, 2030. This is an increase in the state's Renewables Portfolio Standard (RPS) goal of 33 percent by 2020, which was established by SB 2 in 2011. In addition to the state's movement toward renewable energy development, the National Energy Policy Act of 2005 established goals for renewable energy generation. Specific goals were established for generation specifically on public lands, for which the BLM has been working to meet (California Energy Commission, 2014).

As of 2013, the BLM had identified over 9.8 million acres of potentially developable public lands for solar energy development within California and Nevada (Averill-Murray et al., 2013). Projects designed to meet increasing renewable energy targets have already been approved by the BLM within federal lands, and though this is a positive gain in support of clean energy and air pollution reduction, over 400,000 acres of these approved projects are within the range of threatened and endangered species, such as the desert tortoise (Averill-Murray et al., 2013). In 2005, the BLM completed a Programmatic Environmental Impact Statement (PEIS) for its wind energy development program for such projects. In 2008, a PEIS was also prepared for renewable geothermal energy access and development on the BLM-administered land. Additionally, the BLM is working jointly with the Department of Energy to develop a PEIS for a solar energy development program applicable to new solar energy projects on BLM land within six southwestern states, including California (California Energy Commission et al., 2014). The BLM's PEISs for the each of the three renewable energy development programs will or already do guide the permitting mitigation measures for applicable projects, in support of national renewable energy production efforts (California Energy Commission, 2014). Because the BLM

operates under the multiple-use mandate, these renewable energy efforts require the consideration of land use allocation changes within desert conservation areas managed by the BLM.

Though the proposed California DCRA includes a substantial gain in wilderness for the California desert region, it also facilitates the growing pressure for renewable energy development in the desert regions. The bill potentially displaces several solar energy developments from new desert protected areas, yet it gives solar energy companies opportunity for relocation, some of which is within areas surrounded by national parks and wilderness (Feinstein, 2015). The DCRA also provided for transmission line rights-of-way that travel through national monuments to bring solar energy form its source to energy customers. These energy rights-of-way are prohibited from wilderness areas but can still substantially impact plant and wildlife population movement through the region as a whole, causing permanently fragmented landscapes and temporary, but intensive construction impacts.

State and federal agencies have recognized that the push for renewable energy in the California desert region conflict with habitat and wildlife conservation efforts. Accordingly, the California Energy Commission, California Department of Fish and Wildlife, BLM, and USFWS have prepared the Draft Desert Renewable Energy Conservation Plan (DRECP), which will provide a streamlined permitting framework for energy projects for the next 30 years. The DRECP's planning area, shown in Figure 3: Draft Desert Renewable Energy Conservation Plan Area covers the California portions of the Mojave and Sonoran Deserts. The California Energy Commission's 2015 Draft Energy Policy Report has identified the DRECP as the "most noteworthy progress" in identifying areas for the distribution and generation of utility-scale renewable energy development.

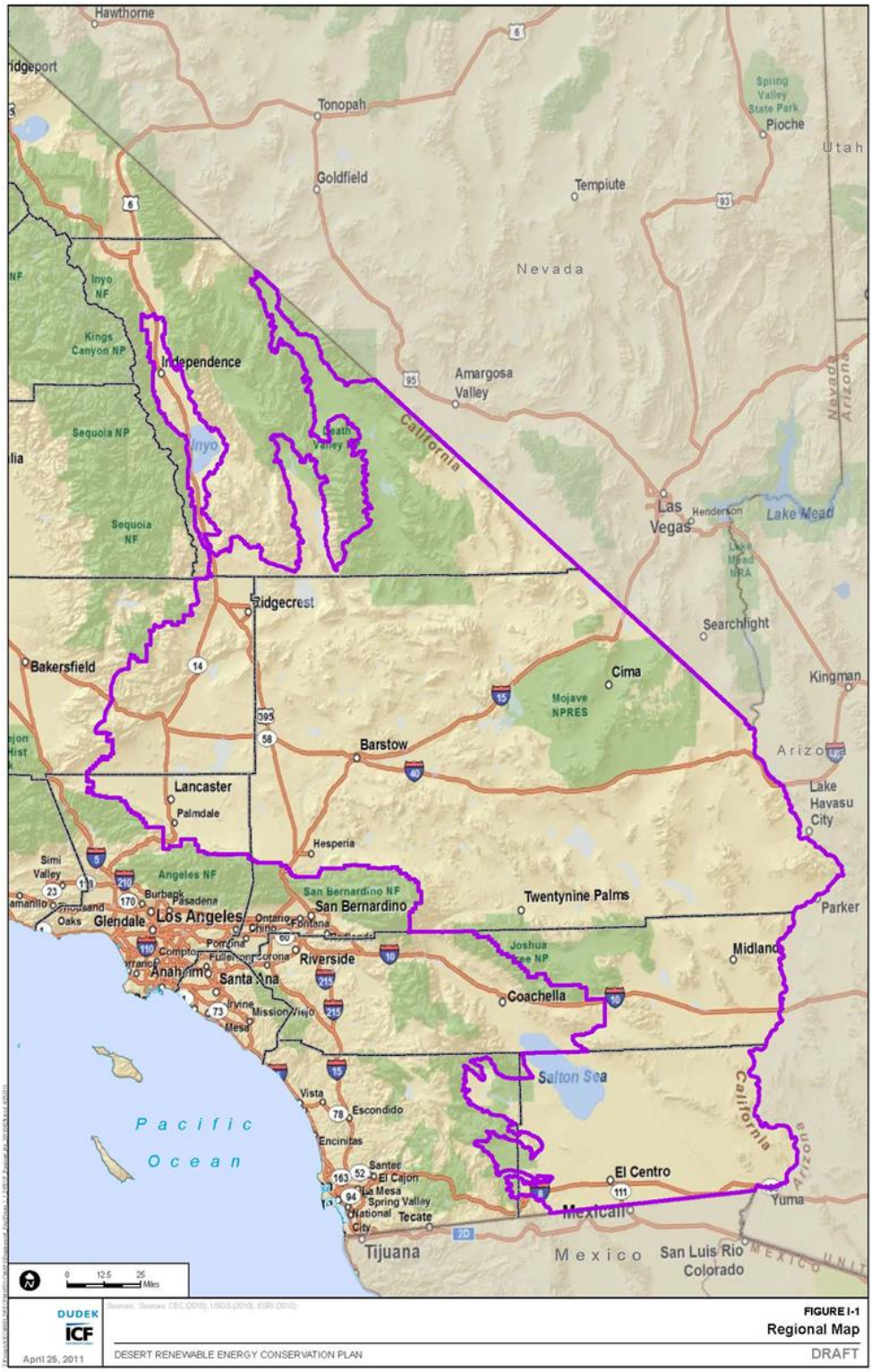


Figure 3: Draft Desert Renewable Energy Conservation Plan Area

Source: California Energy Commission et al., 2014

The DRECP will also plan for the long-term conservation of plant and wildlife species within over 22.5 million acres of the California desert region over the next 25 years (California Energy Commission et al., 2014). Within the DRECP planning area, there are hundreds of thousands of wilderness acres, and over 420,000 acres of new or extended wilderness is proposed. The DRECP includes the BLM Land Use Plan Amendment, which covers nearly 10 million acres of BLM land and establishes management direction for land use updates that promote renewable energy and transmission development (California Energy Commission et al., 2014). Wilderness and WSAs within BLM lands are excluded from land use authorization permits due to the preserved status of the lands.

Though the DRECP addresses lands with wilderness characteristics, comments on the Draft Environmental Impact Report/Environmental Impact Statement for the DRECP have stated concerns that not enough has been done to protect or evaluate potential wilderness lands that could be affected. For example, the Wilderness Society suggested that a range of alternatives that clearly identify all lands with wilderness characteristics per BLM Manuals 6310 and 6320 be provided in the Final EIR/EIS. The Wilderness Society also provided feedback on the lands that the BLM had identified as not having wilderness characteristics, stating that some areas should be reconsidered. In addition, the California Wilderness Coalition identified over 1 million acres of additional areas that meet the wilderness characteristic criteria, stating that the BLM inaccurately evaluated these lands and non-wilderness.

Climate change is one of the most imminent and far-reaching environmental concerns. California is already experiencing its effects in the form of more extreme wildfires, storms, floods, and heat waves, which are causing tremendous human health, ecological and economic impacts (California Energy Commission, 2015). Reducing greenhouse gas emissions by switching from fossil-fuel-based energy to renewable energy sources is key in the state's and nation's efforts to curb climate change. It is not feasible or desirable to prohibit renewable energy infrastructure projects in the California desert region; however, it is still important to keep the changing energy setting in mind during preservation planning, particularly in wilderness planning. Renewable resources in California will substantially support the state's and nation's goals in addressing climate change by reducing dependency on energy sources that emit greenhouse gases (California Energy Commission et al., 2014).

However, this increasing energy development demand causes an urgent need to relook at the preservation planning in the California desert region. There is inadequate evidence that renewable energy development in this region is compatible with wildlife, and this is particularly true for sensitive species such as the desert tortoise (Lovich and Ennen, 2011). While new large infrastructure projects are generally prohibited from crossing through wilderness borders, these projects can have a vast impact on the habitat quality of surrounding non-wilderness lands and can decrease the overall connectivity of the desert landscapes at a greater scale. Energy infrastructure development also has the potential to prevent areas from being eligible as wilderness (e.g., they would reduce the area's ability to meet the "untrammeled by man" requirement) when they might have otherwise been a strategic addition to wilderness connectivity or ecologically important to lands within the NWPS.

Wilderness planners must attempt to continue to expand the NWPS in a way that minimizes the devastating effects that additional habitat fragmentation will have on its existing and potential lands. Efforts such as those of the DRECP prove that California is looking for a compromise between renewable energy goals and those of desert conservation. The following sections introduce a concept that has been found to support the persistence of species diversity and ecosystem health. This concept—ecological connectivity—can be used as a preservation planning tool as more renewable energy projects are brought to the California desert. The NWPS—the highest form of preservation available in the U.S.—does not yet directly incorporate such biological and ecological conservation goals that could be crucial to maintaining healthy ecosystems within the wilderness of the California desert region.

4 – ECOLOGICAL CONNECTIVITY IN WILDERNESS PRESERVATION PLANNING

Conservation and ecology studies typically use defined boundaries when referring to ecosystems (Vimal et al., 2012). However, prior to urban encroachment, the California desert ecosystems were once connected and acted as one fluid ecological system. Urban development in the California desert region, including roads and linear infrastructure, has disrupted the functional integrity of the desert region, fragmenting large areas of habitat into smaller, isolated patches that are more susceptible to local extinction and the spread of non-native species (Penrod et al., 2012). Recent conservation biology scholars have recognized that the spatial scale of ecological processes goes beyond protected boundaries, and the concept of ecological connections has become an important feature in preservation planning (Vimal et al., 2012). The subsequent subsections discuss how the concept of ecological connectivity can be used to preserve the natural corridors necessary for species persistence and the preservation of plant and wildlife biodiversity in the California desert region.

4.1 Overview of Ecological Connectivity Concepts

Though the direct impacts caused by the activities of human encroachment, recreation, and resource extraction can be avoided within the protected NWPS lands, indirect impacts from neighboring land uses are harder to avoid. Habitat fragmentation can impact plant and wildlife populations within wilderness—particularly populations that migrate in and out of wilderness boundaries—and can preclude unprotected lands from becoming wilderness. In addition, the threat of climate change to existing ecosystems—regardless of the land's protection status—is eminent. The combination of habitat fragmentation and climate change is especially threatening to native plant and wildlife populations because organisms are prevented from moving out of areas that no longer provide suitable habitat (Baranyi et al., 2011). However, there is evidence that increasing the size, number, and connectivity of conserved land networks can increase the resiliency of wilderness areas (Hole et al., 2009).

Ecological connectivity is the concept that large, connected preserved systems are better at maintaining ecosystem function, species persistence, and/or biodiversity than small and scattered preserved areas are (Tewksbury et al., 2002; Araújo et al., 2004; Hole et al., 2009; Baranyi et al., 2011). Figure 4: Ecological Connectivity Illustration provides a simple drawing of less

connected "habitat patches" and more connected habitat patches to demonstrate the concept. Connecting ecosystems within larger landscapes is essential, if not necessary, for seasonal and generational species dispersal, gene flow, migration, seed dispersal, and population response to disturbances or changes in climate (Penrod et al., 2012; Creech et al., 2014). Though the numbers of remaining pristine landscapes available for preservation continue to lower in number and size, incorporating ecological connectivity into the areas already protected or planned for protection will connect otherwise isolated plant and wildlife species and habitats and contribute to their persistence (Baranyi et al., 2011). By utilizing the connectivity concept in wilderness planning, the NWPS can be utilized to continue use of the Wilderness Act's wilderness definition as well as more modern approaches to preservation (e.g., biodiversity, habitat, and ecosystem preservation). The following subsections provide further explanation of the benefits of utilizing ecological connectivity concepts in preservation planning.

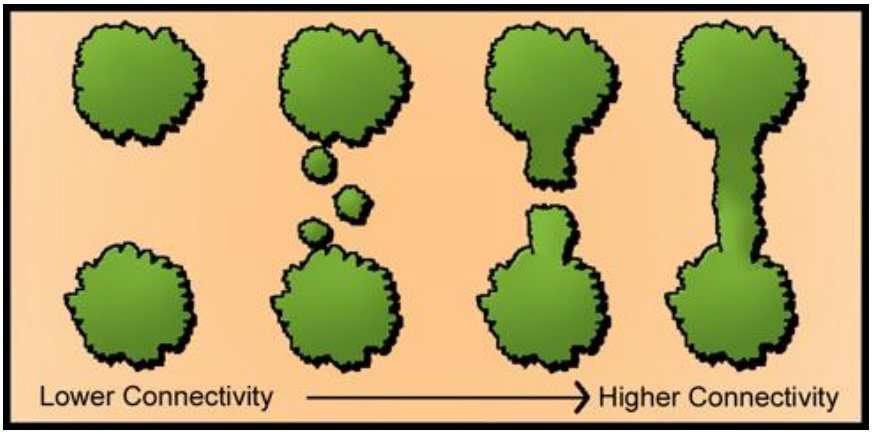


Figure 4: Ecological Connectivity Illustration

Source: USDA, 2015

4.2 Benefits of Ecological Connectivity to Species Population Health

Spatial distributions of wildlife and plant species within ecosystems are not static; rather, ecosystems are dynamic systems that occur over broad scales, with species populations fluctuating over time and space (Araújo et al., 2004; Vimal et al., 2012; Leroux and Rayfield, 2014). Movement—including daily food, shelter, and reproduction movement patterns; generational dispersal of offspring; and seasonal migration—is essential to wildlife persistence (Penrod et al., 2012). In addition, as local populations die out, either from anthropogenic causes or naturally, new species move in and shift their geographic range to recolonize (Penrod et al.,

2012). Preserved areas that do not provide ecological connections across the greater landscape do not allow populations to continue these natural ebbs and flows associated with daily, seasonal, and generational species movements. Habitat fragmentation is a primary reason that many small and/or isolated protected areas are ineffective. When a landscape is fragmented by urban or other human uses, plant and wildlife species are not able to escape habitat areas that are no longer suitable (Baranyi et al., 2011). Planning conserved areas to include strategic connections that allow for continued biological exchanges across large-scale landscapes can mitigate the effects of fragmentation.

Connected populations are less susceptible to local and regional extinction than isolated populations are (Penrod et al, 2012). Protecting these ecological connections have shown positive effects on biodiversity and the persistence of natural ecosystems (Saura and Pascual-Hortal, 2007). For example, connecting preserved areas with a preserved corridor can have significant beneficial effects on the ability of plant species to persist and even increase their range in areas that are bordered by hostile land uses such as urban development (Tewksbury et al., 2002). Populations that do not have the ability to move between suitable habitats become more susceptible to local extinctions; without connections to suitable habitat elsewhere, escape from or relocation following fire, flood, disease, and other adversities is not possible (Penrod et al., 2012).

In addition, a 2002 study by Tewksbury et al. found that select plant species within large-scale landscapes with corridors that connect protected habitat areas showed increased fruit and seed dispersal, which had positive effects on the species' gene flow and population dynamics. Preserving connectivity of habitats also has positive effects on gene flow in wildlife populations, allowing for natural range shifts due to changing or seasonal environmental conditions (Averill-Murray et al., 2013; Creech et al. 2004). The previously-mentioned 2002 study also identified that connecting the protected areas benefits terrestrial animals, birds, and flying insects as well, facilitating species and population movement and maintaining key inter-species mutualistic relationships (Tewksbury et al., 2002). Though the aforementioned study focused on smaller areas, the research team predicted that the effects of corridors would have even greater demographic and genetic benefits at larger scales, where movement among protected habitats becomes increasingly rare.

The Californian deserts are home to many sensitive plant and wildlife species that require particular attention to local populations in conservation planning. As previously discussed, preserving connectivity of habitats has positive effects in species persistence and abundance through encouraged gene flow in wildlife populations and by allowing for natural range shifts due to changing or seasonal environmental conditions. This is especially important in the context of desert ecosystems because populations of plant and wildlife species alike tend to be low-density and dispersed across a greater area.

Connectivity is also crucial for the continued existence of many sensitive and endangered species. For example, the desert tortoise—a threatened wildlife species—requires large corridors between conservation areas to move to suitable habitat, rather than a narrow band of linkages, due to their susceptibility to surrounding land uses (Averill-Murray et al., 2013). Corridors widths for the desert tortoise often must be substantially wider than even their home range diameter to provide a successful linkage between habitats when surrounded by human land uses (Averill-Murray et al., 2013). Wilderness provides shelter from many of the uses that have contributed to the decline of desert tortoise, including urban development, roads, and energy infrastructure construction. Therefore, connecting wilderness areas across the larger geographic landscape could have positive effects on this desert species' movement.

Connecting habitats is also an important concept in planning for the conservation of the desert bighorn sheep, as shown in the 2014 publication, "Using network theory to prioritize management in a desert bighorn sheep metapopulation" by Creech el al. The recommendations by the group centered on the fact that providing connected habitats are essential for desert bighorn sheep recolonization. Other sources support this claim, concluding that the lack of connectivity caused by urban development and highways in the California desert landscape have had long-term repercussions for the persistence, recolonization, and genetic diversity of the desert bighorn sheep (Campbell, 2001). Because the desert bighorn sheep's core habitat—where the species reside, forage, and breed—remains largely intact (e.g., desert mountainous areas, much of which is protected in some form) it is the surrounding areas that are of the most concern (Creech et al., 2014). The surrounding flat, desert habitat has been largely fragmented by highways, infrastructure, urbanization, and other intensive human uses, and populations of desert bighorn sheep are left isolated without connections between populations or new suitable habitat.

These connections are pertinent to populations' long-term survival should current habitat degrade or their populations become too small to persist. Protecting existing connected areas that allow the animals to disperse naturally is anticipated to have a positive effect on population persistence and genetic diversity of the desert bighorn sheep (Creech et al., 2014).

The Mohave ground squirrel is another threatened wildlife species of the California desert region, and populations are threatened by both landscape fragmentation and the increasing solar and wind energy infrastructure development in the region. One 2010 study by Bell and Matocq looked at the regional genetic connections between populations of Mohave ground squirrel throughout the state of California. The study found patterns in genetic distributions that indicate Mohave ground squirrels have historically migrated across landscapes, likely in response to climate shifts that change the availability of suitable habitat (Bell and Matocq, 2010). Connectivity in desert ecosystems has historically supported populations across generations by allowing the organisms to migrate to and from areas as habitat quality degrades and renews, often over extensive geographic landscapes. As such, preserving connectivity today is especially important for the persistence of species populations in a region that has been encroached upon by multiple human uses.

4.3 Species Movement and Climate Change

Climate change is projected to have large-scale effects on species population dynamics, including range shifts (generally northward) in entire populations of plant and wildlife species and in the abundance of species present in a given area (Burns et al., 2003; Araújo et al., 2004; Clinton et al., 2004). Some wildlife species have already shown significant changes in range distribution, likely in response to warming temperatures resulting from climate change (Burns et al., 2003). Desert habitats may be even more at risk. Warmer and dryer conditions are anticipated in some areas, such as in the southwestern deserts, leading to more severe droughts and consequential impacts on plant and wildlife communities (Clinton et al., 2004).

Specifically, a 2003 analysis conducted by Burns et al. concluded that if the current atmospheric carbon dioxide levels were to double, the majority of national parks would lose on average just over 8 percent of current mammalian species, with some parks losing up to 20 percent. The shift of current species out of protected areas is not the only potential impact that climate change will

bring to preserves; the shift of species not previously found in protected areas also poses a threat to these ecosystems. The entry of new species from elsewhere due to warming temperatures may change the existing interactions among species in protected areas, bringing in new competition for resources and new predator-prey relationships (Burns et al., 2003). In addition, plant and wildlife species are also expected to show significant shifts in the timing of breeding, flowering, and/or migration, generally occurring earlier as a result of the warmer temperatures attributed to climate change (Burns et al., 2003).

The 2003 analysis that predicted losses in mammalian species also found that parks with a heterogeneous mix of habitat types such as Yellowstone National Park (i.e., forests and alpine habitats) are more likely to retain the species currently found within their boundaries (Burns et al., 2003). Because the Californian desert habitats don't provide the same dense vegetation and concentration of different habitat types, desert species may be more dramatically affected by climate change. The southernmost parks studied in the 2003 analysis were projected to see the greatest loss of mammalian diversity, though none of these parks were in the California desert region.

Though the effects of climate change on ecosystems seems daunting, a 2004 European study projected that, based on climate change forecasts, 93 percent of the species included in its study would maintain some degree of overlap in their present and future range distributions. Where overlap in present and future species ranges exist, species are more likely to persist in the face of climate change. Providing connectivity of the current and future ranges, or ecosystems, allow for even greater possibility of species persistence. In addition, for species that do not have overlapping present and future distributions, extinction is more likely when present ecosystems are not connected. Therefore, persistence is only guaranteed if species are able to move between suitable habitats through preserved connections along their ranges (Araújo et al., 2004).

The uncertainty of species persistence, including the threat of species extinction, associated with climate change can be dealt with by ensuring protected areas provide both suitable habitat and connectivity to other protected areas with suitable habitat (Araújo et al., 2004). In addition, though many species' current habitats will shift to unsuitable or marginal habitat due to warming trends, new suitable habitat for sensitive species might emerge in what was previously unsuitable

or marginal habitat (Araújo et al., 2004). This would be yet another benefit of an extended connected wilderness system in the face of climate change as a connected system would allow species to move to new habitats to escape areas that are no longer adequate for survival.

Climate change may degrade certain existing habitats by inducing warmer and dryer conditions, decreasing the availability of suitable habitat for species already characterized by small population sizes and low dispersal rates (Clinton et al., 2004). For example, desert bighorn sheep populations have already noticed adverse effects of climate change. One 2004 study by Clinton et al. concluded that populations of desert bighorn sheep within lower elevations are more likely to become extinct as water sources dry out, and food sources become less available and lower in nutritional value. Not only are desert bighorn sheep susceptible to future climate change-induced population decline, but warming average temperatures have also already affected their distribution in California (Clinton et al., 2004).

While the Californian deserts are somewhat connected by a framework of preserved lands, ranging from national monuments to wilderness areas, the region is fragmented by roads, pockets of development, and energy infrastructure. Wilderness protections are the highest form of land preservation in the U.S.; however, wilderness areas themselves may not provide adequate long-term protection with regards to biodiversity if their boundaries are not drawn to consider the context of the larger geographic region or neighboring ecosystems. A better-connected preservation system—particularly those that are connected based on general species' ranges and ecosystem relationships—will provide for more resilient desert ecosystems in the face of climate change. Providing a more connected system of wilderness may be the best option in maintaining biodiversity and allowing for species persistence as human encroachment and renewable energy infrastructure continue to progress, and as climate change forces populations of plants and wildlife out of their historic ranges.

Wildlife connectivity in the California desert region has received recent attention through the DCRA, the previously discussed proposed California legislation that will, if passed, add new and extended wilderness areas. The DCRA states that the BLM must "establish policies and procedures to ensure the preservation of wildlife corridors and facilitate species migration likely to occur due to climate change" (DCRA, 2015). Though the bill includes the rights for various

transportation and energy rights-of-way within the new monument and other lesser protections, it does not specifically permit such rights-of-way in the wilderness it aims to designate. In addition, the DCRA's nod towards the need for ecological connectivity and action to provide wilderness persistence in the face of climate change is a substantial improvement in wilderness policy efforts.

5 – **APPLYING ECOLOGICAL CONNECTIVITY TO WILDERNESS**

"The future of our wild legacy is dependent upon the remaining natural areas being functionally connected as part of a large network of open space." –A Linkage Network for the California Deserts

A 2015 study identified all of the different ecosystem types in the U.S.—a total of 565 ecosystems—and quantified how many of these ecosystems were represented by designated wilderness (Dietz et al., 2015). The study concluded that the current NWPS does not offer a fair representation of the ecosystem types the U.S. has to offer. In fact, the study found that the NWPS under-represents the full ecosystem diversity found on federal lands as a whole (Dietz el al., 2015). Further, the ability of wilderness managers to retain and protect the ecosystems within their boundaries as climate change alters geographic distributions and behavior patterns is ambiguous (Burns et al., 2003). Within the California desert region, a significant amount of preserved lands exist, including NWPS lands. However, even the existing wilderness and other preserved lands, including the resources they support, may be irreparably damaged by the loss of connections between them (Penrod et al., 2012). Introducing and prioritizing a mandatory ecological component to the legal wilderness definition would allow the NWPS to better maintain its current species and protect its future biodiversity.

While conservation planners focused on biodiversity are using ecological connectivity concepts as a priority in their efforts, wilderness preservation planners are not. Guided by the Wilderness Act, wilderness agencies must instead prioritize the aesthetic definitions of naturalness during wilderness preservation planning. Biodiversity conservation and wilderness preservation are not mutually exclusive, but there are some important differences. Biodiversity conservation generally aims to preserve a heterogeneous mix of native plant and wildlife populations, justified by science and ecosystem services, while wilderness planning generally aims to preserve landscapes without human interference, justified by aesthetic interests (Sarkar, 1999). However, the wilderness Americans have come to appreciate cannot exist without the sustained conservation of the plant and wildlife populations within them. As such, the two concepts of biodiversity conservation and wilderness preservation can be combined into an integrated wilderness planning process that will better preserve wilderness as a whole. Thus, the following subsections offer recommendations for utilizing ecological connectivity in wilderness

preservation planning to better equip the wilderness agencies for the long-term preservation of the functioning ecosystems, biodiversity, and aesthetic and recreational value of the California desert region.

5.1 Recommendations for Wilderness Preservation

Wilderness areas, once designated, require little or no management intervention, are better able to naturally retain biodiversity, and are more resilient to the effects of climate change (Leroux and Rayfield, 2014). By further refining the wilderness review processes to prioritize biodiversity conservation concepts, such as ecological connectivity, the nation's strongest land preservation system can better withstand the threats of climate change and landscape fragmentation. Wilderness areas are less threatened by surrounding land use changes than any other types of protected areas; this may be largely due to the fact that most wilderness areas are surrounded by other public lands and are often located in mountainous terrain (Martinuzzi et al., 2015). While the NWPS has been a successful means to preserving the wild character of what is remaining of the country's undeveloped land, the identification and designation process is based on an aging statue. The Wilderness Act has not explicitly addressed ecological preservation, and there has been no substantive policy or goals to move the wilderness identification processes towards this objective.

Though other preservation systems and conservation efforts in the U.S. do prioritize ecological function, the NWPS is unique in that it is already well-established, including over 109 million acres, and—most importantly—provides a type of protection from human impacts that other protected areas may not (Wilderness Institute, et al., 2015). As such, the NWPS has perhaps the highest potential for long-term preservation success than any other conservation system. Like any law or planning process, the NWPS practices should be consistently reviewed and revised according to new and changing environmental concerns. As discussed in Section 4: Ecological Connectivity in Wilderness Preservation Planning, ecological connectivity provides many benefits to preserved ecosystems that aid in species persistence, including:

- Gene flow (due to an increased capacity for dispersal);
- Relocation from habitats that have been degraded my human uses or that have inadequate resources; and

- Connection of current and future ranges induced by climate change.

Prioritizing ecological connectivity while identifying new wilderness for inclusion in the NWPS would strengthen the ability of the ecosystems and species within them to persevere the ever-increasing effects of fragmentation and climate change, creating a more resilient NWPS.

Further wilderness conservation efforts should focus on preserving areas that add to the overall ecological connectivity of the NWPS as a whole. Because the NWPS is an existing system, though its implementation is complex and varied, connectivity concepts can be incorporated into the wilderness review processes that already exist. The following subsections offer specific recommendations as well as challenges and solutions to implementing ecological connectivity in wilderness planning.

5.1.1 Applying Ecological Connectivity to the Wilderness Definition

Lands managed by the BLM include approximately 20 percent of the rare and declining species present in the U.S. (Dickson et al., 2014). Within the California desert region, the BLM is the largest wilderness administer by acreage; for this reason, this section's recommendations focus on the BLM wilderness designation process. To exemplify the opportunities available to the BLM in California desert conservation, an overview of the BLM's land ownership in comparison with its land that has been designated as wilderness or identified as a WSA is provided in Figure 5: BLM Lands. Figure 6: California Desert Region Wilderness Areas provides the BLM wilderness and WSA areas in context of the greater NWPS in the California desert region. The BLM, like the other wilderness agencies, uses an agency-wide approach to identifying wilderness rather than regionally specific approaches. Under the FLPMA, the BLM identifies roadless land under its management as WSAs. WSAs are chosen based on the three mandatory Wilderness Act criteria:

- *Size*: the area is a roadless area of at least 5,000 acres or otherwise of a sufficient size
- *Naturalness*: the area has been primarily affected by natural forces and the man-made world is not present
- *Opportunities*: the area provides outstanding opportunities for solitude or primitive and unconfined types of recreation (BLM, 2015)

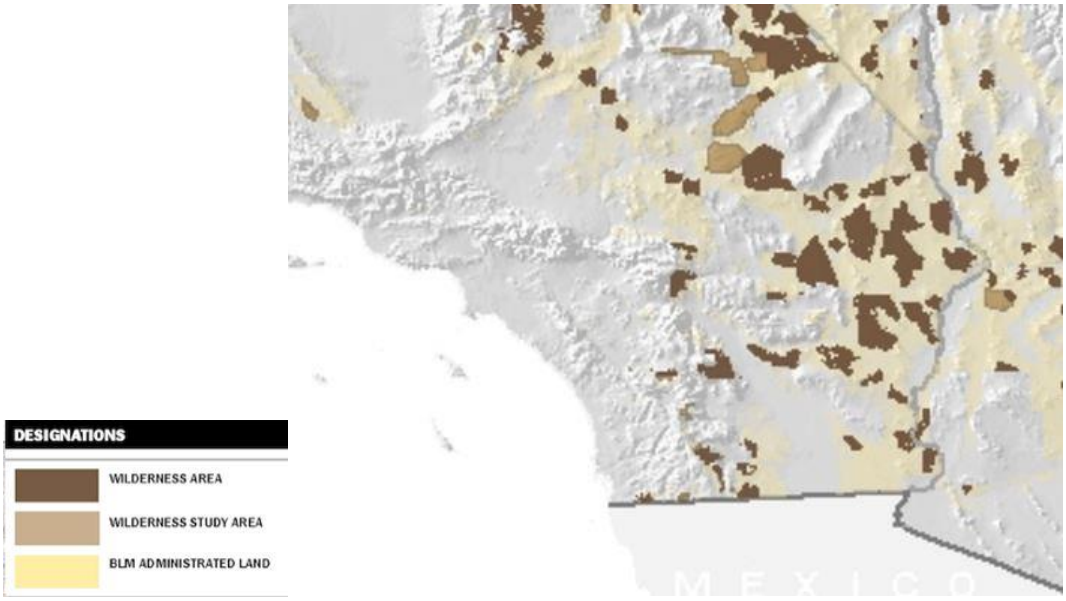


Figure 5: BLM Lands

Source: BLM, 2015

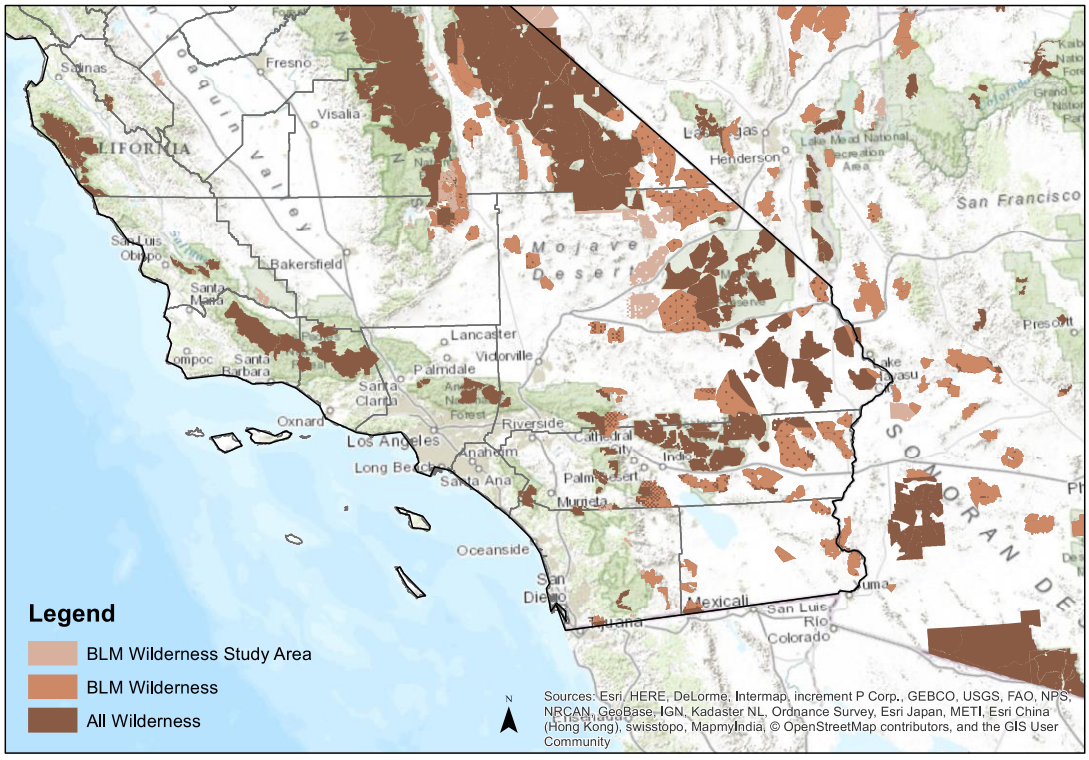


Figure 6: California Desert Region Wilderness Areas

Data Source: BLM, 2015; Map Source: Lauren Kahal

The fourth, optional criterion is that the land may provide another value, such as ecological, geological, cultural, or scenic value.

Based on the findings of this paper, it is recommended that the BLM exercise its authority to interpret the Wilderness Act slightly differently than the status quo to better provide for the persistence of plant communities and wildlife within the NWPS, particularly of that within the California desert region. The fourth, optional prong within the Wilderness Act specifically states ecological value as a potential value a wilderness may provide. Therefore, the following new wilderness designation criteria is recommended to be prioritized by the BLM as a mandatory value in identifying WSAs and eventually in designating wilderness:

- *Ecological connectivity*: the area contributes to an ecologically connected NWPS or otherwise promotes an ecological connection between habitats or future habitats that are key to the success of species throughout the region.

This new wilderness criterion would not supersede or replace any of the existing criteria. In fact, it's inclusion would promote an integrated conservation approach that aims to preserve land for a variety of resources, including those valued by wilderness recreationists (e.g., solitude, remote hiking, wildlife viewing) and those necessary for the long-term survival of species (e.g., genetic diversity, migration paths, connections to new habitat). Identifying ecological connections must be evaluated on a case-by-case basis and must consider the needs of regional plant and wildlife populations as well as the land uses of surrounding lands (including wilderness and preserve statuses). Planning wilderness boundaries that provide or add to connections that are essential to certain threatened and endangered species may be a priority to wilderness agencies, particularly to the USFWS. However, the BLM as a multiple-use agency has many other priorities to consider, even in wilderness planning. Thus, to stay true to the Wilderness Act, ecological connectivity alone cannot constitute the decision for drawing a wilderness boundary. A balance between the new ecological connectivity criterion and all three current mandatory criteria must be found.

Because the BLM is the largest land manager in the California desert region, the BLM has ample opportunity to add to the existing wilderness system of the region in an ecologically-minded manner. BLM Manual 6310—which provides guidance on wilderness characteristics for the

agency's wilderness planners—should be updated with the new criterion. As shown in Figure 5: BLM Lands, what is now a series of isolated wilderness areas could become a more connected system, as BLM non-wilderness lands exist where connections could be valuable. Updating Manual 6310 could shift the focus of the BLM's wilderness planning efforts towards identifying which federal lands would provide beneficial ecological connections to the NWPS within the region. While the BLM and its wilderness planning efforts are pertinent to the preservation of the California deserts, the wilderness planning process must be implemented by all four agencies to benefit the entire NWPS.

To promote the concept of ecological connectivity in wilderness across all managing agencies, a tactical advisory committee (TAC) could be formed. The TAC would include wilderness officials from each administering agency tasked with planning the implementation of the new mandatory criterion. Each agency may incorporate the ecological connectivity wilderness criterion differently, including how to prioritize it while identifying and studying potential wilderness. Therefore, a specific TAC among the agencies would help to align the agencies' wilderness designation processes and incorporate ecological connectivity in the planning phase. In addition, the wilderness agencies have a common training center—the Arthur Carhart National Wilderness Training Center—where wilderness planning is one of six core competency areas in the NWPS training program. The training center offers an appropriate platform for the TAC to coordinate among agencies and to educate wilderness planners in how to effectively roll out a newly defined wilderness criterion.

Once the new criterion is effective, studies to determine ecological corridors or linkages based on a particular set of species or region should be conducted where existing data and study gaps exist. Vital areas of ecological connectivity are typically areas of high wildlife movement or wildlife migration pathways, and should be selected on a site-by-site basis. This is necessary determine how best to draw wilderness boundaries with ecological connectivity as a priority. However, existing programs can be utilized as a tool for the process in the California desert region, as some past and current studies present important information regarding existing linkages throughout the region and for many key species within it. The following subsections introduce such existing sources that are valuable to wilderness and preservation planners.

5.1.2 Incorporating Existing Efforts

Existing efforts are underway to promote the use of ecological connectivity in preservation planning. The California Essential Habitat Connectivity Project (CEHCP) provides an analysis of connectivity throughout the state for use by conservation and transportation planners. The multiple public agencies and experts involved in the project have identified ecological connections in California that connect large and small landscapes that include some element of preservation (Spencer et al., 2010). Over 300,000 acres and 119,000 acres of essential connectivity areas were identified within the California Mojave and Sonoran Deserts, respectively, containing the largest size in essential connectivity throughout all California eco-regions (Spencer el al., 2010). These identified ecological connections are mainly located within BLM land managed for multiple uses; 45 percent of the identified ecological connections in California are located in protected land within the Mojave Desert and 15 percent are located within protected land in the Sonoran Desert (Spencer el al., 2010).

A more site-specific project that could assist with ecological connectivity in wilderness planning of the California desert region is the California Desert Connectivity Project (CDCP), which is similar to the CEHCP, but focused specifically on the California deserts. For the CDCP, linkages of key habitat connectivity were identified between blocks of high ecological integrity. Its primary goal is to identify areas where maintenance or restoration of ecological connectivity would be essential for conserving the unique desert ecosystems and wildlife in the California desert region (Penrod et al., 2012). The CDCP recognizes the need for better tools to truly conserve desert ecosystems in the face of human land use encroachment and fragmentation as well as climate change (Spencer el al., 2010).

Connection areas identified important linkages for multiple key species for today's conditions, as well as linkages that account for future climate change conditions, considering the shifts that will likely occur in habitats and species distributions. The CDCP identifies many connection areas within the California desert region for individual special-status species, as well as connection areas that combine many species' needs and connection areas that connect current habitat types with future habitat types per climate change forecasts. Ecological corridors for "umbrella" species can also be chosen; habitat connections identified for one key species will offer similar benefits to other species. For example, the CDCP looked at the desert tortoise, among other

species, and found that the desert tortoise is an umbrella species for other reptiles in the region, including coachwhip, glossy snake, desert horned lizard, western banded gecko, and leaf-nosed snake (Penrod et al., 2012).

The program identifies ecological connections for a range of benefits, all of which could be used by wilderness planners and could be tailored for a specific outcome. Particularly, connections for key sensitive and protected plant and wildlife species were identified within the California desert region, including the threatened and endangered wildlife species that were discussed earlier in this paper (i.e., desert bighorn sheep, desert tortoise, and Mohave ground squirrel). Twenty-two species in total were assigned their own "Linkage Planning Area"; these connections, or linkages, were chosen with the following goals:

- "*Provide more-through habitat for all focal species;*
- *Provide live-in habitat for species with dispersal distances too short to traverse linkage in one lifetime;*
- *Provide adequate area for a metapopulation of corridor-dwelling species to move through the landscape over multiple generations;*
- *Buffer against edge effects such as pets, lightening, noise, nest predation and parasitism, and invasive species;*
- *Allow animals and plants to expand their range to an adjacent wildland block through an individual linkage over relatively short time periods (1-2 decades);*
- *Allow species to shift their geographic range across hundreds of miles over several decades via the network of cores*[3] *and linkages*" (Penrod et al., 2012)

Because these goals are consistent with ecological connectivity, they provide an example of what could be incorporated into wilderness agencies' guidelines for identifying wilderness and in choosing their boundaries.

In addition, maps depicting the connectivity findings for the three previously discussed desert species and others can be found in the CDCP. Figure 7: Least-Cost, Multi-Species Connections provides a map from the project that synthesizes the least-cost corridors for each of the species in Linkage Planning Areas, identifying the ecological connections that would be provide the most far-reaching benefits. The connections cover over 2 million acres and contain diverse

[3] "Cores" refer to primary, or core, habitat areas for a species.

geographic, elevation, and vegetation areas (Penrod et al., 2012). Another map produced by the study, included here as Figure 8: Least-Cost Connections for Climate Change, incorporates land characteristics that would serve species under changing climate conditions. These "land facet" corridors provide connectivity of permanent land features that will interact with future climate conditions to support future habitats (e.g., sunny lowland flats or steep north-facing slopes) (Penrod et al., 2012).

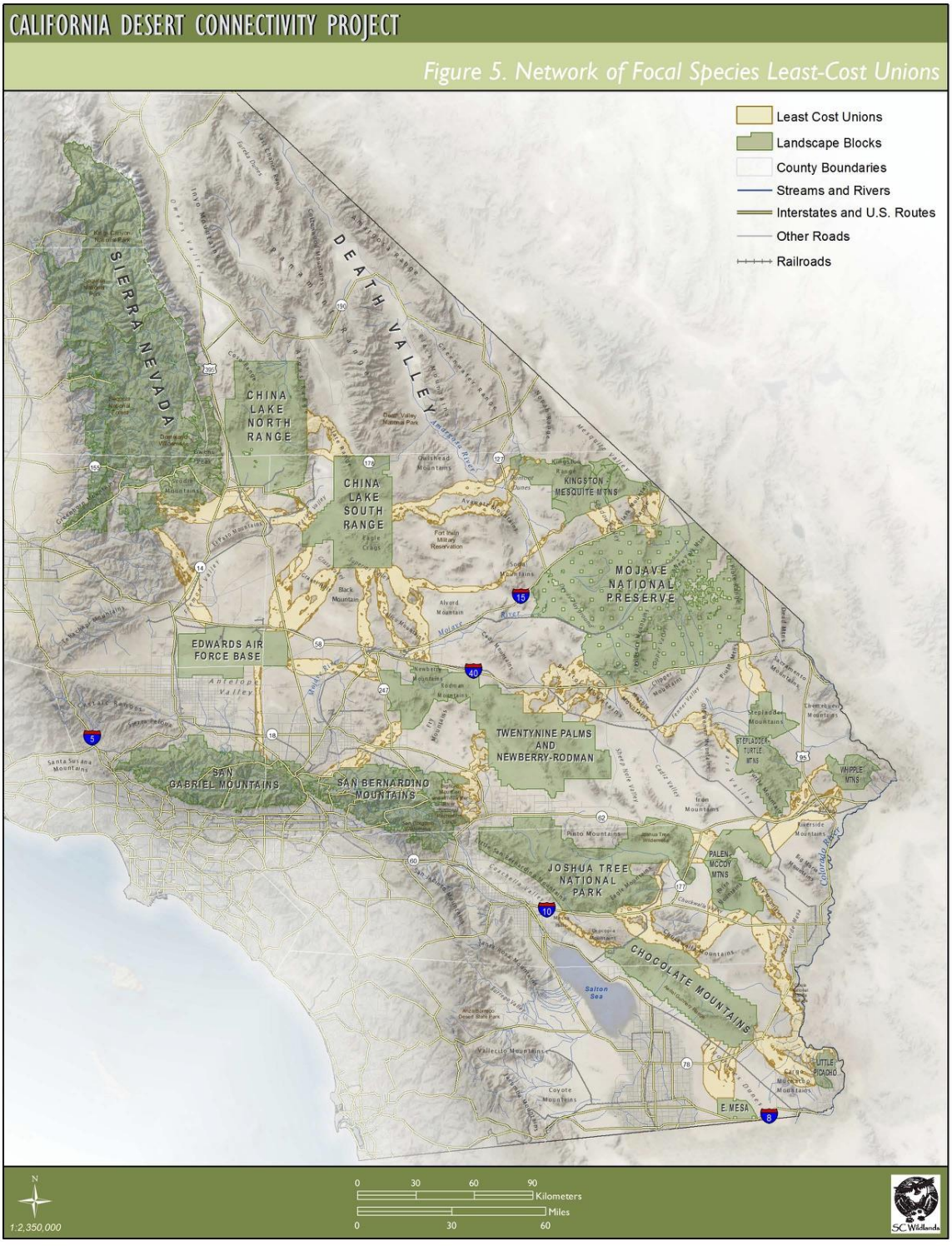


Figure 7: Least-Cost, Multi-Species Connections

Source: Penrod et al., 2012

Figure 8: Least-Cost Connections for Climate Change

Source: Penrod et al., 2012

With a few exclusions, the ecological connections identified in the CDCP are not yet riddled with many barriers such as developments, roads, water canals, and rail lines (Penrod et al., 2012). However, some existing barriers already inhibit wildlife movement within many of the identified linkages, meaning that future development could severely constrain wildlife movement and plant distributions between the connected blocks (Penrod el al., 2012). While the CDCP is a valuable tool for wilderness planners, new and planned development will have to be considered.

5.2 Challenges to Applying Ecological Connectivity to Wilderness Planning

The Wilderness Act states that wilderness "shall be administered for the use and enjoyment of the American people". As such, the NWPS was designed to ensure the protection of areas with aesthetic and recreational potential rather than areas with the most biodiversity potential (Glicksman, 2014). Therefore, the current language of the law and the historic interpretation of it by the administering agencies does not allow for ecological connectivity or other biodiversity conservation concepts to act as a driving criteria in wilderness planning. However, one can argue that the natural aesthetics of wilderness, along with the opportunities for solitude and primitive recreation, would not exist without natural living communities. For example, the aesthetics and solitude that wilderness provides are not only the result of awe-inspiring geography but also that of being among other living, wild organisms. Without the interaction of vegetation and wildlife with the natural landscape, wilderness would not continue to provide the type of recreation that the Wilderness Act was written for. Wilderness and ecological conservation must be treated as one in the same to better serve both the purposes of the Wilderness Act and those that it failed to address (e.g., ecological health).

A challenge in incorporating any sort of ecological-based planning tool in the wilderness identification process is that the Wilderness Act has been implemented for over 50 years. Each of the four administering agencies has drafted and re-drafted standards and procedures that are used to inventory and evaluate their lands for wilderness, according to the Wilderness Act but also in alignment with their overall goals and other governing statutes. An amendment to the Wilderness Act to include ecological connectivity in the wilderness definition would be a lengthy process, and competing interests might result in a failure. Therefore, it might be most effective for the individual agency's wilderness identification processes to place a higher importance on the fourth prong of wilderness characteristics: "may also contain ecological,

geological, or other features of scientific, educational, scenic, or historical value" (Wilderness Act, 1964). This "important value" is an option criterion both as defined in Wilderness Act and in the wilderness agencies' manuals and procedures for identifying wilderness. Agencies could revise their internal processes to utilize this optional criterion instead as a priority, directing ecological connectivity to be a desired condition that meets the "important value" goal.

In addition, not all conservation planners agree that ecological connectivity is essential for all life. Relying solely on identified corridors for particular habitat types may cause challenges as connectivity for certain species is often maintained in naturally irregular and changing landscapes (Vimal et al., 2012). Nonetheless, as previously discussed, ecological connections have been shown to positively affect species genetic diversity for many species of plants, insects, and animals; therefore, connections between habitats are vital to the sustainability of many sensitive species. Additionally, some have argued that ecological networks may not provide solutions to habitat fragmentation if the habitat patches being connected are too small to begin with (Vimal et al., 2012). This fact must be carefully considered in the planning phase and when drawing boundaries for preserved connections.

Another challenge to incorporating ecological connectivity in wilderness planning is the fact that many important ecological corridors have already been urbanized or degraded by human uses. Some argue that conservation should focus on finding methods to protect and promote biodiversity within the urban landscapes that surround and traverse conserved lands, rather than attempting to find connections to designate as preserved land (Vimal et al., 2012). Solutions could involve incorporating ecological protections within land use policy rather than focusing efforts on extending preserves. Nonetheless, this idea still acknowledges the importance of ecological connectivity in conservation planning, going a step farther than including it in preserve boundary planning. Perhaps focusing on the ecological connectivity concept in preservation planning would reinforce the perceived black and white distinction between the human world and nature, which is an unwanted effect (Vimal et al., 2012). Going beyond the boundaries of protected areas to include ecological links in the planning of urban and preserve settings alike could both further the conservation of biodiversity and promote society to view the human world and nature as one congruous concept (Vimal et al., 2012).

5.3 Additional Desert Conservation Efforts

Many desert conservation-planning efforts are underway, including the California Desert Conservation Area Plan, Desert Tortoise Recovery Plan, and Mojave Plans, as well as the previously discussed CDCP, and DRECP. These plans and programs include their own desert conservation strategies, which may or may not straightforwardly align with future efforts by wilderness planners. In addition, not all utilize ecological connectivity as a primary conservation goal. However, each of the wilderness agencies has been involved in some form in many desert conservation and/or restoration efforts within California, and efforts do not necessarily have to be disconnected. In particular, DRECP, a program to plan for California's renewable energy needs, focuses on conserving the California desert region's unique biodiversity. The DRECP excludes wilderness WSAs from land use authorization permits for renewable energy development. Though this is not necessarily above-and-beyond, as NWPS lands are intrinsically protected from such development permits under the Wilderness Act, it is still an important nod towards wilderness preservation in a statewide renewable energy planning document.

The DRECP presents a conservation strategy that aims to add between 1.6 and 5.3 million acres of BLM lands to the National Landscape Conservation System while protecting 2.7 to 3.6 million more acres of BLM lands (California Energy Commission et al., 2014). While this is not necessarily a challenge to wilderness planning, it does not designate any new wilderness. However, it could provide ecological connectivity benefits to the NWPS by offering some form of protections to additional lands that are adjacent or connect to wilderness. It also provides protection of additional land that may in the future be up for inclusion as wilderness by the BLM. In addition, as part of the DRECP planning efforts, BLM non-wilderness lands with wilderness characteristics that could be affected by the renewable energy or other development facilitated by the DRECP were inventoried in 2012 and 2014 through BLM Manual 6310.

According to the DRECP, the preferred alternative would implement management plans to protect almost 300,000 acres of lands with wilderness characteristics. This number is quite small in comparison to the total federal lands included in the DRECP planning area, as the BLM administers a total of approximately 9.9 million acres of lands covered by the DRECP (California Energy Commission et al., 2014). Nonetheless, efforts by the BLM and other agencies to conserve natural resources within the California desert region while facilitating

renewable energy development does not contradict this paper's recommendations. Utilizing ecological connectivity concepts in wilderness planning to further the BLM's evaluation of WSAs and identification of new wilderness can be implemented congruently, becoming part of an interdisciplinary effort to conserve the region using various protection statuses and conservation policies.

6 – **CONCLUSION AND RECOMMENDATIONS**

More than one-quarter of the land in the U.S. is federally owned, and great opportunities to maintain and protect biodiversity exist in the federal lands of the western U.S. (Dickson et al., 2014). However, only 12 percent of the nation's land area is managed primarily for biodiversity conservation – well below what is needed to ensure regional biodiversity throughout the U.S. (Dickson et al., 2014). The NWPS, a mature yet growing preservation system with the highest level of protection offered in the U.S., may better account for this need by incorporating concepts that maintain ecological connections. In the 50 years since the Wilderness Act was enacted, the U.S. has seen an unprecedented level of fragmentation of its natural landscapes (Vimal et al., 2012). In particular, ecological function and biodiversity within the California desert region has been increasingly strained as a result of expanding urban uses, agriculture, and energy and transportation development.

To ensure the persistence of plant and wildlife species within the California desert region, existing preservation systems should be augmented. The NWPS already offers the nation's highest land preservation status, providing protections from extractive land uses and allowing for natural processes to exist without human intervention. Natural watersheds, airsheds, and critical habitat are among the many benefits wilderness provides. The NWPS, a half-century-old system, can be augmented to further support biodiversity conservation in the California desert region in the face of ever-increasing urban encroachment and climate change. The push renewable energy infrastructure development in the California desert region also calls for additional efforts in wilderness planning to ensure both conservation and renewable energy goals can be met.

The presence of ecological connectivity within preserved habitats has positive effects on species' genetic diversity, distribution/dispersal, and population persistence. In addition, ecological connections among the NWPS will allow for the long-term persistence of species as climate change alters the availability and geographic location of suitable habitat. Threatened and endangered species such as the desert bighorn sheep, desert tortoise, and Mohave ground squirrel have suffered population decline largely due to increasingly fragmented habitats and the resulting isolation. By integrating ecological connectivity into the wilderness identification process, the NWPS would be better positioned to continue to protect its resources for years to

come. Each of the wilderness agencies must evaluate potential wilderness areas, including where the boundaries of new wilderness areas are drawn. Particularly, if included in the BLM's wilderness definition and wilderness identification process, the NWPS would become an important tool in preserving biodiversity and ecosystem function of the California desert region.

To incorporate ecological connectivity into the planning process for new wilderness areas, the agencies would have to include the concept in their definitions of wilderness and while drawing of wilderness boundaries. New legislation to introduce a general, non-specific ecological connectivity requirement in wilderness planning could be written in a similar, general fashion as the Wilderness Act itself was, thus allowing for a broad interpretation by the agencies. While general language written in law can lead to differences in implementation, it would allow the wilderness agencies to continue to interpret legal wilderness planning on a case-by-case basis. It would also allow for site-specific evaluations to be made, permitting each agency to determine the best methods according to the region.

The BLM is the largest federal land manager in the California desert region; therefore, the BLM has ample opportunity to expand the wilderness system in the region with ecological goals in mind. The BLM's Manual 6310 should be updated to include the new ecological connectivity wilderness eligibility criterion. This would allow for the use of the concept in the BLM's wilderness planning processes without requiring additional legislation. Nonetheless, a TAC—as previously discussed—comprised of representatives from each wilderness agency would assist in streamlining the updated wilderness planning processes, allowing for the NWPS to be strengthened as a whole. New wilderness boundaries can incorporate ecological connections found to benefit areas of high species migration and gene flow, riparian or stream corridors, and other site-specific biological or physical traits (Spencer et al., 2010). Existing efforts such as the CDCP may be utilized by wilderness agencies in the California desert region, saving the resources required to conduct similar connection studies internally.

On a closing note, the California deserts are home to some of the most unique plant and wildlife species found in the nation, all of which play invaluable roles in the quiet yet complex desert ecosystems. Though many private and public land conservation statuses exist in the region, the NWPS—a well-established preserve system with stringent protections at the federal level—is

most poised to sustain species found in the California deserts for decades and centuries to come. To better prepare for this, wilderness planning must incorporate ecological connectivity concepts in order to provide an integrated approach to wilderness that is in line with both the 1964 Act's "human enjoyment" values and the needs for the long-term survival of desert species.

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