NEVADA TEST AND TRAINING RANGE (NTTR)

Land Withdrawal Application Packages/
Case File and Legislative EIS

SPECIAL STATUS SPECIES HABITAT RANGE MODEL FOR THE NEVADA TEST AND TRAINING RANGE AND PROPOSED EXPANSION ALTERNATIVES

FINAL
November 2017

SPECIAL STATUS SPECIES HABITAT RANGE MODEL FOR THE NEVADA TEST AND TRAINING RANGE AND PROPOSED EXPANSION ALTERNATIVES
Final Report

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Acronyms and Abbreviations

BLM	Bureau of Land Management
CAFB	Creech Air Force Base
DEM	Digital Elevation Map
DNWR	Desert National Wildlife Range
DoD	U.S. Department of Defense
DOI	U.S. Department of the Interior
EIS	Environmental Impact Statement
GIS	Geographic Information Systems
LEIS	Legislative Environmental Impact Statement
MSL	Mean Sea Level
MLWA	Military Land Withdrawal Act
NAFB	Nellis Air Force Base
NDOW	Nevada Department of Wildlife
NEPA	National Environmental Policy Act
NNHP	Nevada Natural Heritage Program
NNRP	Nellis Natural Resources Program
NNSS	Nevada National Security Site
NRCS	Natural Resources Conservation Service
NTTR	Nevada Test and Training Range
STATSGO2	U.S. General Soil Map
USAF	United States Air Force
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Introduction

The U.S. Air Force (USAF) is in the process of extending the withdrawal of land for military operations and training on the Nevada Test and Training Range (NTTR). In addition to extending the current withdrawal, the USAF is evaluating three proposed expansion alternatives. The current withdrawal will expire on November 6, 2021, unless Congress enacts legislation to extend it. In accordance with Section 3016 of the Military Land Withdrawal Act (MLWA), the USAF, in coordination with the Department of Defense (DoD), has notified Congress of a continuing military need for the NTTR withdrawal. Furthermore, the USAF plans to submit a Legislative Environmental Impact Statement (LEIS) that supports a legislative proposal through the Department of the Interior (DOI) to extend the withdrawal and provide recommendations for proposed expansion alternatives as analyzed in the LEIS. The National Environmental Policy Act of 1969, United States Code [USC] Sections 18 4321-4370h (NEPA) requires agencies to include an environmental impact statement (EIS) with any proposal for legislation that may significantly affect the quality of the human environment. The land withdrawal renewal includes actions that present potential impacts to species of plants and animals that are currently listed by state and federal agencies. Because of the significant size of the study area (3,221,980 acres), comprehensive surveys for these special status species are not a realistic option for determining their presence on the study area. Therefore, a programmatic approach by using Geographic Information Systems (GIS) models to determine areas that could potentially support species populations is used for this purpose.

Two models were used to determine the potential presence of species on the study area. The Habitat Suitability Model is a model that uses environmental parameters documented in the literature to predict where the species may occur within the boundary of the study area and follows the same principles used by the U.S. Fish and Wildlife Service (USFWS) for determining habitat suitability of wildlife species (Schamberger, Farmer, & Terrell, 1982). The advantage of this model is that, unlike probabilistic models, it does not depend on the presence of sufficient observation points within the study area to map potential habitat. Therefore, this model could be used for all species with sufficient information on their habitat preferences. The second model that was used for this report was Maxent, a probabilistic model commonly used for species habitat mapping. Because sufficient observation points were not always available for species covered by this report, Maxent could only be run on nine of the species. The accuracy of both of the models is dependent on the accuracy of the GIS layers used for the models. In the pages that follow, the results of these habitat models are discussed for each species.

Description of the Study Area

The study area for this report includes NTTR and potential expansion areas designated as Alternatives 3A, 3B, and 3C. NTTR consists of 2,949,603 acres, in rural portions of Nye, Lincoln, and Clark Counties, Nevada (Figure 1). The potential expansion areas are shown in Figure 1 and consist of about 302,000 acres. Alternative 3A is 18,000 acres lying along the southwest boundary of the North Range of NTTR. Alternative 3B is 57,000 acres located immediately south of the South Range of NTTR. Alternative 3C is 227,000 acres immediately east of the South Range of NTTR in the Desert National Wildlife Refuge (DNWR). Geology varies from limestone/dolomite in the south to volcanic fields in the north. The South Range Study Area lies in the eastern Mojave Desert and the North Range Study Area lies in the southern Great Basin (Figure 2).

Natural water sources are scarce across most of the NTTR Study Area. Annual precipitation varies from 3 to 5 inches in the basins, and up to 16 inches in the upper mountain elevations. Vegetation composition is strongly influenced by the amount of precipitation. Most seeps and springs are found in the North Range Study Area, especially in the Kawich, Belted, and Cactus ranges, and Stonewall Mountain. Only five natural springs are presently known in the South Range Study Area, but artificial water developments (guzzlers) have been constructed to provide wildlife with additional sources of water. Guzzlers collect meteoric water from storm events, store it in water tanks, and dispense water at troughs or drinkers.

The South Range Study Area is typical of the Mojave Desert. Except for the higher elevations, most of the mountains are covered by scattered populations of various desert brush and cactus species. Typical physiography of the area consists of mountain ranges which drain into bajadas (collections of alluvial fans) which eventually drain into playas. Most of these areas are considered basins which are self-contained and do not drain into any of the major rivers in the area. Playas tend to have little or no vegetation while bajadas are often dominated by creosotebush (*Larrea tridentata*) and bursage (*Ambrosia dumosa*) in the lower bajadas and blackbrush (*Coleogyne ramosissima*) and Joshua tree (*Yucca brevifolia*) in the upper bajadas. Mountain ranges support scattered populations of bitterbrush (*Purshia* spp.), matchweed

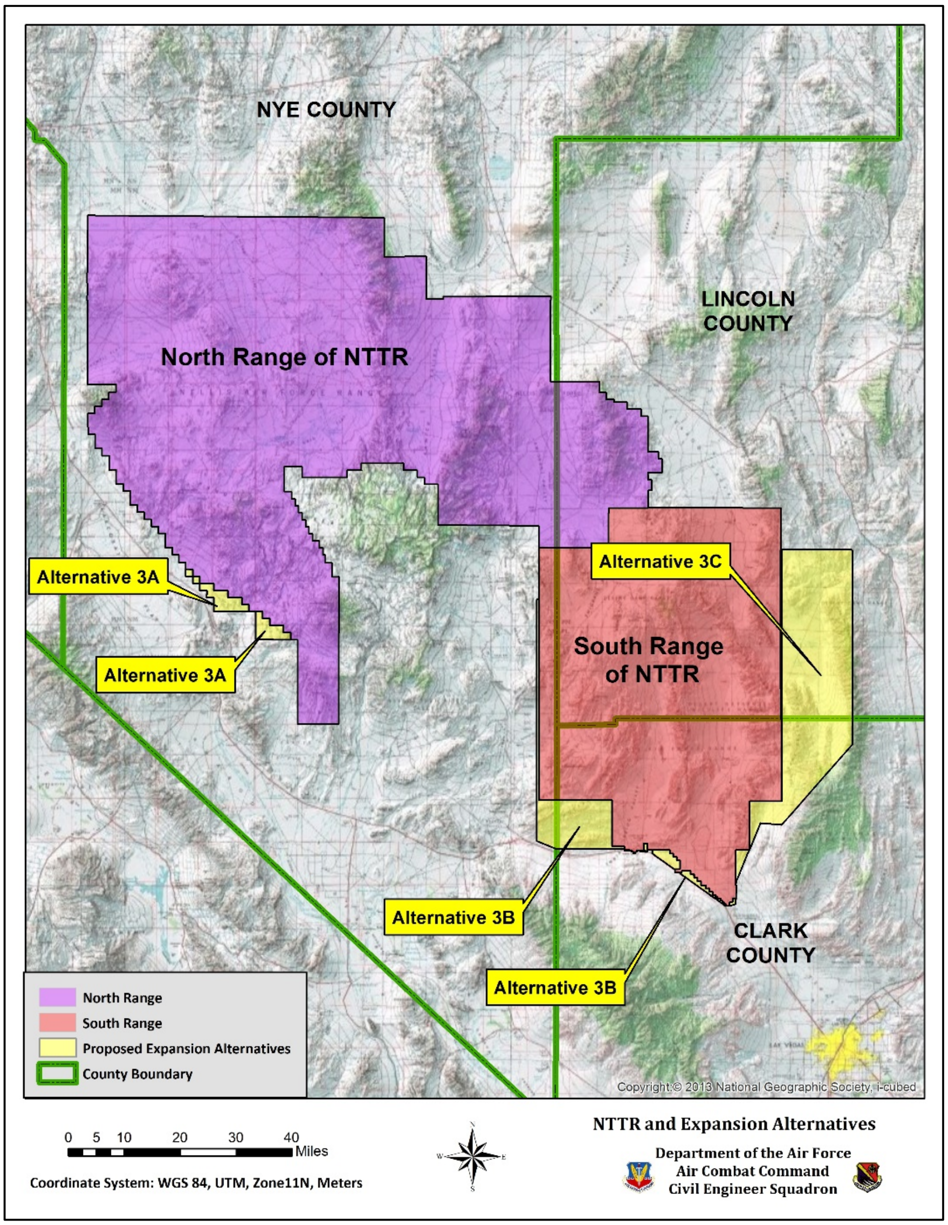


Figure 1. Location of the North and South Ranges of NTTR as well as Alternatives 3A, 3B, and 3C.

(*Gutierrezia* spp.), and shadscale saltbush (*Atriplex confertifolia*). At higher elevations, plant communities may be dominated by Utah juniper (*Juniperus osteosperma*) and pinyon pine (*Pinus monophylla*).

The North Range Study Area is typical of the southern portions of the Great Basin Desert. Again, the physiography of the area is comprised of mountains and closed basins, similar to the South Range Study Area. However, rainfall is slightly higher in the North Range Study Area resulting in denser plant communities. Similar to the South Range Study Area, the North Range Study Area playas tend to have little or no vegetation. From the boundaries of the playas to the base of mountains, plant communities are typically dominated by greasewood (*Sarcobatus* spp.), bud sagebrush (*Picrothamnus desertorum*), and shadscale saltbush in lower elevations and sagebrush (*Artemisia* spp.) in higher elevations. The uppermost elevations in the mountains are dominated by Utah juniper and pinyon pine.

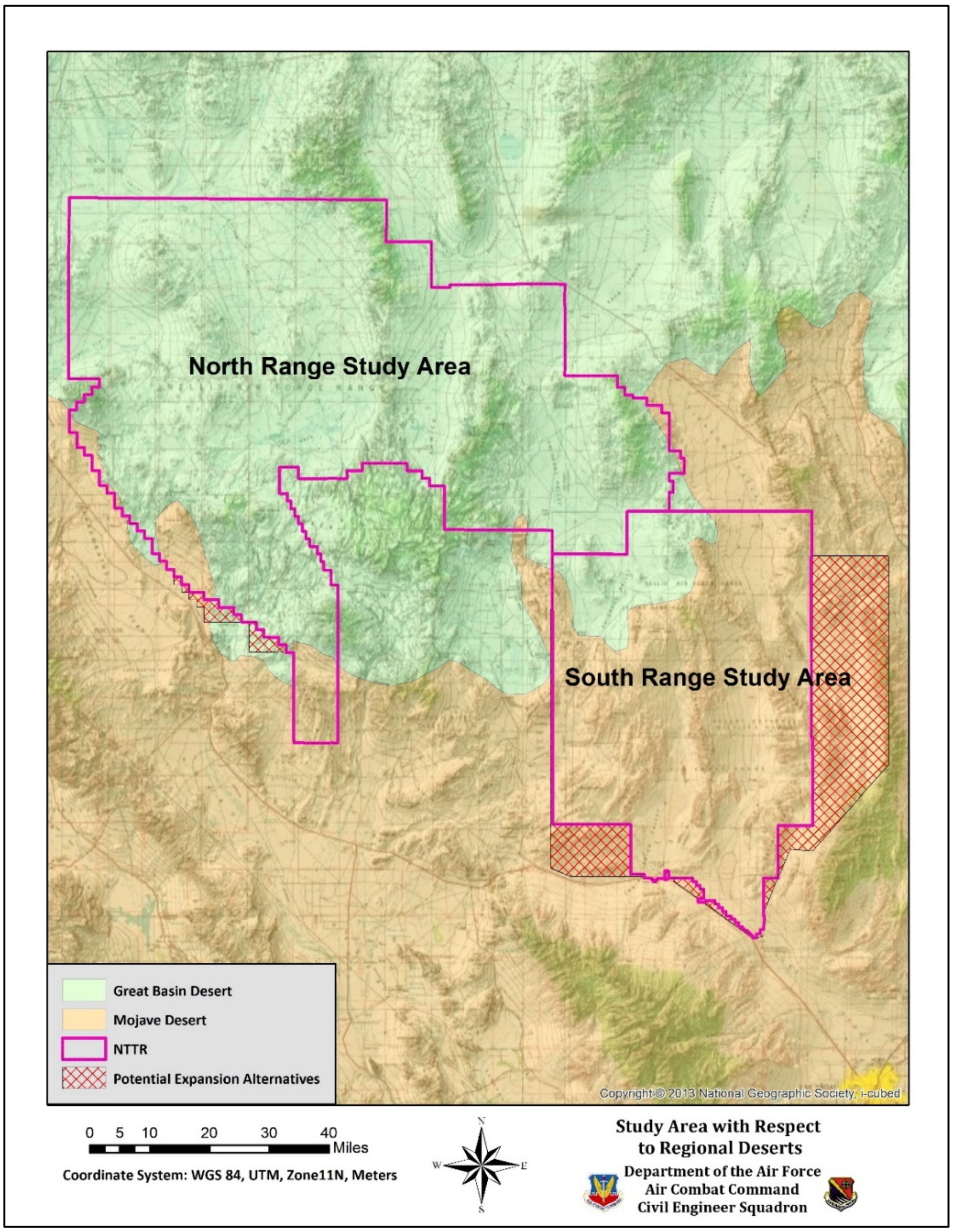


Figure 2. Location of the study area with respect to the Great Basin Desert and the Mojave Desert.

Methodology

For the purposes of this report, a list of special status species was initially developed using a database search of the study area for documented observations of special status species (plants, animals, insects, gastropods, and bryophytes) prepared by the Nevada Natural Heritage Program (NNHP) (Nevada Natural Heritage Program, 2016). The list of species was subjected to a thorough review by cooperating agencies including Nevada Department of Wildlife (NDOW), USFWS, U.S. Geological Survey (USGS), and the Bureau of Land Management (BLM). During the review process, species were selected for being modeled based on the consensus of the agencies. The placement of a selected species was determined by the agencies and was usually based on the regulatory status of the species and potential for the species to be found on the study area. The USFWS assisted in finalizing the list. The list of species to be modeled included those species that have been granted some level of status on state or federal endangered and threatened species lists or were of special interest to cooperating agencies (Table 1). The list includes two amphibians, two reptiles, five birds, ten mammals, one gastropod, one bryophyte, four arthropods, and nineteen plants. All species and their potential habitat range on the study area as determined by the models will be discussed in the results section of this report.

Table 1. List of special status species selected for habitat range modeling.

SCIENTIFIC NAME	COMMON NAME	STATE RANKING	GLOBAL RANKING	USWFS	NEVADA STATUS	BLM STATUS
GASTROPODS						
Pyrgulopsis fausta	Corn Creek Pyrg	S1	G1	None	None	None
ARTHROPODS						
Miloderes sp. 1	Big Dune Miloderes Weevil	S1	G1	None	None	S
Neivamyrmex nyensis	Endemic Ant	S1	G1?	None	None	None
Pseudocotalpa giulianii	Giuliani's Dune Scarab	S1	G1	None	None	S
Aegialia magnifica	Large Aegialian Scarab	S1	G1	None	None	S
AMPHIBIANS						
Anaxyrus nelson	Amargosa Toad	S2	G2	None	PA	S
Lithobates pipiens	Northern Leopard Frog	S2S3	G5	None	PA	S
REPTILES						
Gopherus agassizii	Mojave Desert Tortoise	S2S3	G3	LT	TR	S
Heloderma suspectum cinctum	Banded Gila Monster	S2	G4T4	None	PR	S
BIRDS						
Accipiter gentilis	Northern Goshawk	S2	G5	None	PB	S
Centrocercus urophasianus	Greater Sage-Grouse	S3	G3G4	C	PB	S
Lanius ludovicianus	Loggerhead Shrike	G4	S4	None	SB	S
Spizella breweri	Brewers Sparrow	G5	S4B	None	SB	S
Toxostoma bendirei	Bendire's Thrasher	S1	G4G5	None	None	S
MAMMALS						
Antrozous pallidus	Pallid Bat	S3	G5	None	PM	S
Brachylagus idahoensis	Pygmy Rabbit	S3	G4	None	None	S
Chaetodipus penicillatus	Desert Pocket Mouse	S1S2	G5	None	None	None
Corynorhinus townsendii	Townsend's Big-eared Bat	S2	G3G4	None	SM	S
Microdipodops megacephalus	Dark Kangaroo Mouse	S2	G4T2	None	PM	S

SCIENTIFIC NAME	COMMON NAME	STATE RANKING	GLOBAL RANKING	USWFS	NEVADA STATUS	BLM STATUS
Microdipodops pallidus	Pale Kangaroo Mouse	S2	G3	None	PM	S
Microtus montanus fucosus	Pahranagat Valley Montane Vole	S1S2	G5T2	None	None	None
Myotis thysanodes	Fringed Myotis	S2	G4	None	PM	S
Tadarida brasiliensis	Mexican Free-tailed Bat	S3S4B	G5	None	PM	S
Euderma maculatum	Spotted Bat	S2	G4	None	TM	S
BRYOPHYTES						
Entosthodon planoconvexus	Planoconvex Cordmoss	S1	G1	None	None	None
PLANTS						
Arctomecon californica	Las Vegas Bearpoppy	S3	G3	None	CE	S
Astragalus geyeri var. triquetrus	Threecorner Milkvetch	S2S3	G4T2T3	None	CE	S
Astragalus gilmanii	Gilman Milkvetch	S1	G2	None	None	S
Astragalus inyoensis	Inyo Milkvetch	S1	G3	None	None	None
Chrysothamnus eremobius	PIntwater Rabbitbrush	S1	G1	None	None	None
Cryptantha insolita	Las Vegas Catseye	SH	GHQ	None	CE	None
Echinocereus engelmannii var. ar-matus	Armored Hedgehog Cactus	S1?	G5T2?Q	None	CY	None
Eriogonum corymbosum var. nilesii	Las Vegas Buckwheat	S1S2	G5T2	C	None	S
Eriogonum mensicola	Pinyon Mesa Buckwheat	S1	G2G3	None	None	None
Escobaria vivipara var. rosea	Clokey Pincushion	S3	G5T3	None	CY	None
Galium hilendiae ssp. King-stonense	Kingston Mountains Bedstraw	S1	G4T2	None	None	None
Grindelia fraxinopratensis	Ash Meadows Gumplant	S2	G2	LT	CE	S
Ivesia arizonica var. saxosa	Rock Purpusia	S1	G3T1	None	None	S
Mentzelia leucophylla	Ash Meadows Blazingstar	S1	G1Q	LT	CE	S
Penstemon albomarginatus	White Margined Beardtongue	S2	G2	None	CE?	S
Penstemon pudicus	Bashful Beardtongue	S1	G1	None	None	S
Piptatherum shoshoneanum	Cliff Needlegrass	S1	G2G3	None	None	None
Polyctenium williamsiae	Williams Combleaf	S2	G2Q	None	CE	S
Sclerocactus polyancistrus	Hermit Cactus	S2S3	G4	None	CY	None

USFWS Status:

LT - Listed Threatened – likely to be classified as Endangered in the foreseeable future if threats continue.
C - Candidate for listing as Threatened or Endangered

BLM Status:

S - Nevada Special Status Species, USFWS listed, proposed, candidate species or otherwise protected by Nevada state law

State of Nevada Status:

CE - Critically Endangered Plant
CY - Protected as a cactus, yucca, or Christmas tree
PA - Protected Amphibian (NAC 503.075.2)
PR - Protected Reptile (NAC 503.080.1)
TR - Threatened Reptile (NAC 503.080.2)
SB - Sensitive Birds (NAC 503.050.3)
PM - Protected Mammal (NAC 503.030.1)
SM - Sensitive Mammal (NAC 503.030.3)
TM - Threatened Mammal (NAC 503.030.2)

Global Rank or State Rank:

G - Global rank indicator, based on worldwide distribution at the species level
T - Global trinomial rank indicator, based on worldwide distribution at the intraspecific level
S - State rank indicator, based on distribution within Nevada at the lowest taxonomic level
H - Possibly Extinct — Known from only historical occurrences but still some hope of rediscovery

1 - Critically imperiled and especially vulnerable to extinction or extirpation due to extreme rarity threats, or other factors
2 - Imperiled due to rarity or other demonstrable factors
3 - Vulnerable to decline because rare and local throughout range, or with very restricted range
4 - Long term concern, though now apparently secure; usually rare in parts of its range, especially at its periphery.
5 - Secure – At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
Q - Taxonomic status uncertain

Background information was reviewed for each species to identify documents or reports containing information on environmental factors preferred by the species or that limit or restrict the habitat range of the species. Sources of information included web sites, books, regulatory agency reports, journal articles, and project reports with an emphasis on southern Nevada, the Great Basin Desert, the Mojave Desert, DNWR, and the NTTR. Because these are rare, endangered, and threatened species, baseline information on habitat preferences is still being collected and may not be well understood. Additionally, modeling efforts are limited by the accuracy of GIS layers, many of which are in their infancy of development. As more surveys are conducted for each of these species, more will be understood about habitat preferences. Continued surveys to characterize the natural environment in GIS layers that are high resolution and accurate will provide excellent models to assist with the protection and conservation of these species.

The information gathered for each species was used to develop parameters for the models to predict potential habitat ranges for each species. Because all species modeled for this report are special status species on federal or state lists, research and documentation of their habitat preferences may be scarce or incomplete. In fact, some of the species have not been observed in or around the study area in the last 20 – 40 years, mostly due to the lack of species specific surveys being conducted. Without modeling habitat preferences to restrict survey areas for each species, comprehensive surveys would be impractical for areas as large as the study area. This report documents the results of GIS models of habitat ranges prepared for each of these species based on their documented habitat preferences. This report is prepared to support a programmatic analysis for the LEIS. Habitat ranges modeled by this report are to be used for natural resources management and delineation of areas of concern within the study area. Results will assist planners in locating sites for facilities and activities that pose minimal impacts to special status species. Models will allow judicious conservation of those species by proper management including proper, comprehensive surveying for species' presence in impacted areas and, if required, impose proper mitigation to avoid or minimize impacts. The habitat ranges modeled for this report are not intended to depict exact locations of each species, but only show where each species may potentially be present within the study area. Surveys and mitigation options will be implemented if actions occur within the modeled habitat range of each species. Management options for conservation of these species are not the focus of this report, but will be thoroughly reviewed and discussed in the Nellis Air Force Base (NAFB) Integrated Natural Resources Management Plan and the LEIS for NTTR and the expansion alternatives.

Two different models were run for this report. The first model is a Habitat Suitability Model. The Habitat Suitability Model was run on most of the species listed in Table 1 except for the following species that lacked sufficient habitat information to allow for modelling or have populations isolated to a specific area:

- Pahranagat Valley Montane Vole (*Microtus montanus fucosus*)
- Large Aegialian Scarab Beetle (*Aegialia magnifica*)
- Big Dune Miloderes Weevil (*Miloderes* spp.)
- Giuliani's Dune Scarab (*Pseudocotalpa giulianii*)
- Army Ant (*Neivamyrmex nyensis*)

Desert tortoise is not being included in this report because it will be thoroughly reviewed and modeled separately in the Biological Assessment being prepared for the withdrawn land.

Habitat suitability models typically use existing information of a species ecology and habitat requirements to predict habitat potential (Jackson & Ahibom, 1984). The USFWS used this approach to identify quantitative relationships between key environmental variables and habitat suitability of rare species potentially impacted by human activities (Schamberger, Farmer, & Terrell, 1982). These models "can be seen as operational applications of the ecological niche, using environmental variables to predict the presence/absence or the abundance of a species throughout a study area" (Hirzel & Le Lay, 2008). The Habitat Suitability Model is an excellent tool because it uses known information for determining the habitat range of a species. It is not dependent on having observations of the species in the vicinity of the project or study area. The number of available observation points has no bearing on the results of this model. The weakness of the Habitat Suitability Model is that it is dependent on adequate and accurate information that has been gathered for the species. Information on habitat preferences of rare species is often minimal and inadequate for reliable modeling. Like all models, accuracy is also dependent on the quality of the GIS layers used in the model. For the study area, many of the GIS layers are low resolution, which can negatively affect the accuracy of the model. However, unlike probabilistic models, this model can run with mixed resolutions for different layers and can use a mixture of raster files and vector files. Thus, the model is extremely flexible, but results should be cautiously used for identifying areas where there is potential for species to be present. As such, the models are based on data that may be subject to change in the future as more data is collected and baseline layers used in the analyses are improved. For example, one of the layers used for the analysis is plant communities, a map that is based on the current database for plant alliances for NTTR. The vegetation community map is constantly being updated and changed as more data is collected.

The second model used was Maxent, a probabilistic model (Phillips, Anderson, & Schapire, 2006). This model must have a sufficient number of observation points to run accurately. The model runs on the assumption that the species observation was made where the species prefers to inhabit. With sufficient numbers of observations, this model can provide good information and buffer outlier points that may have been an arbitrary location of the species and not preferred habitat. This is especially a problem for mobile species that may be observed in transit between preferred habitat. Research has indicated that performance of models, such as Maxent, decreases as sample size decreases (Wisz, et al., 2008). Wisz et al. (2008) tested the effect of sample size on twelve different model programs including Maxent and found that "with decreasing sample size, model accuracy decreased and variability increased." None of the models tested predicted consistently well with small sample size (less than 30 samples) (Wisz, et al., 2008). This is accentuated by the fact that the impact of outlier points have greater influence on model results with small sample sizes. Maxent was considered one of the best performers in a test of models for small sample sizes (10 to 30), but the authors suggested that the results be used with caution (Wisz, et al., 2008). Based on this information, it was decided that Maxent would not be run for species having less than ten observation points on the study area. More observations points than ten is preferred, but is often not the case for rare species. Conservative use of predictions based on small sample sizes was encouraged (Wisz, et al., 2008).

Other weaknesses of Maxent include the fact that all observation points must be located within the area covered by available GIS layers. Additionally, all data layers must be converted into ASCII format, which can be extremely difficult if the size of the study area is large and the resolution of raster files is high (less than 10 m^2). Each pixel in the raster file is converted into one record consisting of the attribute value and the x and y coordinates of the location. All layers for the model must be clipped to the exact same area with identical extents (x, y coordinates for corners of the layers) and must have the same resolution. Thus, a great deal of effort is required to prepare suitable layers for this model.

The models presented in this report should be recognized as simplistic because ecological information on habitat requirements for the species is minimal in many cases, and observations are often minimal. The results of the models should be viewed with caution. However, the models are being used to identify areas where species could potentially be present, not to pinpoint where the species is located. This information, in turn, can be used to manage and conserve the species based on their potential presence.

HABITAT SUITABILITY MODEL

For the Habitat Suitability Model, documented parameters for each species were researched and the limiting range of the preference for each parameter was determined. For example, current reports may indicate that the species has only been observed at elevations of 1,500 ft. Mean Sea Level (MSL) to 3,500 ft. MSL. This criterion was entered into the model. If no limits were known for a layer, that layer was not included in the analysis. After layer criteria were entered into the model, each of the layers was weighted based on the importance of the layer in determining habitat range according to the literature. Thus, if a layer was more important than other layers in determining habitat range, it was given a higher weighting factor ranging from 1 to 5. The weighting factor was then used to multiply the base score of each species within a parameter. For example, if the base score for a specific soil association was "2" and the weighting factor was determined to be "3", then the final score for that specific soil association would be 2 times 3 or "6". It is important to note that the weighting factors were determined at the discretion of the biologists preparing the model and based on information derived from the literature. The accuracy and resolution of the GIS layer being used to measure that parameter could also play a role. For example, aspect may be an important factor for a species, but the aspect layer is based on 10 m resolution Digital Elevation Maps (DEM) and complex mathematical conversions, making it a useable, but somewhat inaccurate layer. Thus, its importance factor may be scored lower than if it was a more accurate layer.

Last, if literature indicated that a species was not likely to be found outside of a specified range of values within a layer, that criteria was considered inclusive and if any other criteria used for the model showed suitable habitat outside of those values, those portions of habitat were excluded from the model. For example, a fish would require water and any habitat range criteria outside of perennial water sources would be excluded from the model.

Habitat ranges for the different species were modeled using the Habitat Range Prediction Tool (HRPT), which was recently developed by Adams Ecology for the habitat suitability model. The HRPT uses the weighted criteria and layers from literature to map habitat preferences based on documented limiting factors. The HRPT is a script and associated script tool that was created to model and score locations of a species' preferred habitat. The script for the model was created in Python. To build this tool, environmental layers were used to map suitable habitat for any given sensitive species. Vector layers were converted to raster files, and all layers were clipped to the boundaries of the NTTR and proposed expansion alternatives.

Using "arcpy.GetParameterAsText," user inputs could be entered for each variable directly through ArcMap or ArcCatalog. For each layer, specific inputs were required to allow the script to proceed. Invalid inputs caused an error in the script and it would no longer process. After the script created scoring outputs for each of the environmental layers, they were all multiplied by the weighting factor for each layer using the ArcGIS Raster Calculator tool. A simple addition method was used to sum the resulting scores of all layers. If any layers were labeled "exclusionary," excluded areas were removed from the resulting raster using the Raster calculator.

A form was created in Microsoft Excel that allowed qualified biologists to enter suitable parameters for each sensitive species (Figures 3-4). These preferences could be ranges (elevation or slope) or specific types (soil types, geology, vegetation alliance, etc.). Layers could be included or excluded that did or did not factor into a species' preferred habitat. Additionally, a weighting factor could be entered to assign an individual layer more or less importance in the model based on the species' preferences. A layer could also be labeled as “inclusionary,” meaning any habitat falling outside the parameters for that specific layer would automatically be excluded from the model.

Species Name:	
Is Elevation a Parameter?	
Minimum Elevation (ft):	
Maximum Elevation (ft):	
Elevation Factor:	
Is Elevation Exclusionary?	
Is Slope a parameter?	
Minimum Slope (deg):	
Maximum Slope (deg):	
Slope Factor:	
Is Slope Exclusionary?	
Is Aspect a parameter?	
Aspect:	
Aspect Factor:	
Is Aspect Exclusionary?	
Are Permanent Water Sources a Parameter?	
Permanent Water Source Factor:	
Are Permanent Water Sources Exclusionary?	
Are Temporary Water Sources a Parameter?	
Temporary Water Source Factor:	
Are Temporary Water Sources Exclusionary?	
Is Geology a Parameter?	

Geology:	Cc		Ta2		Tr3	
	CZq		Ta3		Tri	
	Dc		Tb		Ts2	
	MDs		Tba		Ts3	
	Oc		Tgr		Tt2	
	Qa		Ths		Tt3	
	Qp		TKs		Tts	
	QTb		Tmi		Xm	
	Sc		Tob		Zqs	
	SOc		Tr2			
Geology's Factor:						
Is Geology Exclusionary?						
Is NDOW Habitat a Parameter?						

NDOW Habitat:	Barren Landscapes		Lower Montane Woodlands	
	Cliffs and Canyons		Marshes	
	Desert Playas and Ephemeral Pools		Mesquite Bosques and Desert Washes	
	Exotic Grasslands and Forblands		Mojave Mid-Elevation Mixed Desert Scrub	
	Grasslands and Meadows		Mojave Rivers and Streams	
	Intermountain Cold Desert Scrub		Mojave/Sonoran Warm Desert Scrub	
	Intermountain Conifer Forests and Woodlands		Sagebrush	
	Intermountain Rivers and Streams		Sand Dunes and Badlands	
What is NDOW Habitat's Factor?				
Is NDOW Habitat Exclusionary?				
Is Soil a Parameter?				

Soils:	NV200		NV223		NV303		NV385		NV519	
	NV202		NV224		NV304		NV387		NV521	
	NV204		NV230		NV307		NV390		NV522	
	NV205		NV231		NV308		NV507		NV523	
	NV213		NV236		NV309		NV511		NV524	
	NV215		NV237		NV311		NV512		NV526	
	NV221		NV301		NV316		NV513		NV539	
Soil's Factor:										
Is Soil Exclusonary?										

Figure 3. Example of the parameter entry form for the Habitat Suitability Model.

Exclude Mountains?		
Exclude Valleys?		
Is Vegetation a parameter?		
		A0833 Purshia stansburiana Scrub Alliance
		A0869 Atriplex canescens Scrub Alliance
		A0870 Atriplex confertifolia Scrub Alliance
		A1044 Chilopsis linearis - Psorothamnus spinosus Desert Wash Scrub Alliance
		A1046 Sarcobatus vermiculatus Intermountain Wet Shrubland Alliance
		A2108 Pinus monophylla - Juniperus osteosperma / Shrub Understory Woodland Alliance
		A2515 Menodora spinescens Scrub Alliance
		A2572 Ephedra torreyana Shrubland Alliance
		A3144 Coleogyne ramosissima Mojave Desert Scrub Alliance
		A3147 Yucca schidigera Scrub Alliance
		A3148 Yucca brevifolia Wooded Scrub Alliance
		A3170 Pleuraphis rigida Desert Grassland Alliance
		A3171 Grayia spinosa Scrub Alliance
		A3195 Chrysothamnus viscidiflorus Steppe & Shrubland Alliance
		A3196 Ericameria nauseosa Steppe & Shrubland Alliance
		A3198 Artemisia tridentata - Mixed Shrub Dry Steppe & Shrubland Alliance
		A3202 Krascheninnikovia lanata Steppe & Dwarf-shrubland Alliance
		A3203 Gutierrezia sarothrae - Gutierrezia microcephala Dwarf-shrubland Alliance
		A3219 Artemisia arbuscula ssp. arbuscula Steppe & Shrubland Alliance
		A3222 Artemisia nova Steppe & Shrubland Alliance
		A3259 Fallugia paradoxa Desert Wash Scrub Alliance
		A3277 Larrea tridentata - Ambrosia dumosa Bajada & Valley Desert Scrub Alliance
		A3279 Ambrosia dumosa Desert Dwarf Scrub Alliance
		A3496 Juniperus osteosperma / Shrub Understory Woodland Alliance
		A4167 Eriogonum wrightii - Eriogonum heermannii - Buddleja utahensis Scrub Alliance
		A4185 Prunus fasciculata - Salazaria mexicana Northern Mojave Desert Wash Scrub Alliance
		A4186 Psorothamnus fremontii - Psorothamnus polydenius Desert Wash Scrub Alliance
		A4188 Hymenoclea salsola - Bebbia juncea Mojave-Sonoran Desert Wash Scrub Alliance
		A4245 Ephedra nevadensis - Lycium andersonii - Grayia spinosa Scrub Alliance
		A858 Ephedra viridis Shrubland Alliance
		Achnatherum hymenoides Vegetation Alliance (Proposed)
		CEGL000825 Pinus monophylla Woodland
		CEGL001315 Atriplex confertifolia / Tetradymia glabrata Shrubland
		CEGL001452 Picrothamnus desertorum Shrubland
		CEGL001991 Suaeda moquinii Wet Shrubland
		CEGL005294 Yucca brevifolia / Coleogyne ramosissima Wooded Shrubland
		CEGL005751 Ephedra nevadensis - (Salazaria mexicana, Hymenoclea salsola) Shrubland
		CEGL005777 Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida Wooded Shrubland
		Developed or Disturbed Land
		Ericameria spp. Shrubland Alliance (Place holder)
		G569 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation G570 Intermountain Basins Cliff, Scree & Badland Sparse Vegetation
		Lycium (andersonii, shockleyi) Shrubland (Place Holder)
		Microphytic Playa Alliance (Peterson, 2008)
		Sarcobatus baileyi Shrubland Alliance (Peterson, 2008)
Vegetation Factor?		
Vegetation Exclusionary?		

Figure 4. Example of the parameter entry form for the Habitat Suitability Model (Continued).

Habitat preferences documented in the literature could only be used if GIS layers were available for the parameter on the study area. The following GIS layers were available to be used for the Habitat Suitability Model:

- Elevation: USGS Digital Elevation Map; 10 m resolution (Figure 5). The elevation range for the species was considered the highest score and the score for this layer decreased as one moved away from the lower or upper limit of elevation.
- Slope: Created from 10 m DEM using ArcMap (Figure 6).
- Aspect: Created from DEM using ArcMap (Figure 7).
- Geologic Outcrops: Geologic Map of Nevada (Crafford, 2007) (Figure 8)
- NDOW Key Habitats: Nevada Wildlife Action Plan (Wildlife Action Plan Team, 2013) (Figure 9)
- Mines: Map prepared by the U.S. Air Force for the 2000 Land Withdrawal LEIS (U.S. Air Force, 1997) (Figure 10). Scoring was based on distance from the mine with 100 ft. radius being the highest score (5) and the score decreasing by one point as the radius increased (Table 2).
- Mountains: Prepared by Adams Ecology based on digital elevation maps of the area (Figure 11).
- Permanent Water Sources: Created from seeps and springs database from NTTR and DNWR and includes only perennial seeps and springs and construction ponds (Figure 12). Scoring was based on distance from the source with 0.5 mi. radius being the highest score (5) and the score decreasing by one point as the radius increased (Table 2).
- Soil Associations: U.S. Natural Resources Conservation Service STATSGO2 Database (Natural Resources Conservation Service, 2016) (Figure 13)
- Temporary Water Sources: Created from seeps and springs database from NTTR and DNWR and includes all intermittent and ephemeral water features except washes and dry lakes (Figure 14). Scoring was based on distance from the source with 0.5 mi. radius being the highest score and the score decreasing as the radius increased (Table 2).
- Valleys: Prepared by Adams Ecology based on topographic maps of the area (Figure 15).
- Plant Alliances: Map developed by Adams Ecology for the documentation of plant alliances on the study area (U.S. Air Force, 2017) (Figures 16-19).

Scores assigned for mines, permanent water sources, and temporary water sources are shown in Table 2.

Table 2. Buffer distances and associated score values for mines, temporary water sources and permanent water sources.

Buffer Distance from Permanent Water Sources	Buffer Distance from Temporary Water Sources	Buffer Distance from Mines	Score
0-0.1 mi.	0-0.1 mi.	0-100 ft.	5
0.1-0.25 mi.	0.1-0.25 mi.	100-250 ft.	4
0.25-0.50 mi	0.25-0.50 mi	250-500 ft.	3
0.50-1.0 mi.	0.50-1.0 mi.	500-1000 ft.	2
1.0-2.0 mi.	1.0-2.0 mi.	1000-2000 ft.	1

For elevation, which the only GIS layer that is a continuous variable, the user-specified range was scored a five (highest), while scores four through one were determined incrementally by 200 ft. being added or subtracted from the upper and lower ends of the range. For example, if the user-specified elevation range for a species was determined to be 1,000 – 3,000 ft. MSL, scores would be assigned as shown in Table 3.

Table 3. Example of scoring for elevation parameters for habitat models

Elevation Range (ft. MSL)	Score
Less than 200	0
200	1
400	2
600	3
800	4
1,000	5
3,000	5
3,200	4
3,400	3
3,600	2
3,800	1
Greater than 3,800	0

Layers containing discrete variables, such as soil associations, geologic formation, etc., were scored based on presence or absence. If present, the magnitude of the score may be based on level of preference according to the literature. For example, the desert tortoise preferences for vegetation may be scored as follows based on the species preferences:

- Creosote bush communities: 5
- Blackbrush communities: 3
- Shadescale communities: 1

The final resulting output consisted of a raster file with values from zero (no habitat) to the raster's maximum value (prime habitat). A higher score indicates that more preferred habitat parameters were met at that location. For the purposes of this model, the top 75% of the preferred habitat total score will be considered areas where the potential of the species being present is high. This may be adjusted to ensure that all or most of the observation points are included in suitable habitat, which may result in the ranges requiring expansion. Because of the lack of observational data, this is a somewhat arbitrary determination that can be adjusted as more information on the species is obtained and as GIS layers used in the model are improved in accuracy and precision. The final model results for each species were color coded as two classes—suitable habitat and unsuitable habitat.

Maxent

As previously discussed, probabilistic models, like Maxent, require a minimum number of observation points (usually around ten) to statistically determine the parameters for preferred habitat for a species (Wisz, et al., 2008). As the number of observations increases, the accuracy of the model improves. Within the study area, only nine of the forty-two species had sufficient observations to run Maxent. In most cases, the remaining species had less than five and often no observations on the study area. Insufficient data was a result of the lack of historical and current surveys focusing on the species and the lack of presence/absence data available for the species on or in the vicinity of the study area. In some cases, Maxent was attempted for species with very few observation points, but the results were not acceptable. The same twelve GIS layers used for the Habitat Suitability Model were used for running Maxent.

Once the layers were properly converted, Maxent was run for each of the nine species having sufficient observation points within the study area and results are provided with each of those in the sections that follow. Most of the Maxent models were based on a small number of samples (10-30) and, thus, the reader is warned that caution should be observed in interpreting the results. However, the model provided additional information that could be useful for management of the species.

MODEL PROJECT AREA

The area that was used for running all habitat suitability range models was limited by using only the areas within the study area that had been mapped for plant communities (Figure 20). This area included the entire study area with the exception of Range 74A and Range 4808A. Documented wildlife and vegetation surveys are not available for these areas due to access and security restrictions.

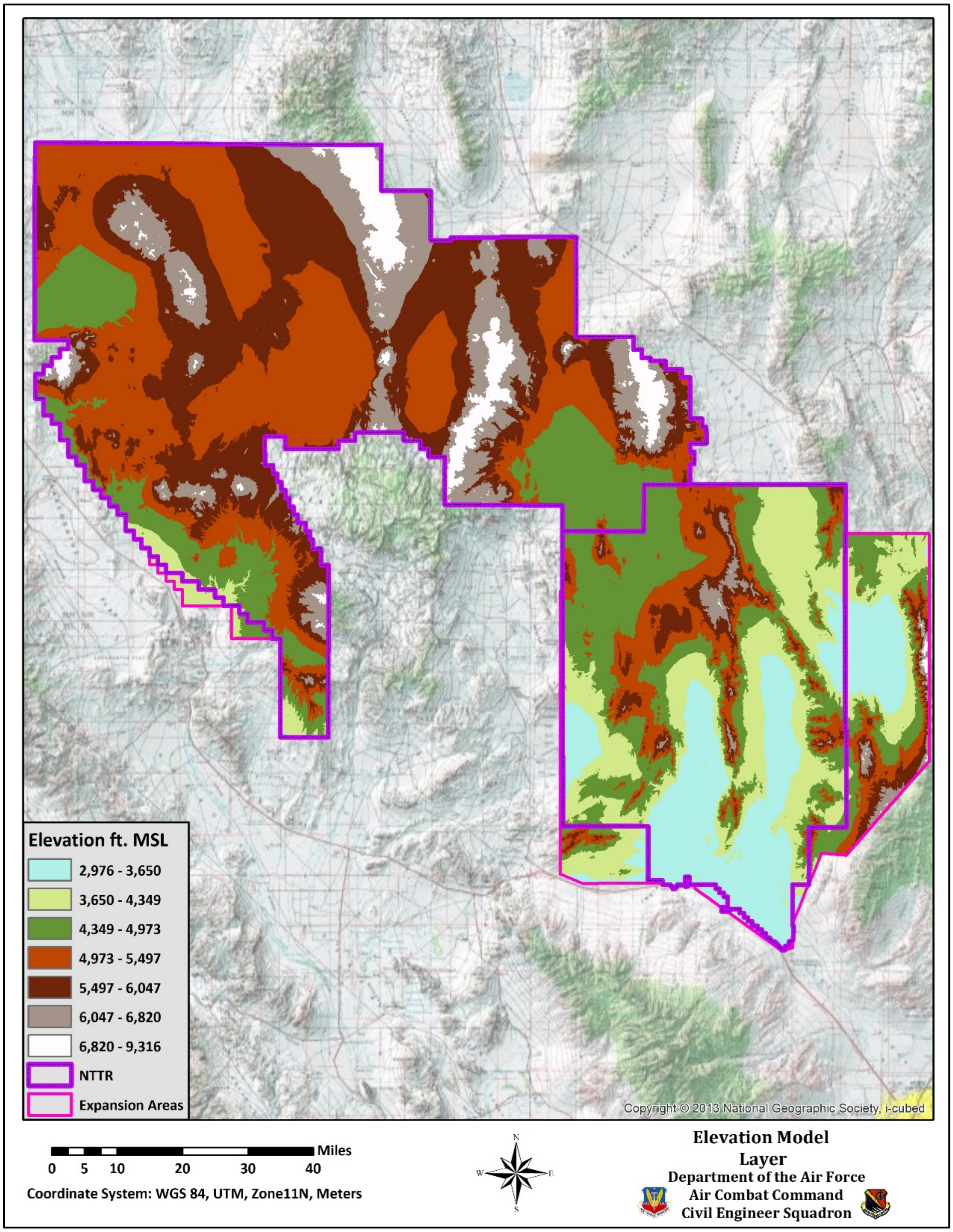


Figure 5. Elevation layer used for the Habitat Range Models.

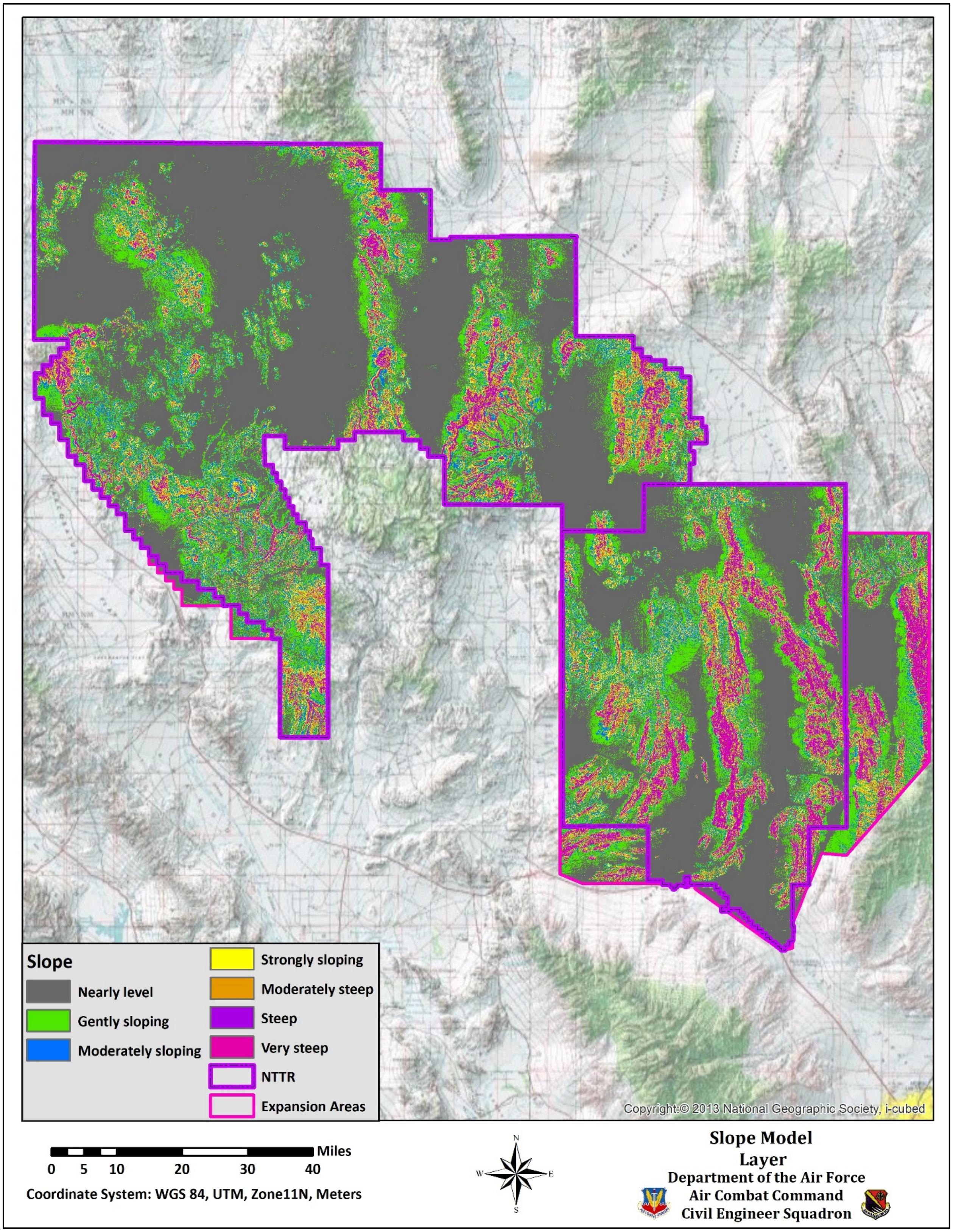


Figure 6. Slope layer used for the Habitat Range Models.

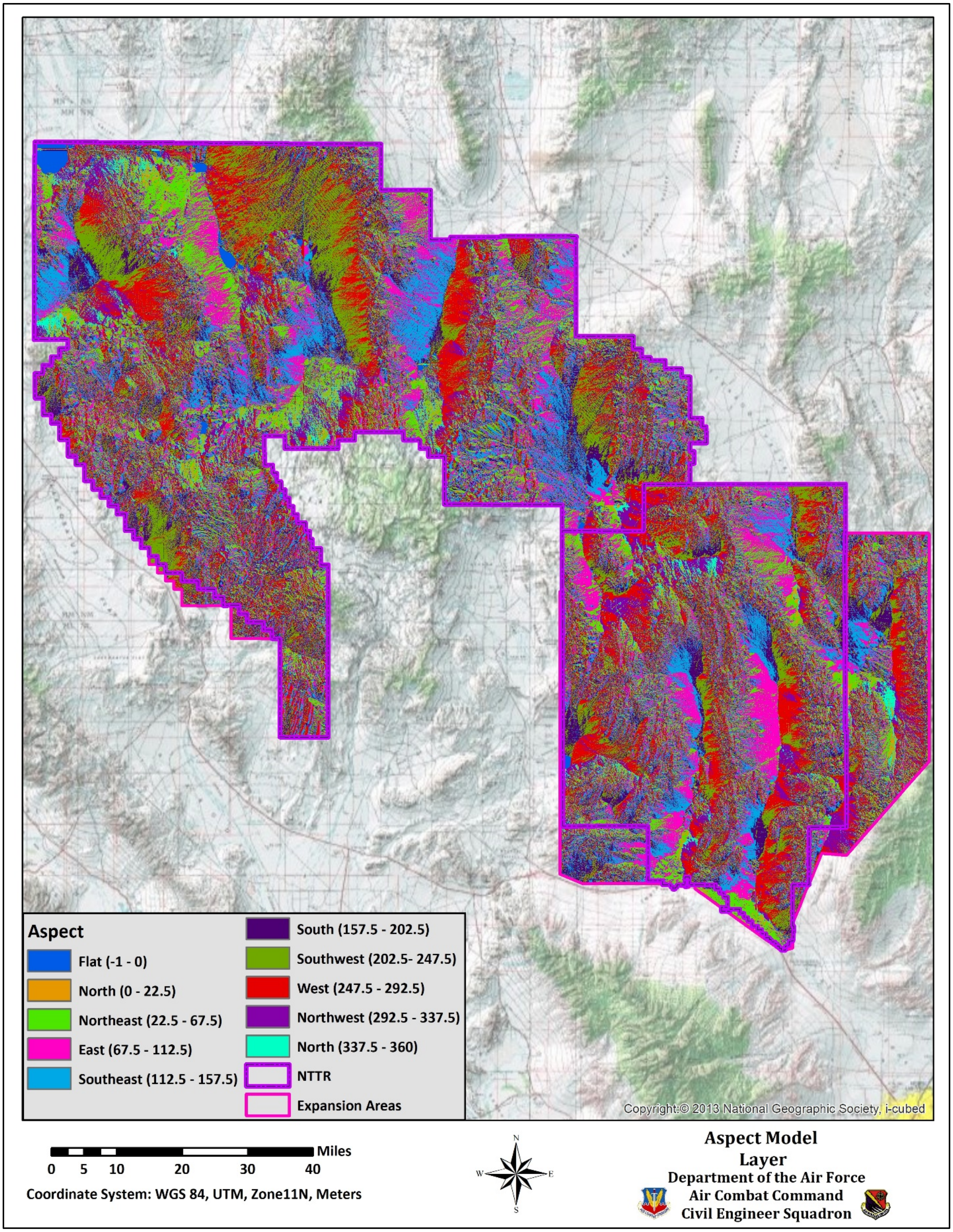


Figure 7. Aspect layer used for the Habitat Range Models.

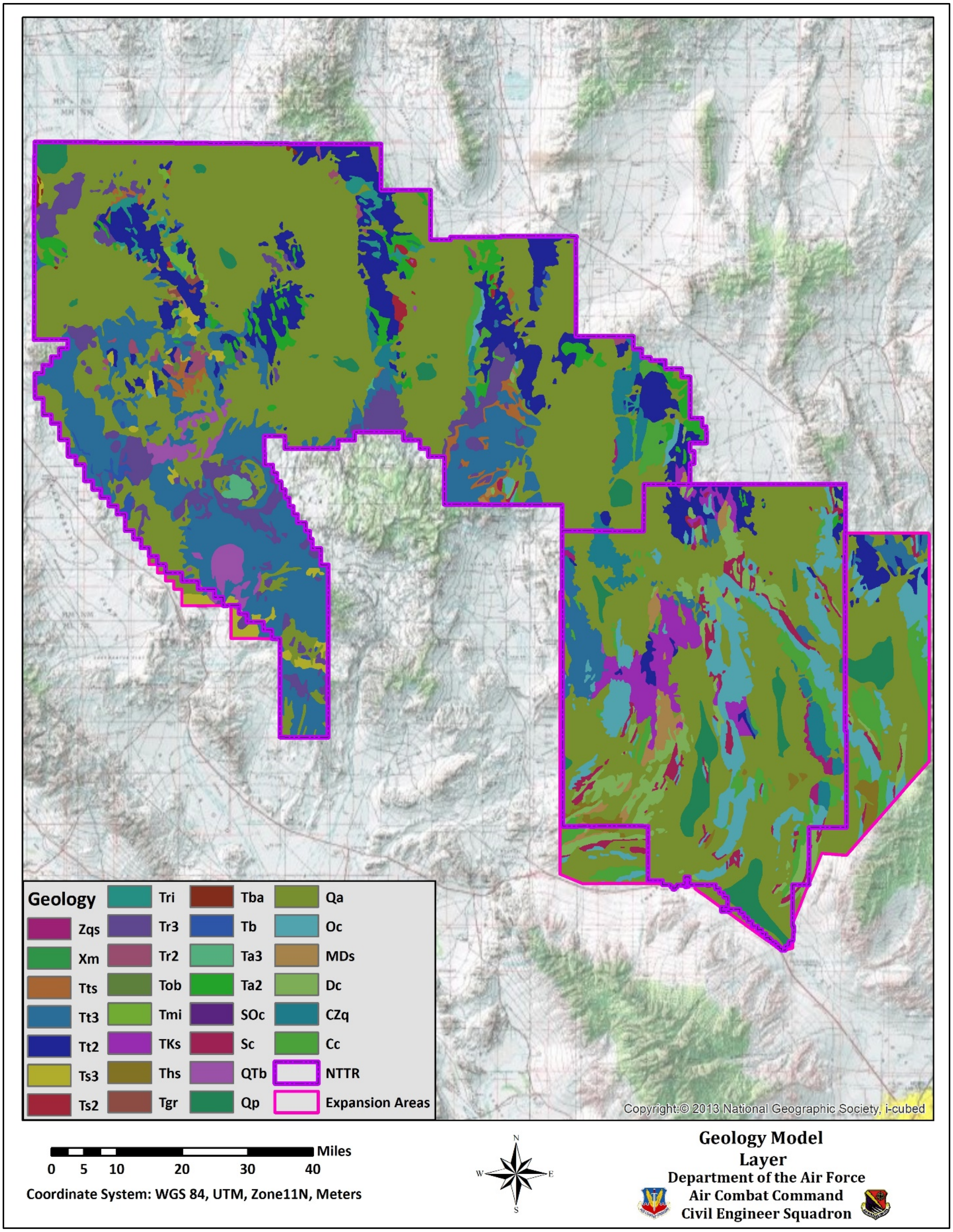


Figure 8. Geologic outcrop layer used for the Habitat Range Models. Acronyms are the standard abbreviations for geologic formations as designated by the USGS.

Table 4. List of acronyms and lithology for the geologic layers of Figure 8.

Acronym	Lithology
Cc	Limestone and dolomite, locally thick sequences of shale and siltstone
CZq	Quartzite and minor amounts of conglomerate, phyllitic siltstone, limestone, and dolomite
Dc	Dolomite, limestone, and minor amounts of sandstone and quartzite
MDs	Shale, siltstone, sandstone, chert-pebble, conglomerate and lime-stone
Oc	Limestone, dolomite, shale and quartzite
Qa	Alluvial deposits
Qp	Playa, marsh, and alluvial-flat deposits, locally eroded
QTb	Basalt flows
Sc	Dolomite
SOc	Dolomite
Ta2	Andesite and related rocks of intermediate composition
Ta3	Andesite and related rocks of intermediate composition
Tb	Basaltic flows
Tba	Andesite and basalt flows
Tgr	Granitic rocks
Ths	Horse spring formation
TKs	Continental sedimentary rocks
Tmi	Intrusive rocks of mafic and intermediate composition
Tob	Older basalt rocks
Tr2	Rhyolitic flows and shallow intrusive rocks
Tr3	Rhyolitic flows and shallow intrusive rocks
Tri	Intrusive rocks
Ts2	Tuffaceous sedimentary rocks
Ts3	Tuffaceous sedimentary rocks
Tt2	Welded and nonwelded silicic ash-flow tuffs
Tt3	Welded and nonwelded silicic ash-flow tuffs
Tts	Ash-flow tuffs and tuffaceous sedimentary rocks
Xm	Metamorphic rocks
Zqs	Quartzite, phyllitic siltstone, conglomerate, limestone, dolomite

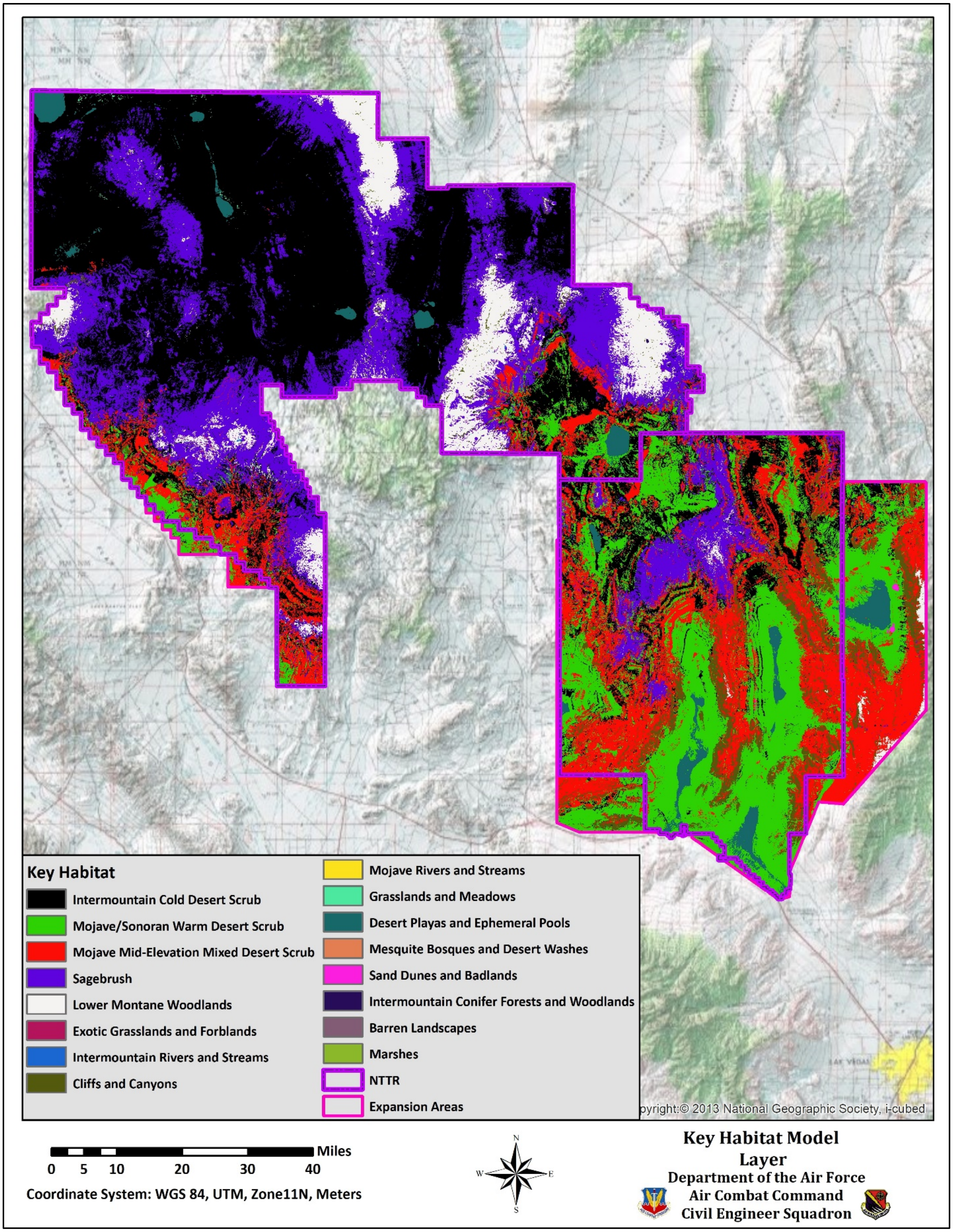


Figure 9. NDOW Key Habitat layer used for the Habitat Range Models.

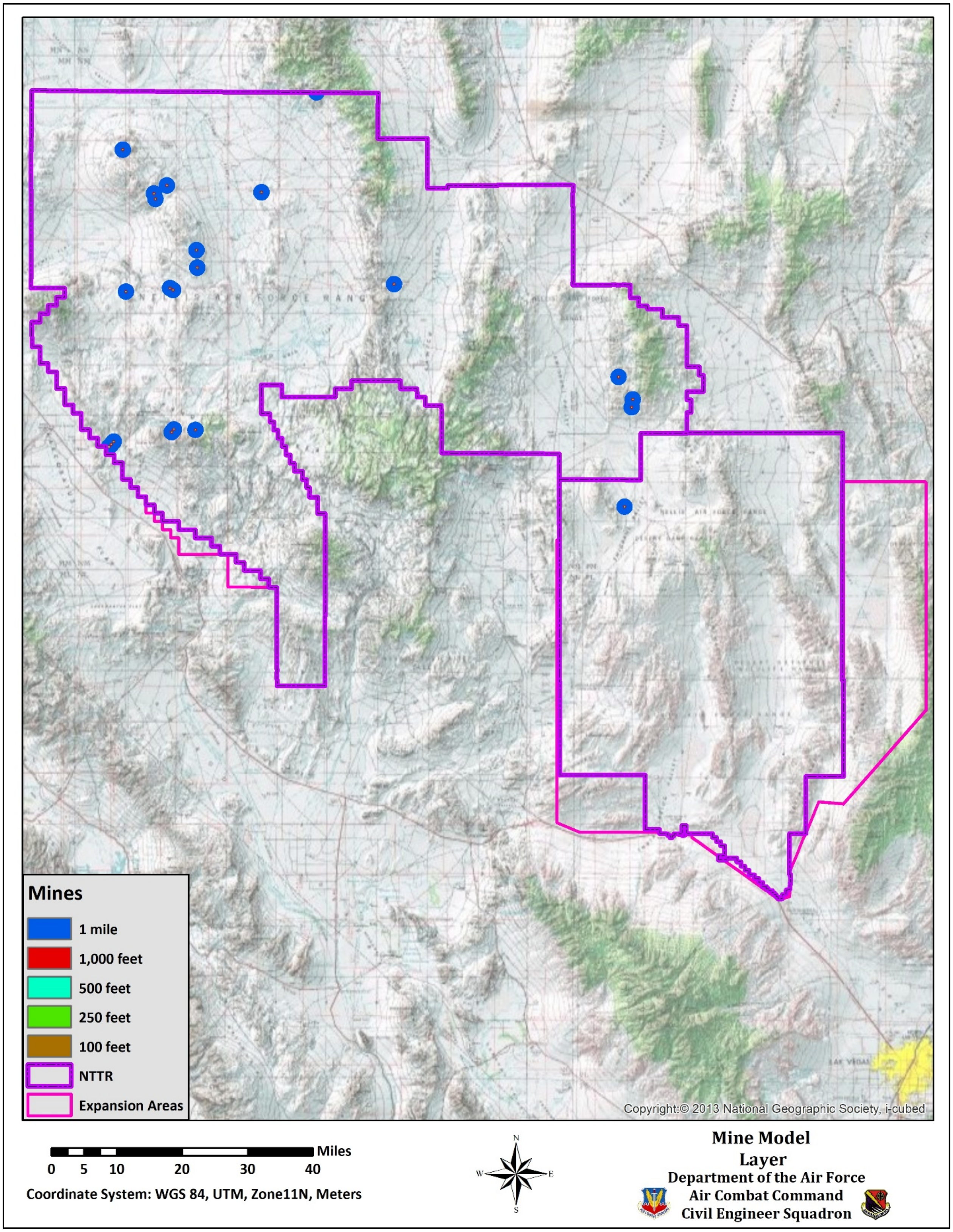


Figure 10. Mine layer used for the Habitat Range Models.

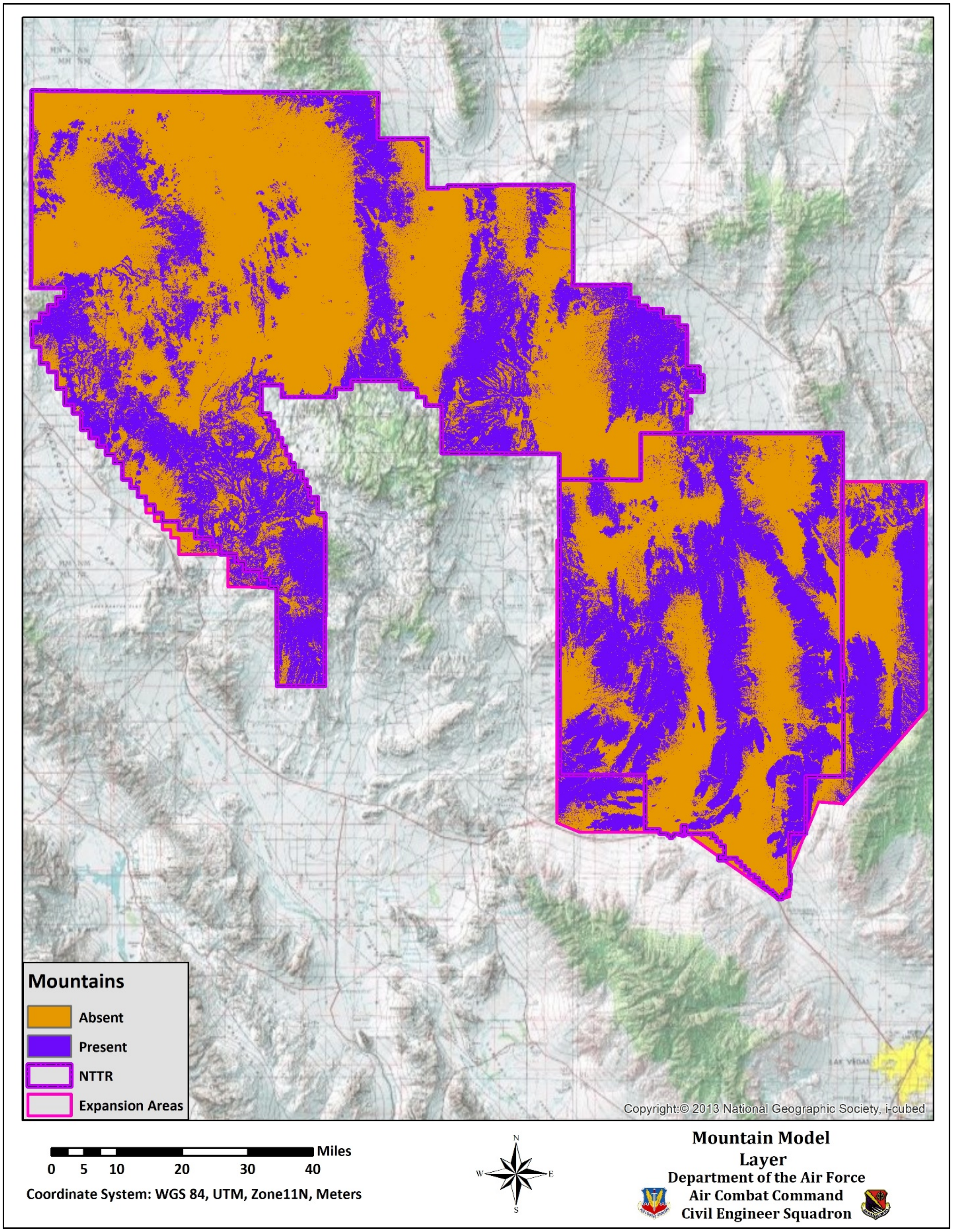


Figure 11. Mountain layer used for the Habitat Range Models. Mountains were mapped based on slope and ruggedness.

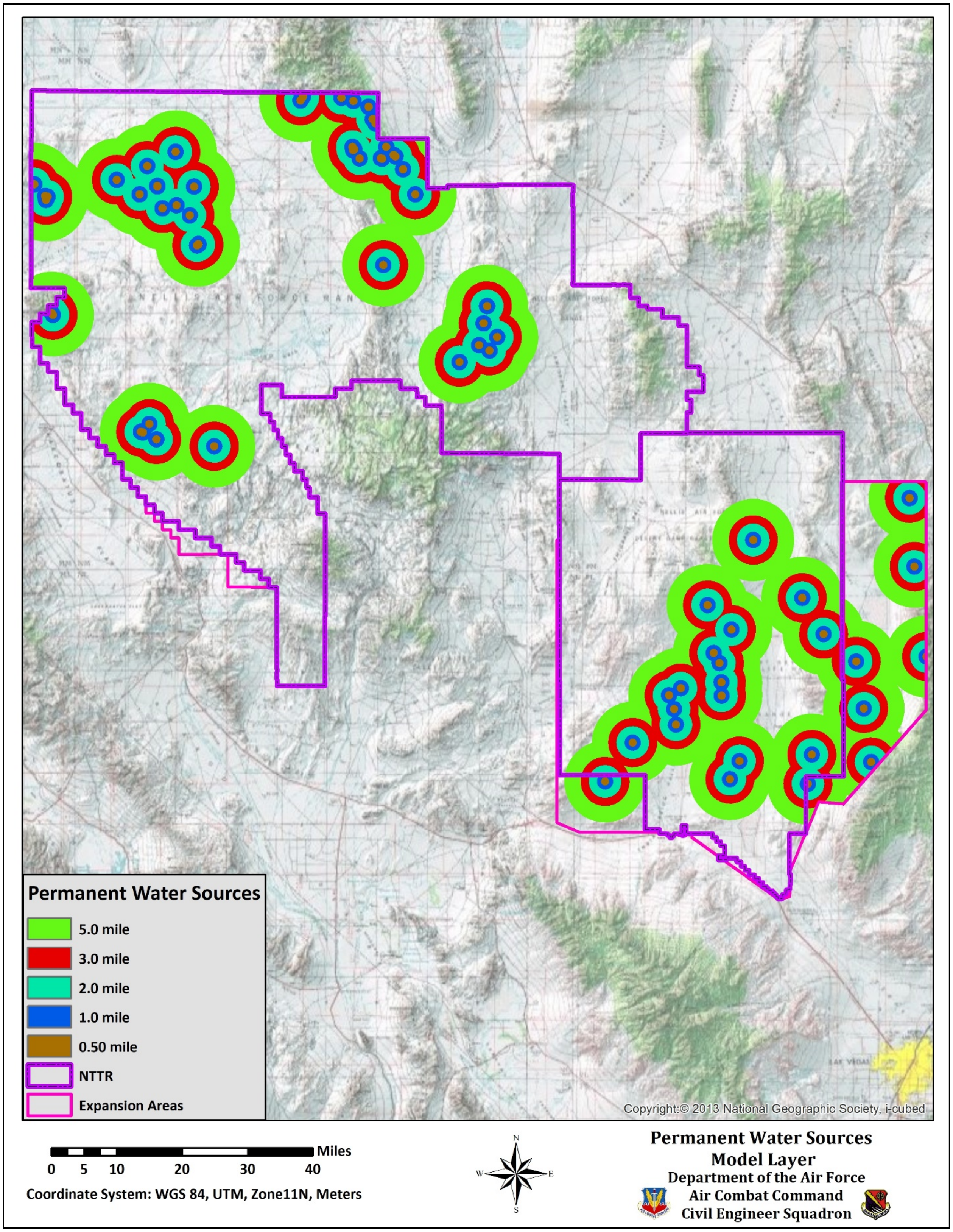


Figure 12. Permanent water sources layer used for the Habitat Range Models.

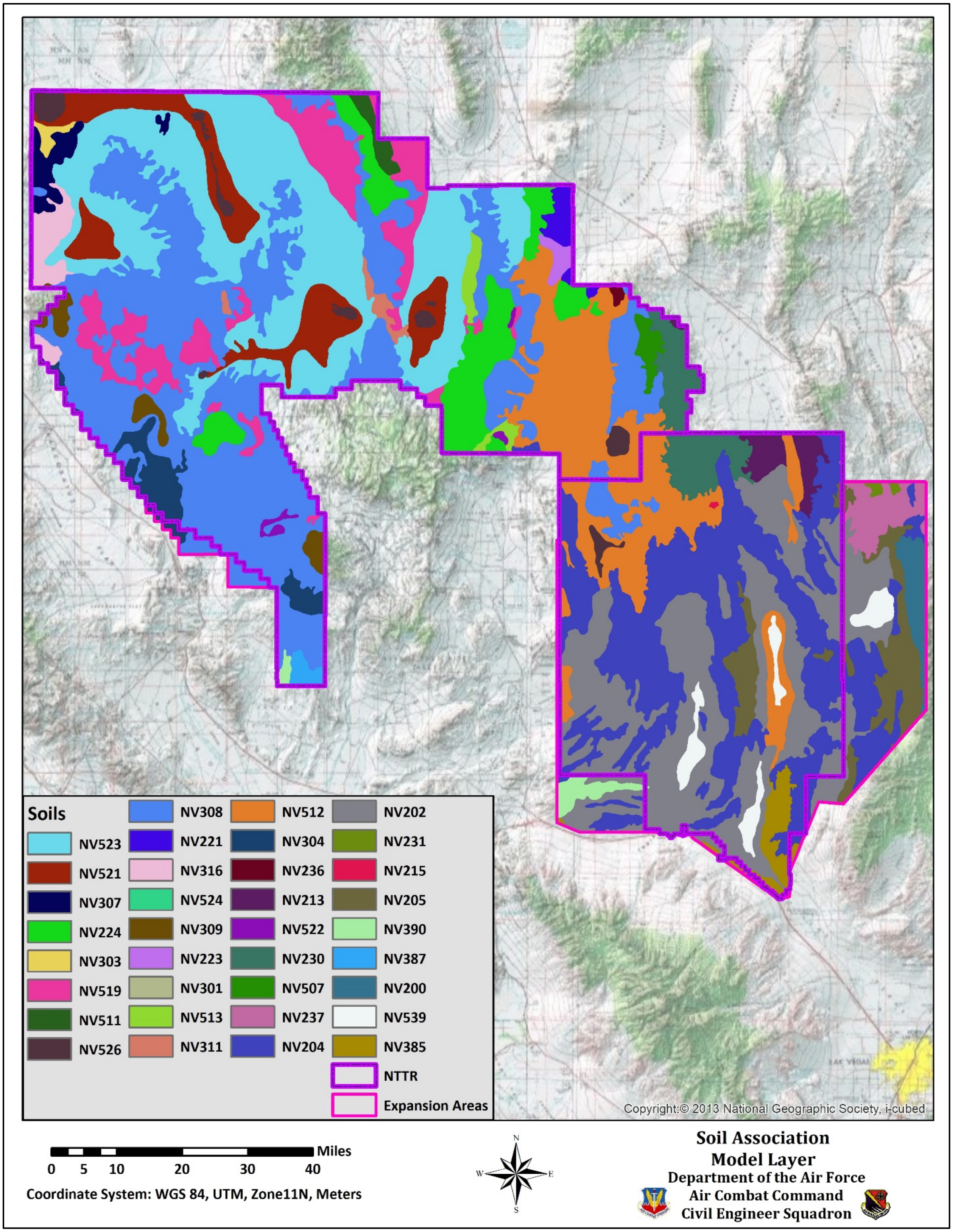


Figure 13. Soil association layer used for the Habitat Range Models. Numbers are assigned to each of the soil associations by the NRCS.

Table 5. List of acronyms and soil associations for the soil layers of Figure 13.

ID	Soil Association
NV200	ZUKAN-WELRING-POOKALOO
NV202	TENCEE-WEISER-COLOROCK
NV204	ST. THOMAS-ROCK OUTCROP-KYLER
NV205	CAVE-AJO-CAVE FAMILY
NV213	MCCARRAN-BLUEPOINT-BRACKEN
NV215	MOKIAK-ROCK OUTCROP-BREKO
NV223	FANG-CLIFFDOWN-SILENT
NV230	MOTOQUA-GABBVALLY-PIOCHE
NV231	JOLAN-PENOYER-GEER
NV236	GABBVALLY-ITCA-MOTOQUA
NV237	AKELA-ROCK OUTCROP-DEDAS
NV301	CIRAC-YOMBA-SLAW
NV303	WARDENOT-IZO-ARDIVEY
NV304	YERMO-GYNELLE-GREYEAGLE
NV307	BLACKTOP-DOWNEYVILLE-ROCK OUTCROP
NV308	STEWVAL-ROCK OUTCROP-GABBVALLY
NV309	BELLEHELEN-RAVENSWOOD-MOHOCKEN
NV311	KYLER-THERIOT-ROCK OUTCROP
NV316	WARDENOT-STONELL-PAPOOSE
NV385	CANUTIO-CAVE-WEISER
NV387	YERMO-UPSPRING-COMMSKI
NV390	ROCK OUTCROP-ST. THOMAS-TECOPA
NV507	LAYVIEW-RAVENSWOOD VARIANT-HACKWOOD
NV511	BELLEHELEN-SQUAWTIP-ROCK OUTCROP
NV512	KEEFA-LEO-UNIVEGA
NV513	KYLER-LODAR FAMILY-EAGLEPASS
NV519	HANDPAH-ZADVAR-RATLEFLAT
NV521	CIRAC-NUYOBE-RUSTIGATE
NV522	LOGRING-KYLER-FLYGARE FAMILY
NV523	UNSEL-KEEFA-KOYEN
NV524	DOWNEYVILLE-ROCK OUTCROP-TOKOPER
NV526	PLAYAS-WENDANE-PARRAN
NV539	NICKEL-ARIZO-BLACKMOUNT

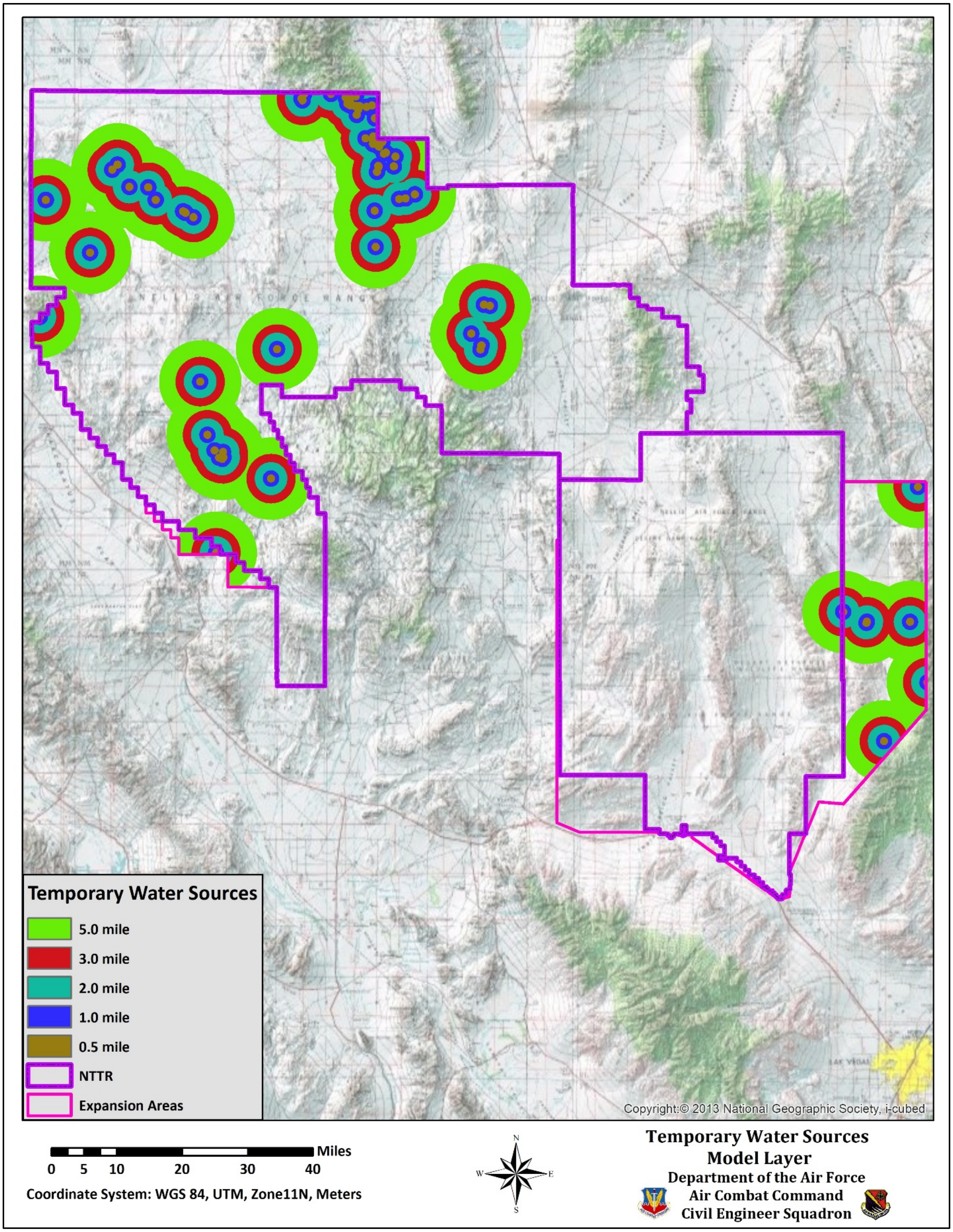


Figure 14. Temporary water source layer used for the Habitat Range Models.

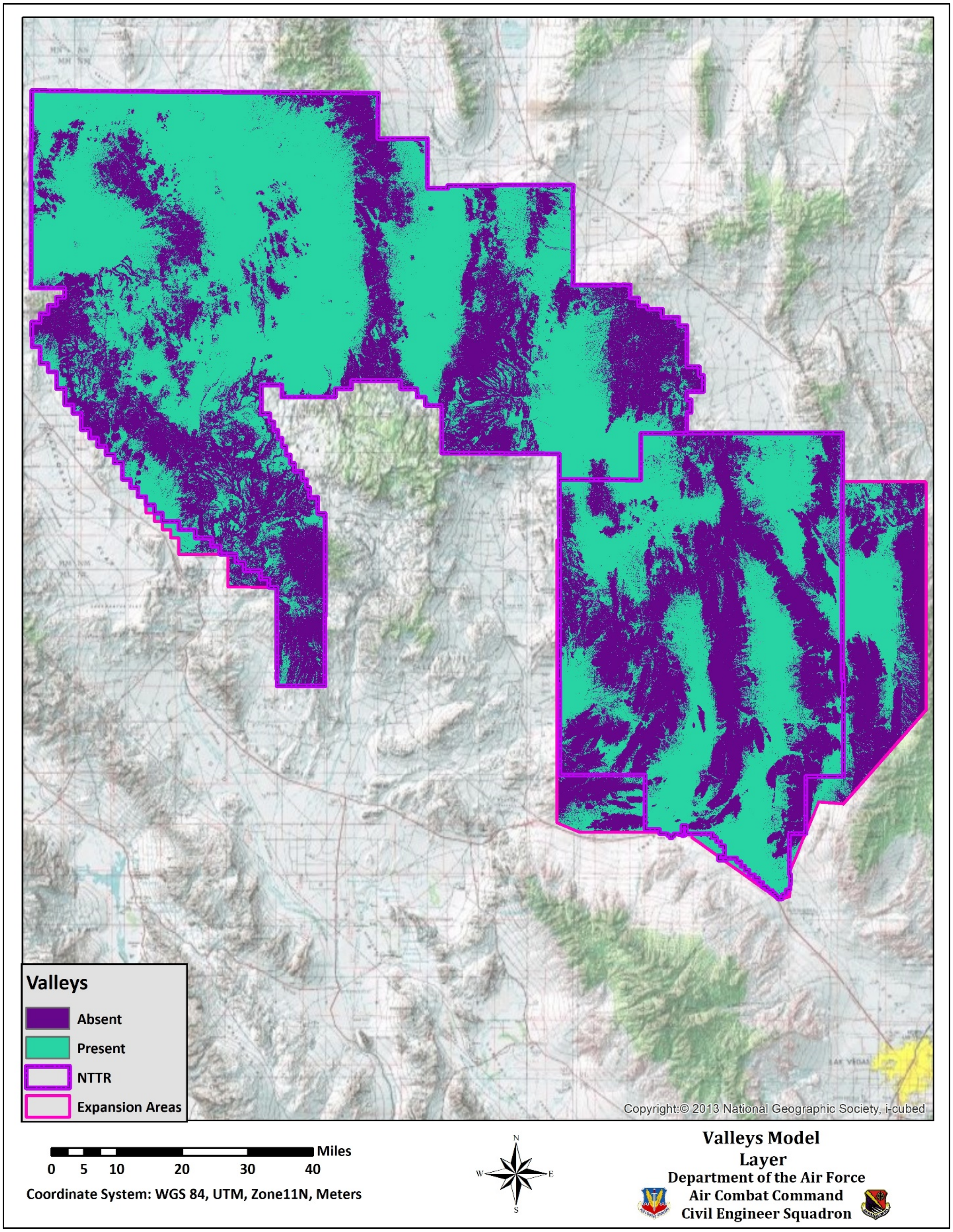


Figure 15. Valley layer used for the Habitat Range Models.

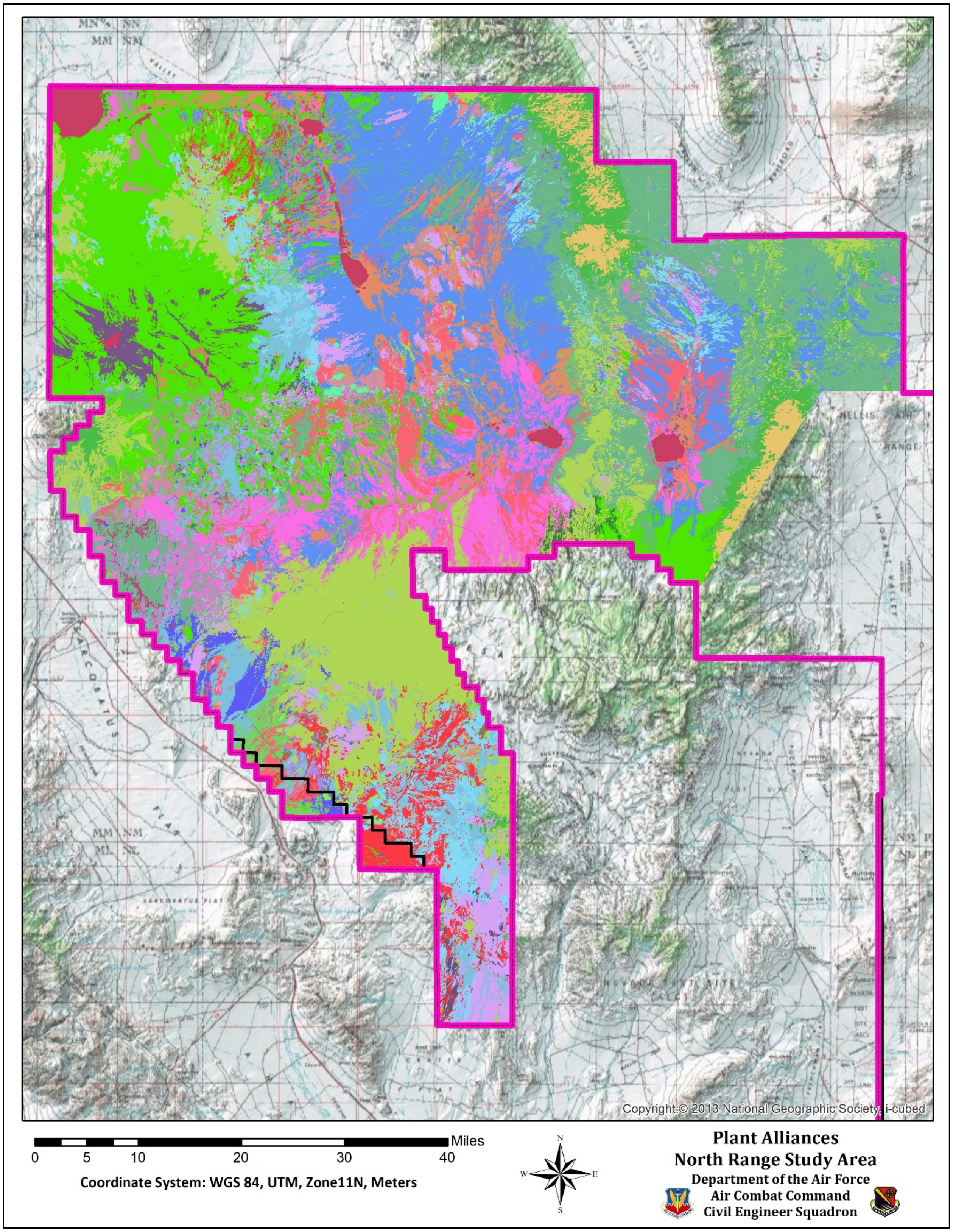


Figure 16. North Range Study Area plant alliance layer used for the Habitat Range Models. Key is provided on the next page.

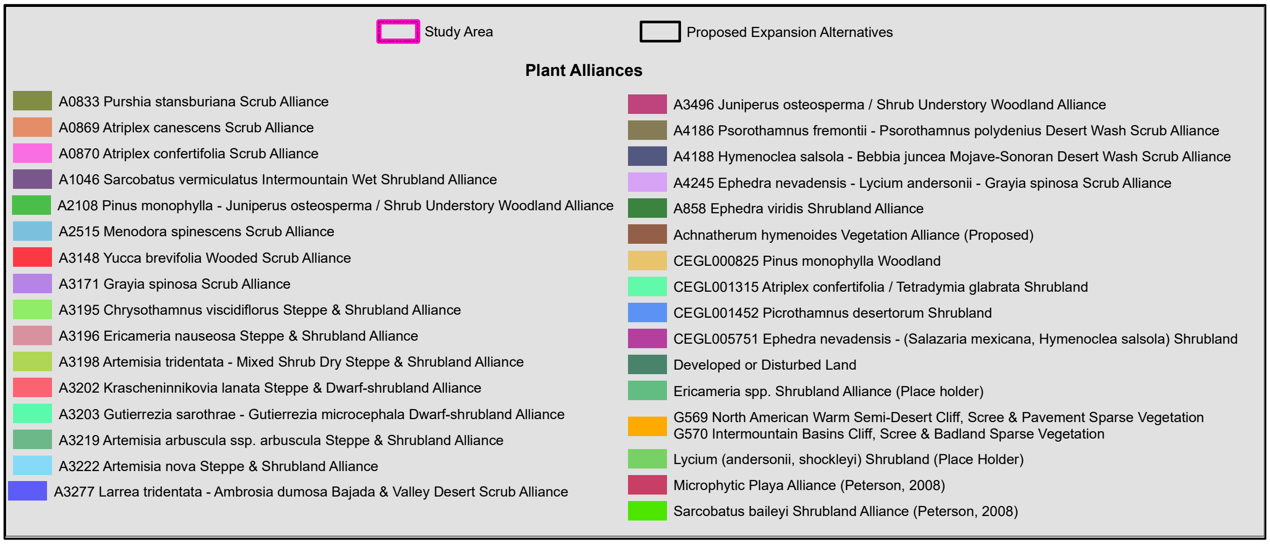


Figure 17. Key for the North Range Study Area plant community layer used for the Habitat Range Models.

Figure 18. Key for the South Range Study Area plant community layer used for the Habitat Range Models.

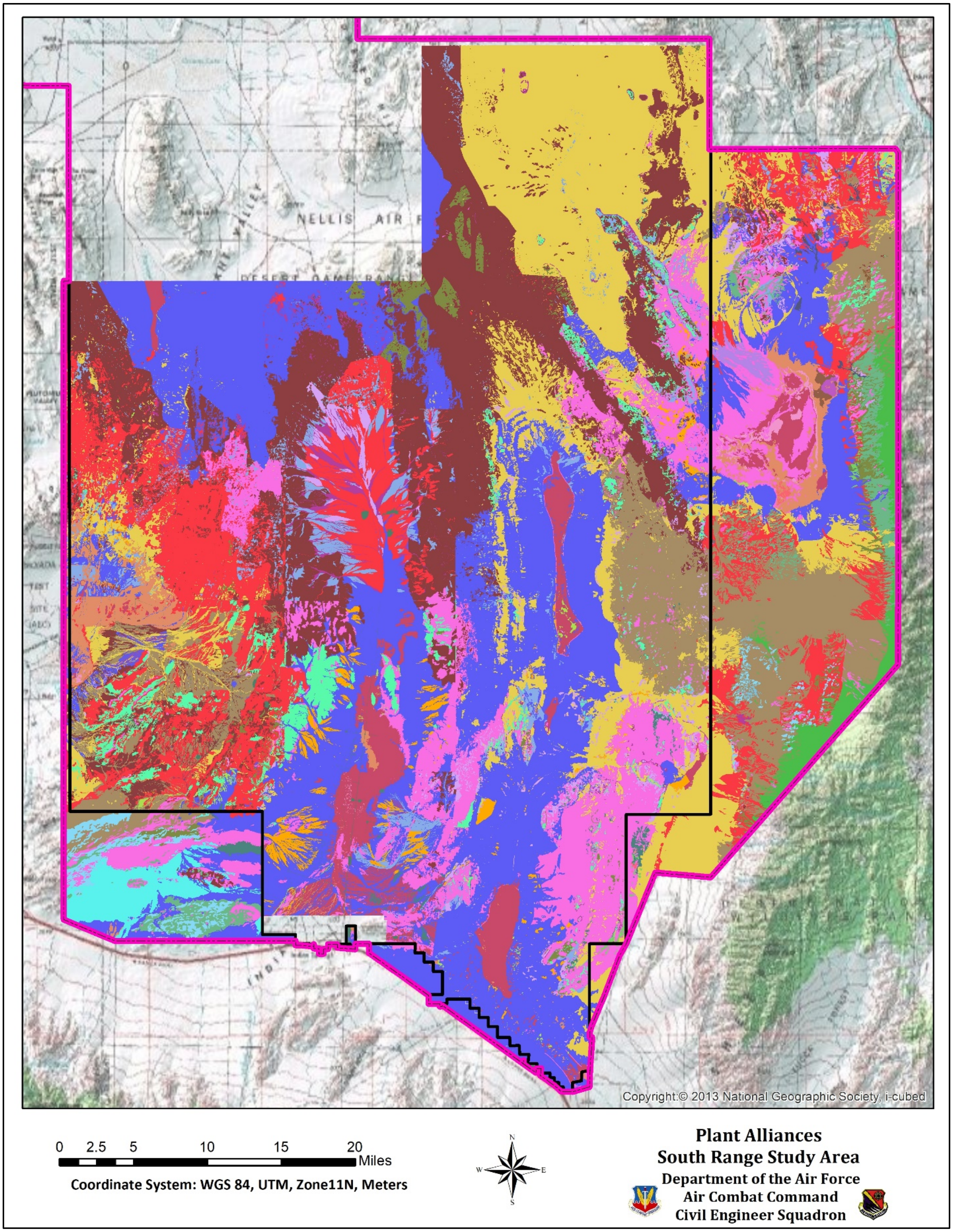


Figure 19. South Range Study Area plant community layer used for the Habitat Range Models.

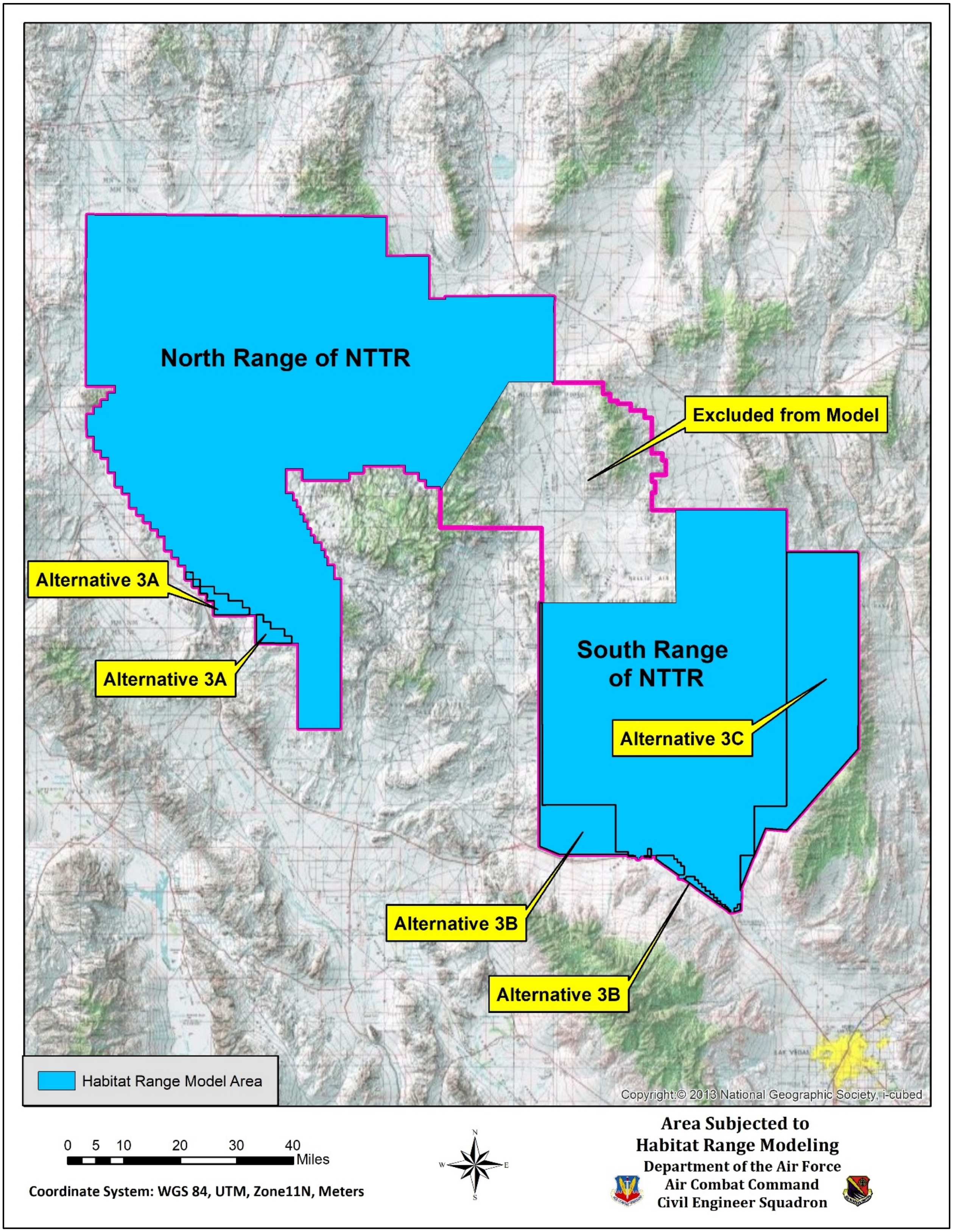


Figure 20. Portion of the study area that was subjected to habitat range modeling for this report.

Results

In the sections that follow, information on the preferred habitat of each of the species listed in Table 1 is discussed. Much of this information has already been presented in the Special Status Species Report (U.S. Air Force, 2017) and information on habitat requirements of the species is reiterated in this report. This report concentrates on the habitat range models prepared for each species and the parameters used to prepare those models.

Gastropods

Corn Creek Pyrg (*Pyrgulopsis fausta*)

The Corn Creek Pyrg is a freshwater mollusk endemic to Corn Creek Spring in southern Nevada. It is a thermal spring, with an average temperature of 73.4 degrees Fahrenheit (NatureServe Explorer, 2016). No other information on habitat requirements was available. It is assumed that the species will require a permanent water source, preferably thermal. Although a few species of this genus are widespread in the region, 22 of the new species that have been identified appear to be restricted to single localities. In general, this fauna is restricted to specific spring areas, but a few springs are known to harbor two or three species of this genus (Hershler, 1998). The Corn Creek pyrg is probably restricted to thermal springs in close proximity to Corn Creek Spring. The Habitat Suitability Model results for this species is entirely based on the presence of a natural permanent water source. Potential for the species being found

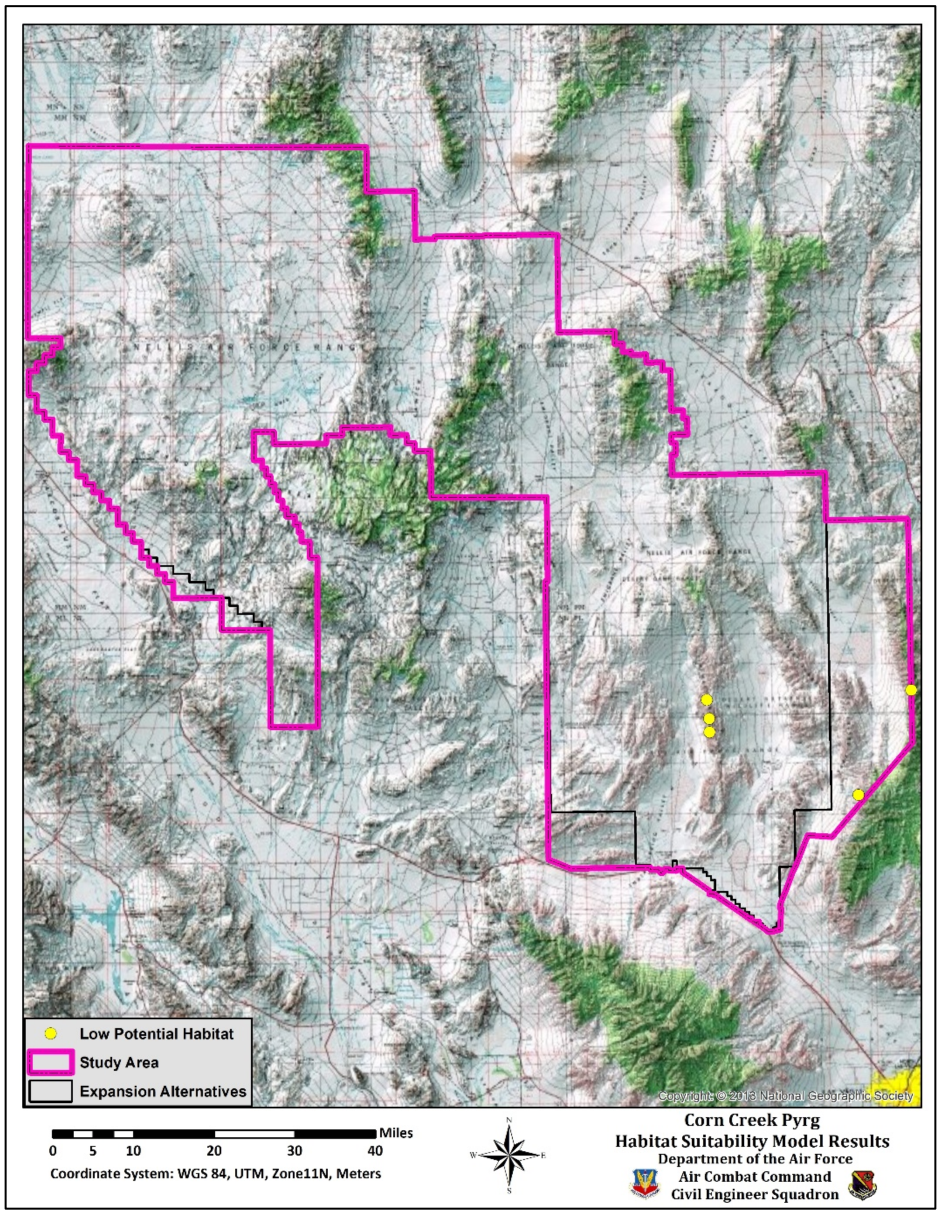
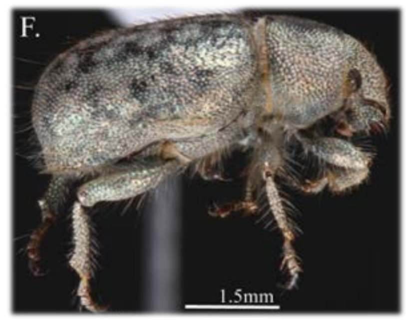


Figure 21. Habitat range of the Corn Creek pyrg as determined by the Habitat Suitability Model.

on the study area was arbitrarily rated as low based on presence of a permanent water source of which the closest is about 19 mi. from Corn Creek Spring (Figure 21). Because the species is gill breathing, it is unlikely that it could migrate to other springs on the study area, especially the North Range Study Area. Therefore, natural springs in the North Range Study Area were removed as potential habitat. Any pyrgs found in springs on the study area are likely not the same species as the Corn Creek Pyrg. It is important to note that most of the water features are likely not thermal, which may further decrease the potential for the species to occur in these waters. Maxent was not run on the species because no observation points for this species occurred on the study area.

ARTHROPODS

Big Dune Miloderes Weevil (*Miloderes* spp.)



Big Dunes Miloderes Weevil (copyright Matthew Van Dam and Charles O'Brien)

The Big Dune Miloderes weevil is a small variety of endemic desert weevil found in the Mojave Desert and the Amargosa desert (Nevada Department of Natural Resources and Conservation, 2016). Their primary habitat is sand dunes, with a major Nevadan site being Big Dune near Beatty/Amargosa, Nevada. Within this habitat, only a portion of the dune offers protection for the insects. Similar to the large Aegialian scarab, the probability of finding this species on the study area is low, but may occur on dunes and sandy areas. Models were not run for this species due to lack of sufficient information and the isolation of the species to specific areas outside of the study area. However, a map showing the location of known populations of the species is provided (Figure 22). For protection of this species, any soil disturbing actions that occur on sparsely vegetated and non-vegetated dunes should be surveyed for this species.

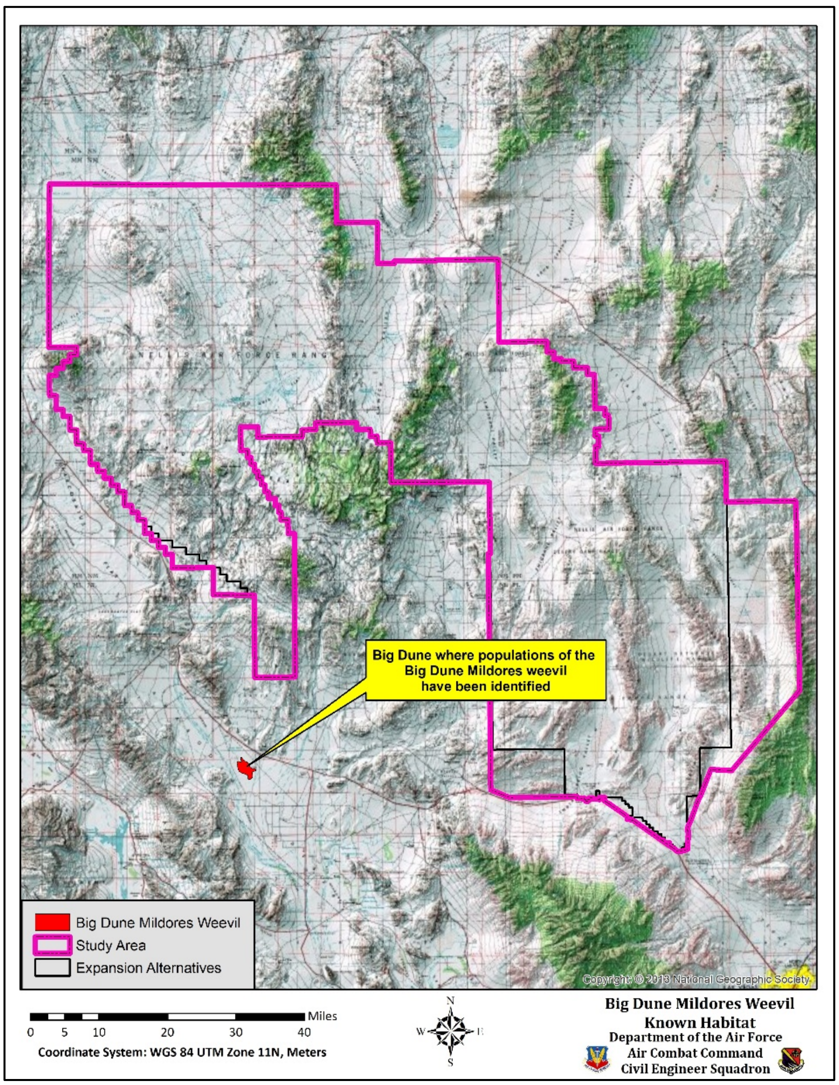


Figure 22. Location of habitat known to support Big Dune Mildores Weevil populations. Note that these are approximate locations based on documented descriptions.

Army Ant (*Neivamyrmex nyensis*)

The endemic ants are a type of army ant present predominantly in Beatty, in Nye County, Nevada. The species has only been found in a limited number of places. Models were not run for this species due to the lack of information available on habitat preferences. This species cannot be managed in a practical manner until more information is available on its habitat preferences and limiting factors.

Army Ant (copyright www.ant-wiki.org/wiki/Neivamyrmex_nyesis)

Giuliani's Dune Scarab (*Pseudocotalpa giulianii*)

Giuliani's Dune Scarab is a sand dune beetle which inhabits Big Dune and Lava Dune, a combined area of approximately 1,200 acres near Beatty/Amargosa, Nevada (U.S. Fish and Wildlife Service, 1978; U.S. Fish and Wildlife Service, 2012). The sandy soils where these insects are found are typically not stable, though the soil at the depth at which the beetles bury is sufficiently stable for short time periods (Figure 23). The beetles live on plant matter in the process of decomposing (WildEarth Guardians, 2016). The beetle appears to prefer vegetated areas at the base of the dunes and not the unvegetated areas (U.S. Fish and Wildlife Service, 1978). Similar to the large Aegialian scarab, the probability of finding the species on the study area is low, but may occur on dunes and sandy areas. Models were not run for this species due to lack of sufficient information and the isolation of the species to specific areas outside of the study area. For protection of this species, any soil disturbing actions that occur on sparsely vegetated and non-vegetated dunes should be surveyed for this species.

Guiliani's Dune Scarab (copyright Richard Rust)

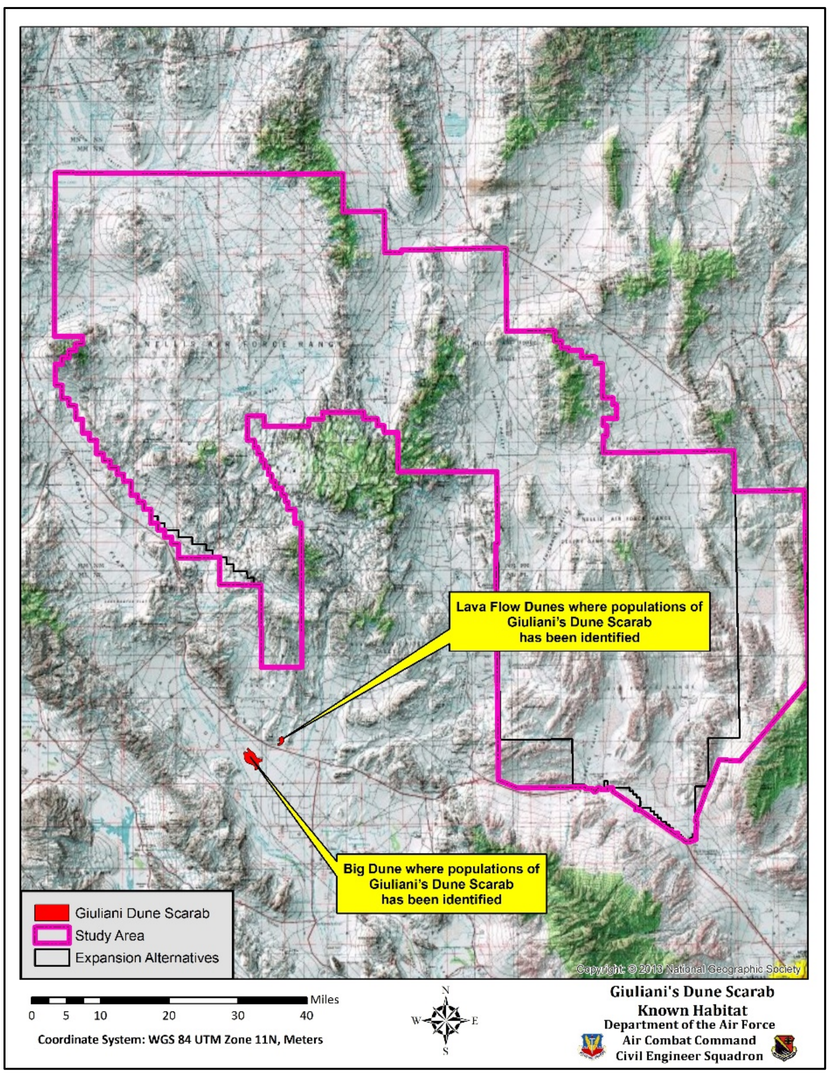


Figure 23. Location of habitat known to support Giuliani's Dune Scarab populations. Note that these are approximate locations based on documented descriptions.

Large Aegialian Scarab Beetle (*Aegialia magnifica*)

The Large Aegialian scarab beetle is a small, reddish beetle found in the Big Dune and Lava Dune complexes and the surrounding sandy areas in Nye County, Nevada (Figure 24). These dunes are found near the towns of Beatty and Amargosa, and range in elevation from approximately 2,700 ft.—2800 ft. MSL (U.S. Fish and Wildlife Service, 2011). Their distribution tends to be patchy within the sand dunes, but may be found in any type of vegetation. The probability of finding the species on the study area is low, but may occur on dunes and sandy areas. Models were not run for this species due to lack of sufficient information and the isolation of the species to specific areas outside of the study area. For protection of this species, any soil disturbing actions that occur on sparsely vegetated and non-vegetated dunes should be surveyed for this species.

Large Aegialian Scarab Beetle (copyright Richard Rust)

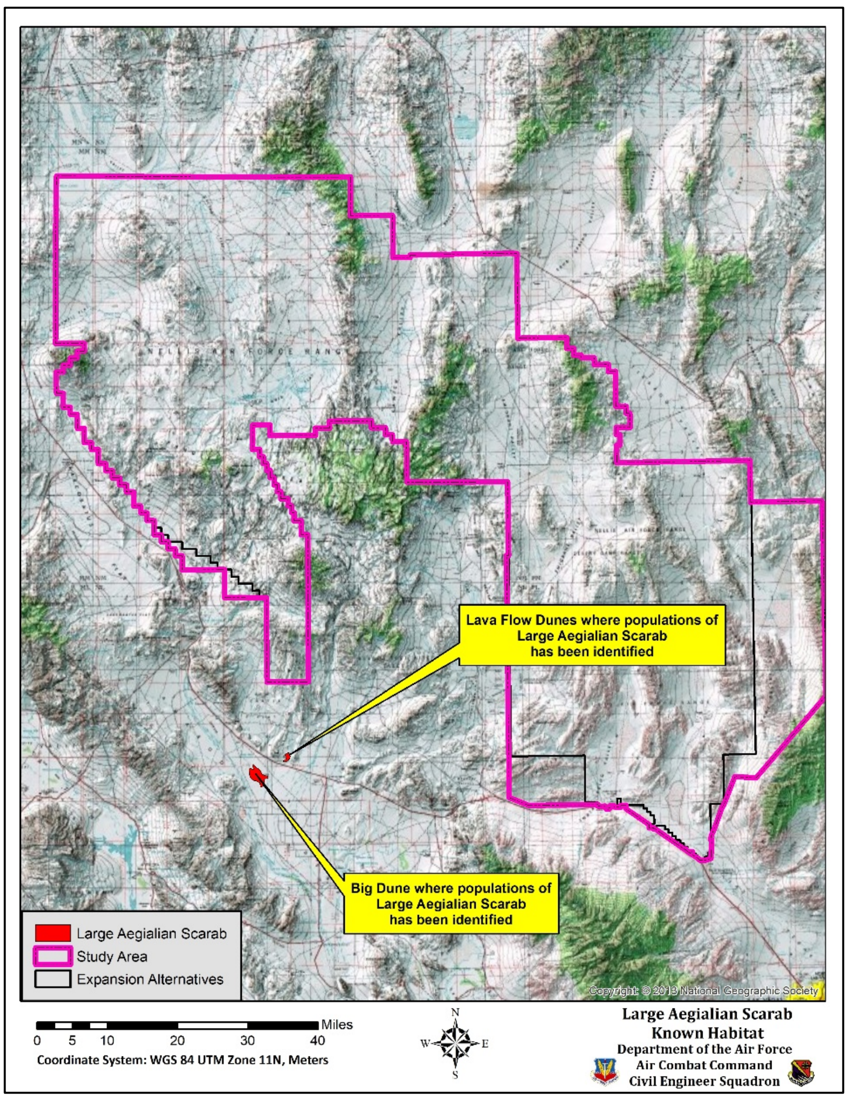


Figure 24. Location of habitat known to support Large Aegialian scarab populations. Note that these are approximate locations based on documented descriptions.

Amphibians

Amargosa Toad (*Anaxyrus nelsoni*)

The Amargosa toad was proclaimed in 1994 to only having 32 adults remaining in the Oasis Valley, NV (Burroughs M. , 1999). They are limited to a 10 mile stretch of the Amargosa river and its nearby springs and marshes. They require open waters (either slowly flowing or still) with some vegetative canopy cover to live and to breed (Nevada Department of Natural Resources and Conservation, 2016). Adults forage on land near water, while tadpoles remain in the water until they are at least 30 days old (Nevada Department of Natural Resources and Conservation, 2016).

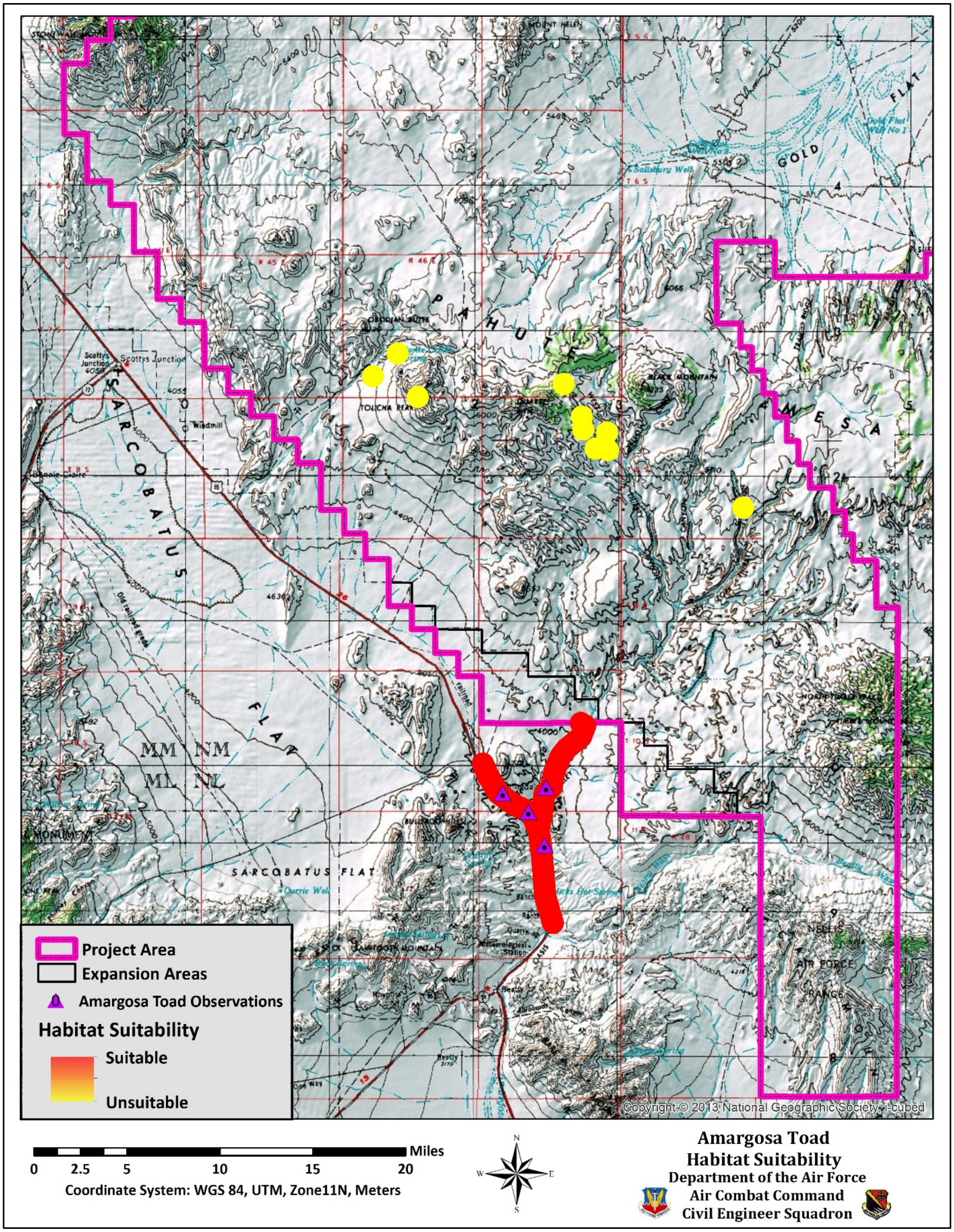
Amargosa Toad (copyright U.S. Department of Agriculture)

Initial efforts were made to have the Amargosa toad listed for federal protection because it was believed that the population was rapidly dropping due to habitat loss, urbanization of the region, off-road vehicles, over-grazing and competition with non-native animal species (bullfrog and crayfish) (U.S. Fish and Wildlife Service, 2016). Other factors that appeared to be adversely affecting toad populations were feral burro grazing, flood control, and commercial development (Jones, 2003). Encroachment of non-native saltcedar also was found to be degrading toad habitat (Burroughs M. , 1999). In 1995, after reviewing the 12-month findings for the listing of the Amargosa toad, the USFWS determined that the supporting data did not warrant listing of the species (U.S. Fish and Wildlife Service, 1996). In 2000, a cooperative conservation agreement was established by several agencies to protect the Amargosa toad (Nevada Division of Wildlife, 2000). The agreement stated that initial surveys for all sites indicate an adult population of over 4,700 toads (Stein, Hobbs, & Wasley, 2000). Annual surveys, population monitoring, and habitat restoration efforts as a result of the conservation agreement have had a positive impact on the protection and management of this toad. Current surveys indicate that the populations are increasing.

All of the observations of the Amargosa Toad have been made in the Amargosa River Valley and Oasis Valley north of Beatty. The earliest recorded observation was made in 1891 and included two observations in two locations. The next documented observation was made in May 1996. In 1998, NDOW and USFWS tagged 6 toads. The next year, NDOW and USFWS tagged 17 toads (11 males and 6 females). In 2000, one toad was tagged by BLM. Three female toads were tagged by NDOW in 2003. In 2008, the population at one location was estimated to be 139 toads which was listed as being 72% below the 10-year average of 499 toads.

NDOW conducts annual surveys to monitor the status of the species in the Amargosa River Valley. Data from these surveys was not available for use in this report, but NDOW indicated that the data is showing a steady improvement in the toad population. The species has not been observed within the boundaries of the study area, although Alternative 3A is in close proximity to areas where the species has been observed. It is doubtful that the toad has established populations in Alternative 3A because the area does not support suitable habitat or perennial springs.

The habitat range for this species only includes the Amargosa River valley and associated streams as well as the Oasis Valley (Figure 25). Perennial water sources on the study area from Tolicha Peak and Black Mountain south to the Yucca Range are included as low potential habitat with a low probability of the species being present. Maxent was not run for this species due to lack of sufficient observation points.



1

Figure 25. Potential habitat range of the Amargosa toad based on documented observations and factors limiting the range.

2

Northern Leopard Frog (*Lithobates pipiens*)

Northern Leopard Frog (copyright U.S. Fish and Wildlife Service-Mountain Prairie)

The northern leopard frog is found across much of the northern United States and in scattered locations across Nevada, Arizona and New Mexico. Northern leopard frogs require open, water to survive, and usually are associated with permanent water features, such as the Pahranagat River in Nevada (Rogers & Peacock, 2012). Shallow waters are used for foraging, breeding, and resting. Deeper waters that do not freeze solid are used for wintering sites (Ohanjanian & Paige, 2004). Typically, they return to the same summer breeding and overwintering sites (Ohanjanian & Paige, 2004). The adults have small home ranges, and forage on land or in the water on a variety of prey such as: insects, arachnids, annelids, and small vertebrates (Ohanjanian & Paige, 2004). The northern leopard frog prefers habitat that is near streams, ponds, lakes, rivers, marshes, and other permanent water sources with rooted vegetation. In the summer, they can be found in open grassy meadows, pastures, or fields; usually a fair distance from the water. Suitable habitat includes river and stream corridors, wetlands, and wetland/upland mosaics in which wetlands are separated by less than 0.5 mi. of upland habitat.

The parameters used to prepare the Habitat Suitability Model for the northern leopard frog were the following:

- Elevation: 2,600 –9,200 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: (Weight factor of 5; Inclusive)
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not a limiting factor
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Not a limiting factor

The only observation of the northern leopard frog was made in 1936 in the Pahranagat Valley about 4 miles south of Alamo, Nevada. The species likely does not occur on the study area, but may be present on perennial water sources.

The Habitat Suitability Model shows some potential for the northern leopard frog to be found around or near the permanent water sources on the study area (Figure 26). It is highly unlikely that the species would be found anywhere on the project area, but permanent water sources should be inspected for the species if impacts are anticipated in the area. Maxent was not run for this species due to the lack of sufficient number of observation points.

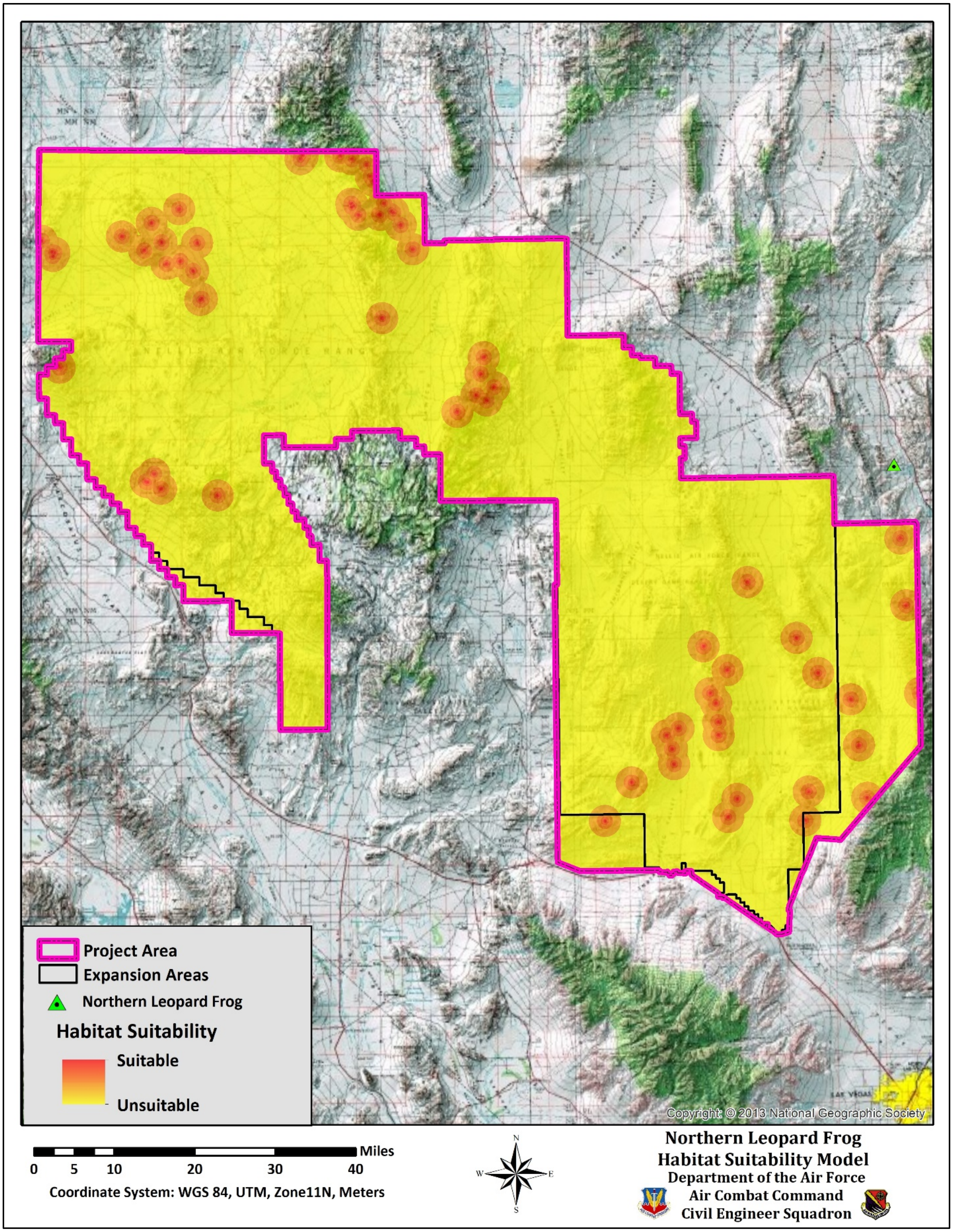


Figure 26. Habitat range of the northern leopard frog as determined by the Habitat Suitability Model.

Reptiles

Banded Gila Monster (*Heloderma suspectum cinctum*)


Banded Gila Monster

The banded Gila monster is found within desert ecosystems throughout southern Nevada, California, Utah, Arizona, and southwestern New Mexico in the Mojave, Sonoran, and Chihuahuan Desert (Nevada Department of Wildlife, 2007). The species is rare, but has been observed in Clark County, Nevada. This venomous lizard is found in desert habitats with clusters of rocky outcrops or canyons with rocky slopes (Nevada Department of Natural Resources and Conservation, 2016). Banded Gila monster habitat may overlap with desert tortoise (*Gopherus agassizzii)* habitat given that tortoise eggs are an important source of food for the lizard (Tracy & Gienger, 2008).

Banded Gila monsters are most active during the warm summer months before the temperatures are excessively high, and seek shelter in the cracks, crevices, and abandoned burrows within their habitat when they are inactive (Beck & Jennings, 2003). It seeks shelter in mammal burrows, thickets, and under rocks in locations with ready access to moisture (Cody, 1999). NDOW has been tracking Gila monsters from 2013 to present and has not found a correlation with Gila monsters and perennial water sources. It is apparent that Gila monsters utilize rocky outcrops in drainages likely retaining surface and subsurface water from precipitation events, but perennial water sources do not seem to be a limiting factor for Gila monsters in southern Nevada (Brad Hardenbrook, 2017, NDOW Review Comments). Habitat in which the species has been observed is characterized by rocky, deeply incised topography, and, in most cases, associated with mountain ranges (Lovich & Beaman, 2007). The preferred habitat within NTTR most likely occurs in rocky outcrops, mountainous slopes, and rocky bajadas which are characteristic of the South Range Study Area. This species is also thought to inhabit, to a lesser extent, thorn scrub, desert grasslands, and oak woodlands (Beck D. D., 2005).

Banded Gila monsters prefer rocky outcrops that retain surface moisture and provide cover (Beck & Jennings, 2003A). Water is critical, and they will leave their shelters immediately after summer rains to find open water to consume and store for later use (Wildlife Action Plan Team, 2013). The species is known to submerge itself in water to cool off (Marshall Cavendish Corp., 2001). Therefore, it may be found in desert washes, springs, and riparian habitats. In Nevada, the species appears to be restricted to the Mojave Desert/lower Colorado River (Lovich & Beaman, 2007). Most of the study area does not meet that criterion.

The parameters used to prepare the Habitat Suitability Model for banded Gila monster were the following:

- Elevation: 1,500 – 5,000 ft. MSL (Degenhardt, Painter, & Price, 1996). (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: (Not weighted; inclusive)

    - Mesquite Bosques and Desert Washes
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities (Weight Factor of 3; not inclusive)
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
    - A3147 *Yucca schidigera* Scrub Alliance

The banded Gila monster has not been observed on the study area. The Habitat Suitability Model indicates that most of the suitable habitat for the Gila monster lies in the bajadas of the South Range Study area with some less suitable habitat in the bajadas of Sarcobatus Flats and Oasis Valley (Figure 27). Maxent was not run for this species due to lack of sufficient observation points.

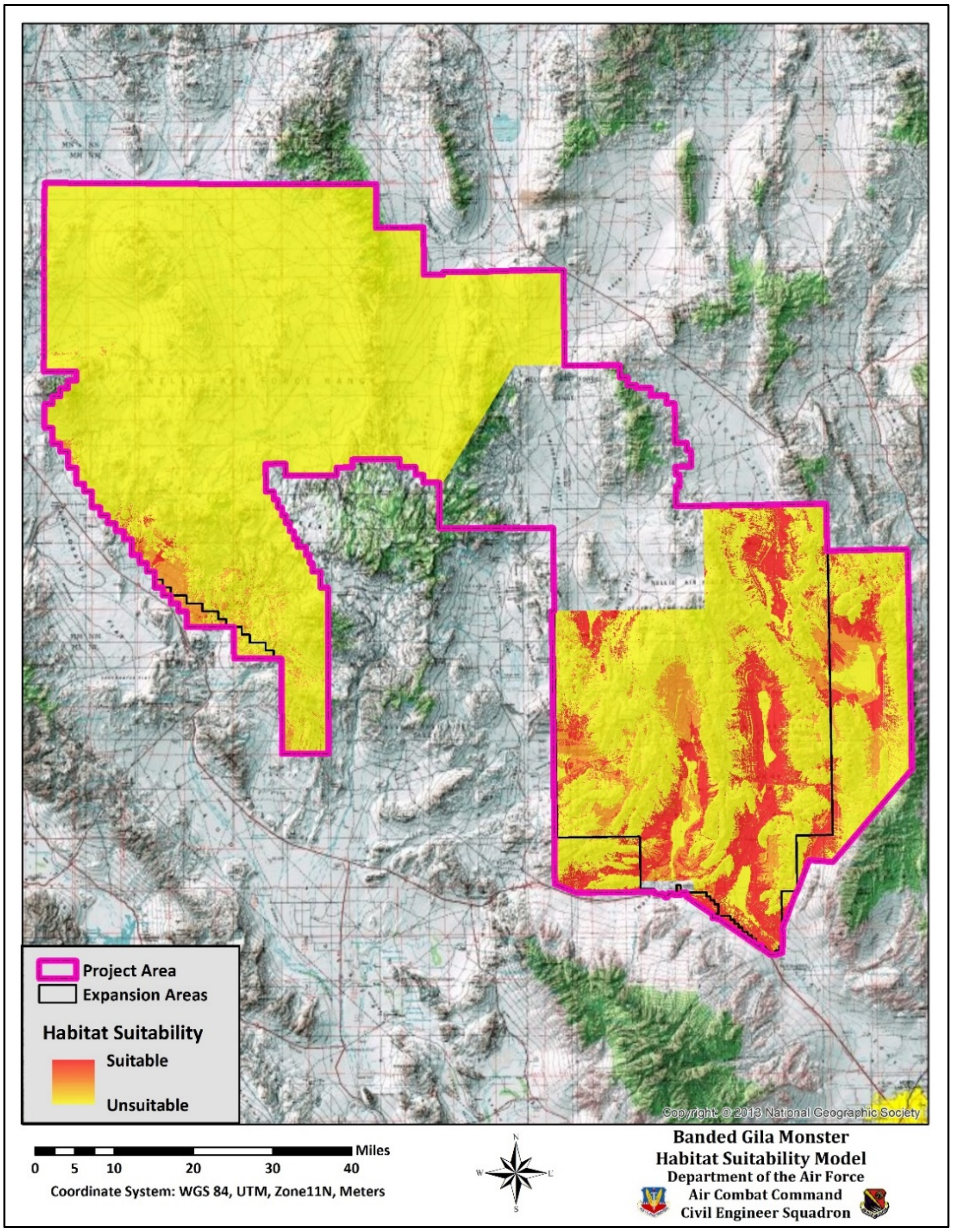


Figure 27. Habitat range of the banded Gila monster as determined by the Habitat Suitability Model.

Desert Tortoise (*Gopherus agassizii*)

The desert tortoise is a federal listed threatened species and is discussed in detail in a separate report (U.S. Air Force, 2017). The habitat model for this species will be prepared as part of the Biological Assessment for the Programmatic Biological Opinion that is currently being prepared for the renewal and potential expansion of the withdrawn land.

BIRDS

Brewer's Sparrow (*Spizella breweri*)

The Brewer's sparrow is a small songbird that inhabits the western United States, primarily in the Great Basin. Brewer's sparrow has a spring and summer habitat preference of shrublands with tall vegetation. It appears to prefer relatively dense sagebrush for cover. During the winter, some populations of the Brewer's sparrow will migrate from the deserts of Nevada to Baja California and Central Mexico (Rising & Beadle, 1996). The birds typically winter in desert scrub habitat dominated by sagebrush, saltbush, or creosote bush (Rotenberry, Patten, & Preston, 1999). The nest is usually built one to twenty inches above the ground in dense foliage of big sagebrush with a canopy height of less than 5 ft. (Knick & Rotenberry, 1995).

Brewer's Sparrow

Typically, Brewer's sparrow habitat is shrub steppe with sagebrush, but it can inhabit shrubby openings of pinyon-juniper and mountain mahogany woodlands. It is considered a sagebrush obligate species. Shrub steppe habitat can be defined as "habitat with a co-dominance of sagebrush and native bunch grass with moderate shrub cover" (Hansley & Beauvais, 2004). Knick and Rotenberry (1995) showed that Brewer's sparrow occurrence was primarily a function of shrub cover, and secondarily, a function of shrub patch size (Hansley & Beauvais, 2004). Altman and Holmes (2000) defined the habitat as: sagebrush cover of 10% to 30%, mean height greater than 25 inches, high foliage density, average herbaceous cover greater than 10%, and bare ground greater than 20%. In a Nevada specific study, Brewer's sparrows preferred sites with fewer trees, greater sagebrush heights, and the presence of surface water within 0.6 miles. Habitat also appeared to be associated with salt desert scrub, but to a lesser extent (Great Basin Bird Observatory, 2010).

The parameters used to prepare the Habitat Suitability Model for the Brewer's sparrow were the following:

- Elevation: 0 – 6,500 ft. MSL (BirdLife International, 2016) (Not weighted; not inclusive)
- Slope: < 30° (Vasquez, 2005) (Not weighted; not inclusive)
- Aspect: Not a limiting factor
- Permanent Water: (Weight factor of 3, but not inclusive).
- Temporary Water: (Weight factor of 2, but not inclusive).
- Geology: Not a limiting factor
- Key Habitat: (Weight factor of 1; not inclusive)
  - Sagebrush
  - Lower Montane Woodlands
  - Intermountain Cold Desert Scrub
  - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities (Weight Factor of 2; not inclusive)
  - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
  - A3219 *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance

- A3222 *Artemisia nova* Steppe & Shrubland Alliance
- A0870 *Atriplex confertifolia* Scrub Alliance
- A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
- CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
- A3147 *Yucca schidigera* Scrub Alliance
- A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance

NNRP has made 30 observations of Brewer's sparrow from 2007 to 2015 on NTTR (Nellis Air Force Base, 2016). Additionally, Adams Ecology ornithologists recorded 14 observations of Brewer's sparrows on Alternative 3C on the DNWR. No observations have been recorded in or around the study area in bird surveys conducted prior to 2007.

The Habitat Suitability Model placed importance on the water sources and plant community layers (Figure 28). This resulted in most of the habitat being found in mountain ranges where sagebrush and pinyon-juniper habitat occurred on the North Range Study Area. In contrast, on the South Range Study Area the model showed most of the habitat on the bajadas where Joshua tree and creosote bush were dominants. Some of the observations of Brewer's sparrow did not occur in suitable habitat according to the model. This may be attributed to birds flying through unsuitable habitat in route to suitable habitat. The trend toward the species being found in mountains on the North Range Study Area and bajadas of the South Range Study Area is supported by the locations of species observations.

The Maxent Model emphasized permanent water sources and slope with less importance placed on geology, soils and aspect (Table 6). The resulting habitat range was similar to that of the Habitat Suitability Model (Figure 29). The model appeared to be fairly accurate because most of the observation points fell on fair to good suitability of habitat. In the North Range Study Area, the more suitable habitat was found on the foothills and slopes of mountain ranges. In the South Range Study Area, most of the suitable habitat was found on the upper bajadas.

Table 6. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the Brewer's sparrow model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	1.3	17
Geology	8.8	0
Soil Association	6.8	0
Key Habitat	8.9	8
Temp. Water Source	0.7	17
Permanent Water Source	35.2	26
Mountains	2.4	0
Valleys	0.0	8
Mines	0.0	8
Slope	35.0	8
Elevation	0.0	8
Aspect	0.9	0

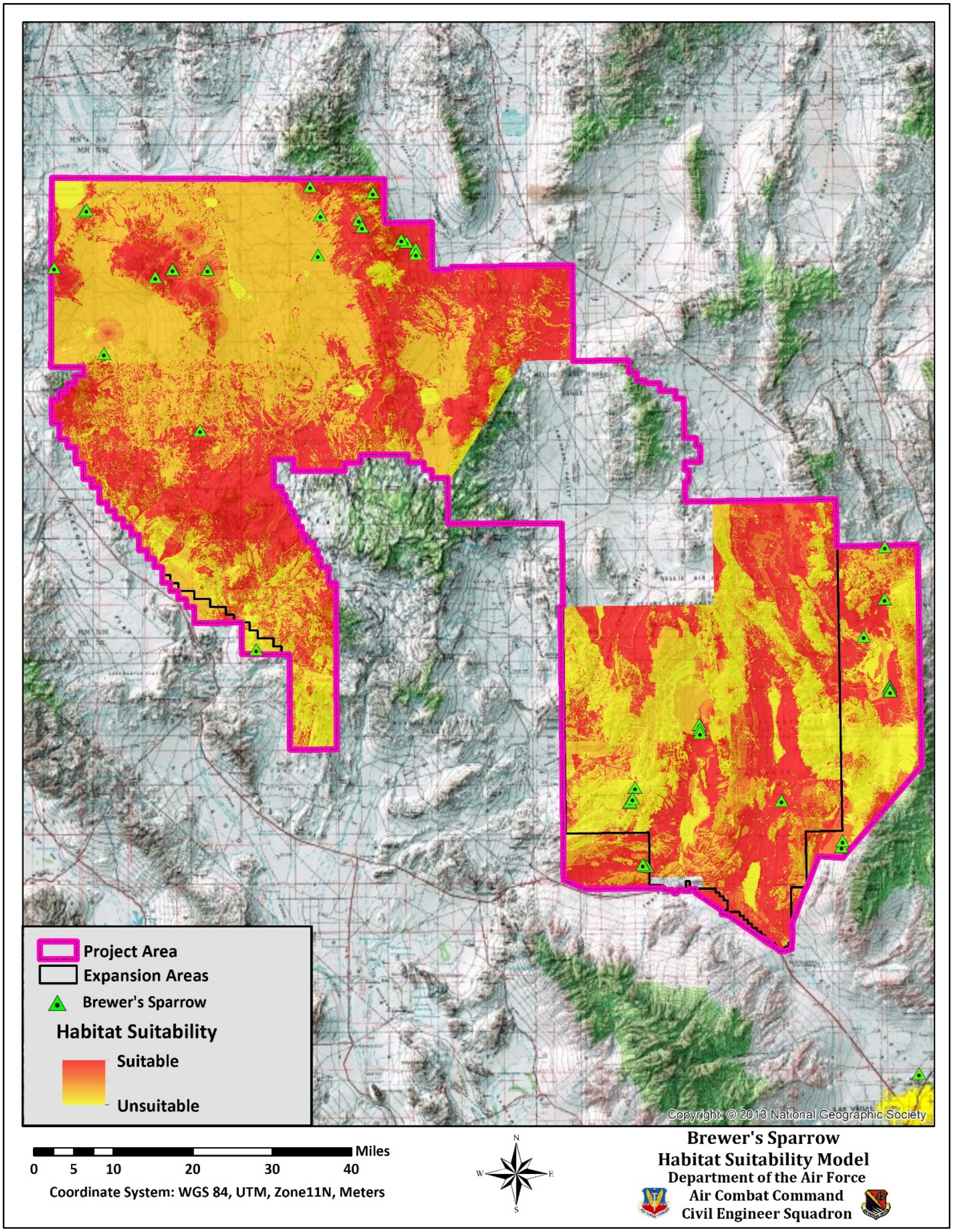


Figure 28. Habitat range of Brewer's sparrow as determined by the Habitat Suitability Model.

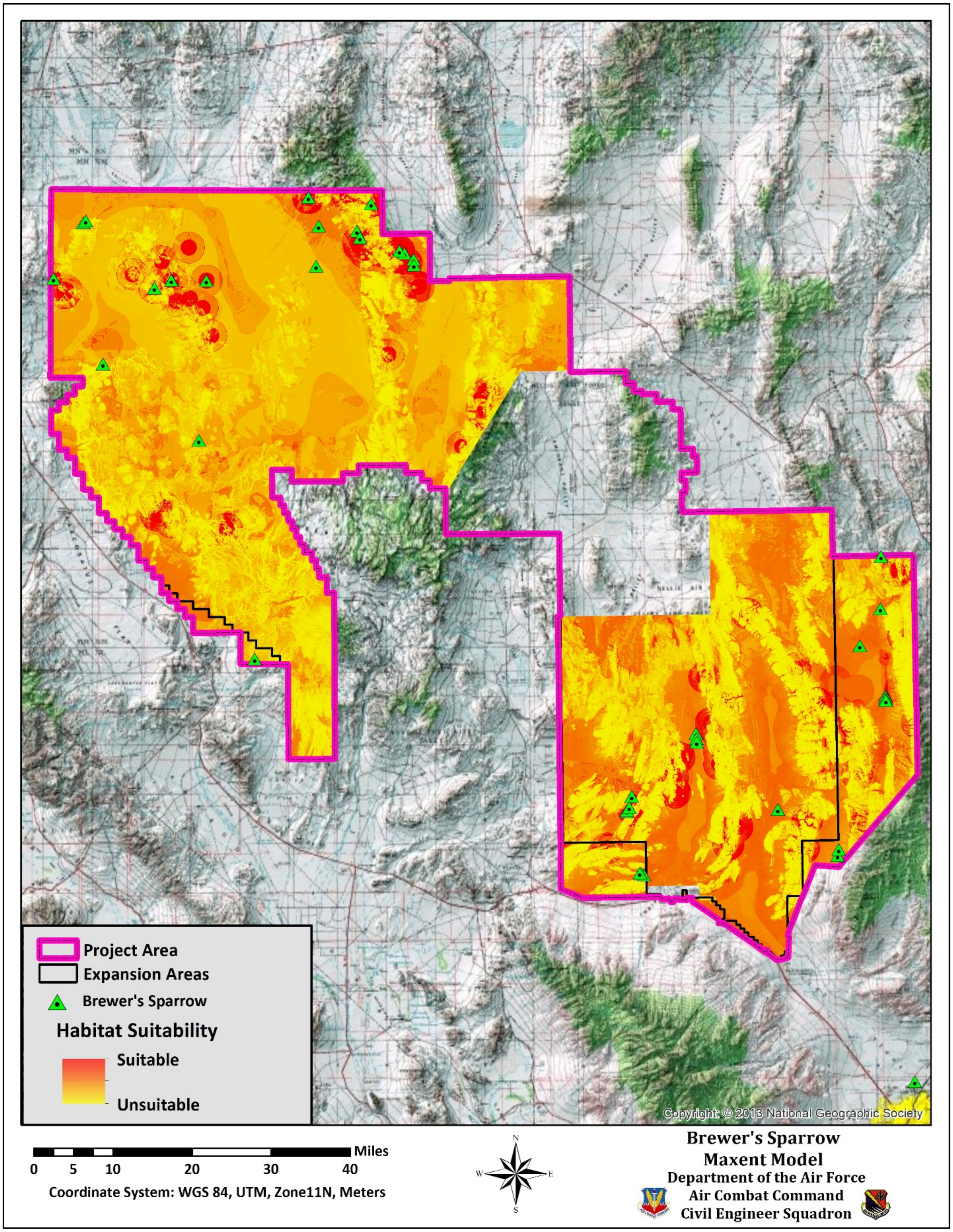


Figure 29. Habitat range of Brewer's sparrow as determined by the Maxent Model.

Bendire's Thrasher (*Toxostoma bendirei*)

Bendire's Thrasher (copyright Dominic Sherony)

The Bendire's thrasher is found exclusively in warm desert environments. They visit water developments and other water sources to bathe and possibly drink, but water sources are not essential for survival (Lynn, Chambers, & Rosenstock, 2006). Nests are placed 3 to 10 ft. above the ground in shrubs, trees, or cacti. Favorite plants used as nest sites include cholla, yucca, mesquite, acacia, and desert hackberry (Kaufman, 2016). The thrasher appears to avoid rocky soils and slopes that prevent digging (Nevada Natural Heritage Program, 2016). Primary habitat for this species is within areas of tall vegetation, cholla cactus, creosote bush and yucca, in juniper woodland (Cornell Lab of Ornithology, 1993). Bendire's thrasher may occasionally be found in catclaw, palo verde, hackberry, willow, and saltbush. The birds are not found in dense vegetation, such as riparian corridors, but may be found in the edges. Populations are restricted to 0 – 5,900 ft. MSL (England & Laudenslayer, 1993).

The parameters used to prepare the Habitat Suitability Model for Bendire's thrasher were the following:

- Elevation: 0 – 6,000 ft. MSL (England & Laudenslayer, 1993) (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: (Not weighted; not inclusive)
- Temporary Water: (Not weighted; not inclusive)
- Geology: Not a limiting factor
- Key Habitat: (Weight factor of 2; inclusive)
    - Mesquite Bosques and Desert Washes
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities (Weight Factor of 3; not inclusive)
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - A3148 *Yucca brevifolia* Wooded Scrub Alliance
    - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
    - A3147 *Yucca schidigera* Scrub Alliance

Bendire's Thrasher has not been observed in or around the study area recently or historically. The Habitat Suitability Model emphasis was on key habitat and vegetation for mapping this species habitat range (Figure 30). Mountains were excluded. The model showed suitable habitat located in the bajadas of the South Range Study Area and creosote bush and Joshua tree dominated plant communities in Alternative 3A and the southwest North Range Study Area. Areas of highest potential occurrence of the species were found in the east and central South Range Study Area. Maxent was not run for this species due to lack of sufficient observations.

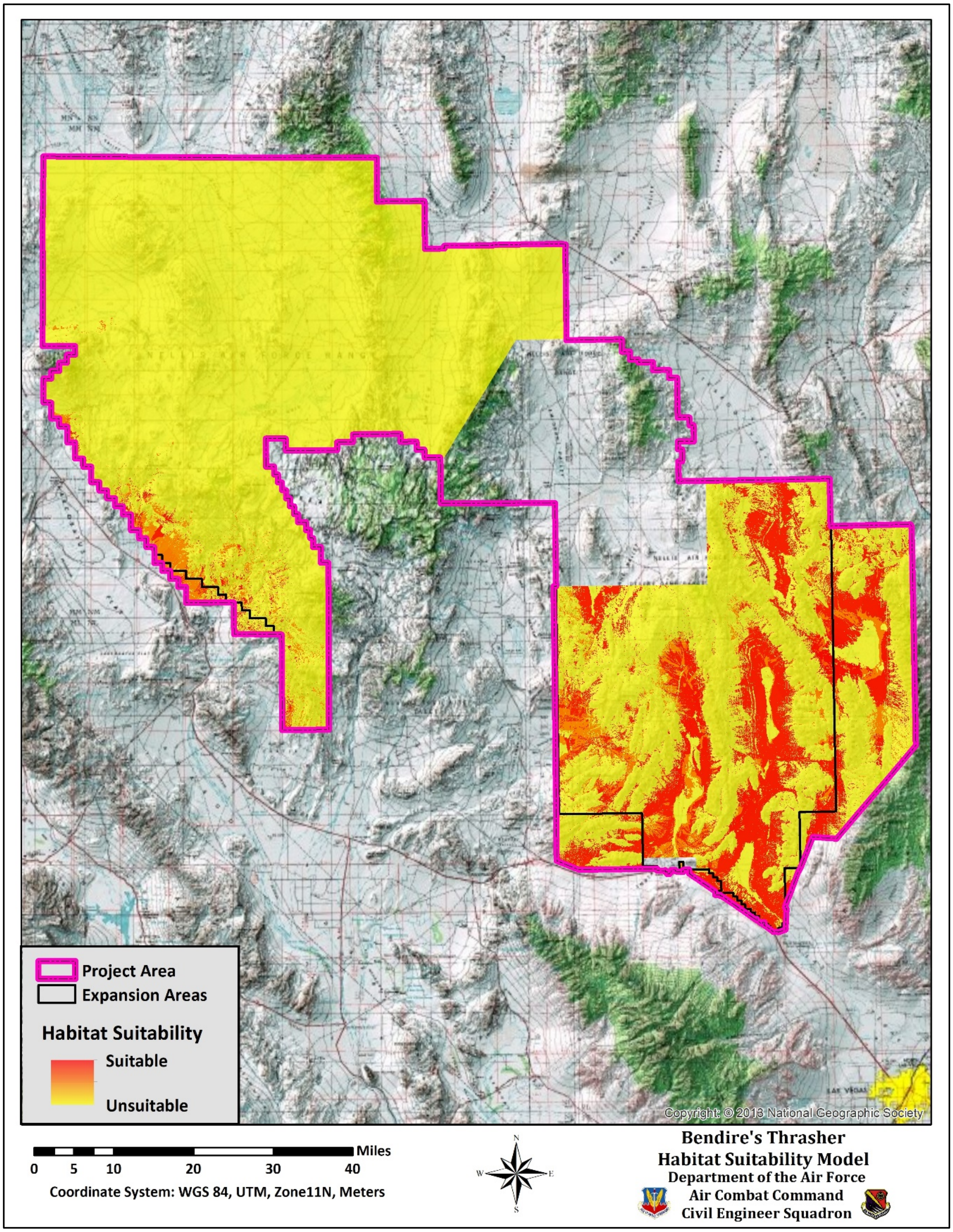


Figure 30. Habitat range of Bendire's thrasher as determined by the Habitat Suitability Model.

Northern Goshawk (*Accipiter gentilis*)

Northern Goshawk (copyright Norbert Kenntner, Berlin)

In North America, the goshawk habitat ranges from western central Alaska and the Yukon territories in the north to the mountains of northwestern and western Mexico (Clark & Wheeler, 1987). Northern goshawks are year-round residents in Nevada and across all of their range (Nevada Department of Wildlife, 2017; Squires & Reynolds, 1997). The goshawk is often considered a "mature forest" indicator species because of its preference for older, well-established forests for nesting and foraging (Mahon, 2009).

They prefer canopy closure of greater than 60%, with coniferous trees being favored, however aspen trees may be favored as well (Great Basin Bird Observatory, 2010). Mixed forests are also acceptable (Great Basin Bird Observatory, 2010; Greenwald, Crocker-Bedford, Broberg, Suckling, & Tibbitts, 2005). This raptor selects habitat that has an open water source, but it is not known if the raptor consumes water from these water sources (Great Basin Bird Observatory, 2010). In Nevada, northern goshawks nest primarily in aspen and riparian habitat (Nevada Department of Wildlife, 2017). It has been suggested that goshawks may be habitat specialists with regard to forest structure, but generalists in terms of tree species composition (Greenwald, Crocker-Bedford, Broberg, Suckling, & Tibbitts, 2005). However, the northern goshawk appears to prefer some tree species including ponderosa pine, lodgepole pine, douglas fir, white fir, and hemlock spruce. Of these species, only very sparce populations of white fir and ponderosa pine are found within the study area in the higher elevations of the Kawich, Belted and Sheep Ranges. Goshawks are found at almost any elevation ranging from sea level to alpine (The Cornell Lab of Ornithology, 2017).

The parameters used to prepare the Habitat Suitability Model for northern goshawk were the following:

- Elevation: Not a limiting factor
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: (Weighting Factor of 3; not inclusive)
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: (Weighting factor of 2; not inclusive)
    - Intermountain Conifer Forests and Woodlands
    - Lower Montane Woodlands
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities (Weight Factor of 3; not inclusive)
    - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - CEGL000825 *Pinus monophylla* Woodland

As of 2016, no northern goshawks had been observed on the study area. The Habitat Suitability Model emphasized pinyon pine and mountainous habitat for this species (Figure 31). Thus, the resulting map showed suitable habitat for the northern goshawk to be on most of the mountain ranges of the North Range Study Area where pinyon pine was present, especially Timber Mountain, Stonewall Mountain, the Kawich Range, and the Belted Range. Maxent was not run for this species due to lack of sufficient observations.

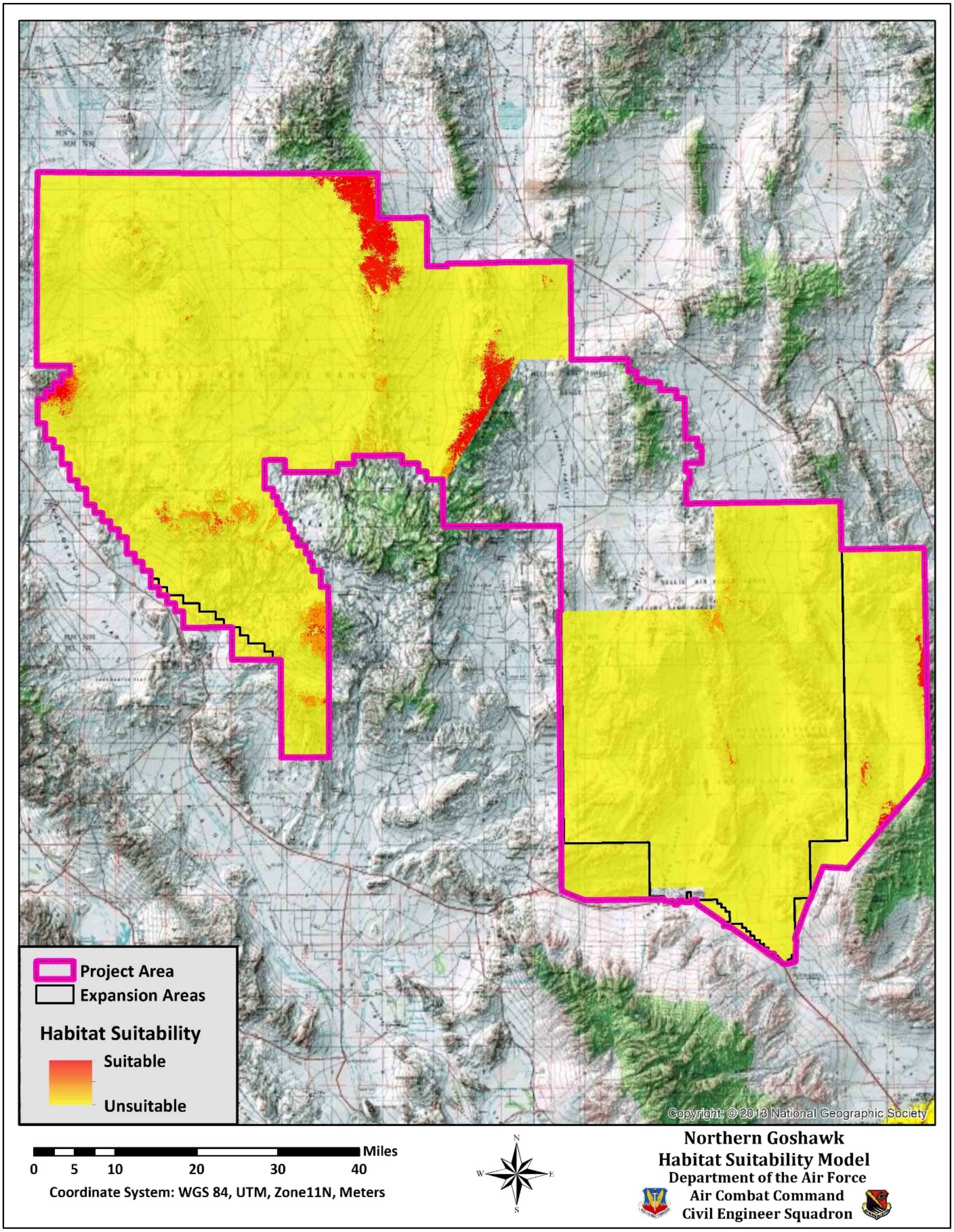


Figure 31. Habitat range of the northern goshawk as determined by the Habitat Suitability Model.

Loggerhead Shrike (*Lanius ludovicianus*)

Within the United States, the loggerhead shrike is found in the central to southern states and Mexico (Wiggins, 2005). The loggerhead shrike is a resident in the southern range and migratory in the more northern ranges (The Cornell Lab of Ornithology, 2013). It is also a resident species throughout Nevada, except in the Sierra Nevada mountains where it may be a migrant (Wildlife Action Plan Team, 2006).

Loggerhead Shrike

Loggerhead shrikes are generally found in open country with scattered trees and large shrubs (Yosef, 1992; Dorn & Dorn, 1999). Shrikes appear to prefer lower elevations relative to the surrounding topography (Hall & Legrand, 2000). The most important habitat feature is likely the presence of dense shrubs or trees for nesting with nearby open herbaceous areas for foraging for insects and small reptiles (Keinath & Schneider, 2005). The shrike has not been documented as requiring water in desert areas but is often observed near water sources (Miller A. , 1931).

Loggerhead shrikes have often been observed at many locations on the study area. According to the NNRP geodatabase, the species has been observed in six key habitats and several plant communities that are listed in the habitat parameters below (Nellis Air Force Base, 2016).

The parameters used to prepare the Habitat Suitability Model for loggerhead shrike were the following:

- Elevation: Not a limiting factor
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: (Not weighted; not inclusive)
- Temporary Water: (Not weighted; not inclusive)
- Geology: Not a limiting factor
- Key Habitat: (Not weighted; not inclusive)
    - Desert Playas and Ephemeral Pools
    - Intermountain Cold Desert Scrub
    - Lower Montane Woodlands
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Mojave/Sonoran Warm Desert Scrub
    - Sagebrush
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities (Not weighted; not inclusive)
    - A3279 *Ambrosia dumosa* Desert Dwarf Scrub Alliance
    - A3219 *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance
    - A3222 *Artemisia nova* Steppe & Shrubland Alliance
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
    - A0869 *Atriplex canescens* Scrub Alliance
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A3144 *Coleogyne ramosissima* Mojave Desert Scrub Alliance
    - Developed or Disturbed Land

- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
- A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
- CEGL001452 *Picrothamnus desertorum* Shrubland
- A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
- *Sarcobatus baileyi* Shrubland Alliance (Peterson, 2008)
- A1046 *Sarcobatus vermiculatus* Intermountain Wet Shrubland Alliance
- A3148 *Yucca brevifolia* Wooded Scrub Alliance
- CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland
- CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
- A3147 *Yucca schidigera* Scrub Alliance

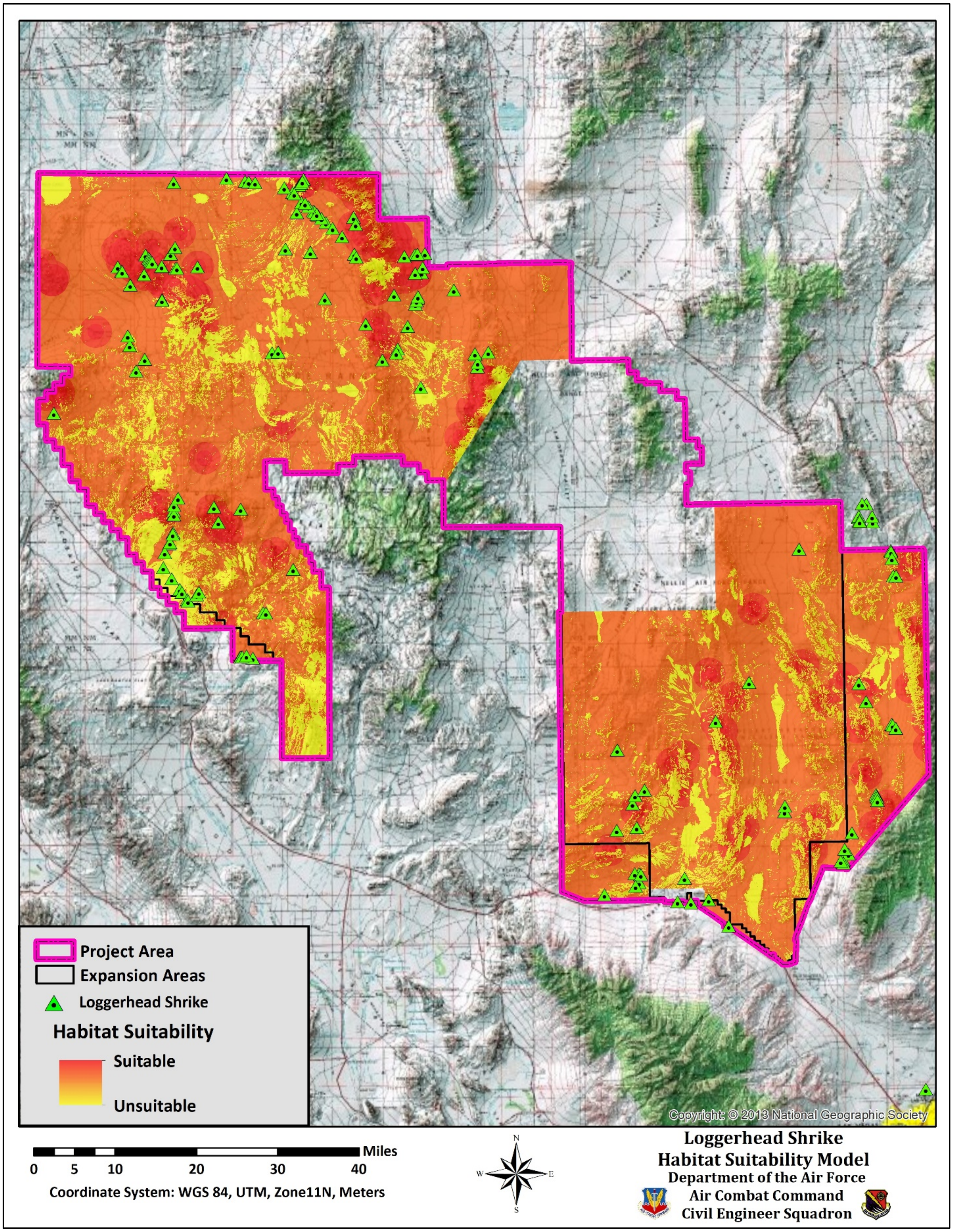
Loggerhead shrikes have been observed across the study area with a total of 158 observations being made. Most of the observations have been made in basins and foothills, but not mountains.

The Habitat Suitability Model assigned equal importance to vegetation, key habitat, temporary water sources, permanent water sources, mountains, and valleys for mapping of habitat since the species is widespread across the study area (Figure 32). The resulting map basically showed that the species preferred the foothills and slopes of mountain ranges and upper bajadas. Some of the observations of the species did not occur in suitable habitat according to the model, especially just north of Alternative 3A in the Sacobatus Flats. These observations could have been due to movement of birds between suitable habitats. Additionally, habitat ranges could be adjusted by refinement of the model as more habitat preference information and GIS layers are available.

The Maxent Model placed the highest importance on slope with secondary importance on soils, permanent water sources, and geology (Table 7). The Maxent model was similar to the Habitat Suitability Model on the North Range Study Area, but did not show significant habitat in the South Range Study Area (Figure 33). The Maxent Model appeared accurate on the North Range Study Area based on observations, but not as accurate on the South Range Study Area. In general, the models were comparable, but Maxent showed less suitable habitat than the Habitat Suitability Model.

Table 7. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the fringed myotis model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	4.0	17
Geology	8.3	0
Soil Association	14.0	0
Key Habitat	2.4	17
Temp. Water Source	1.7	17
Permanent Water Source	12.9	17
Mountains	0.0	17
Valleys	0.0	17
Mines	0.0	0
Slope	49.5	0
Elevation	0.0	0
Aspect	0.2	0



1
2 Figure 32. Habitat range of the loggerhead shrike as determined by the Habitat Suitability Model.
3

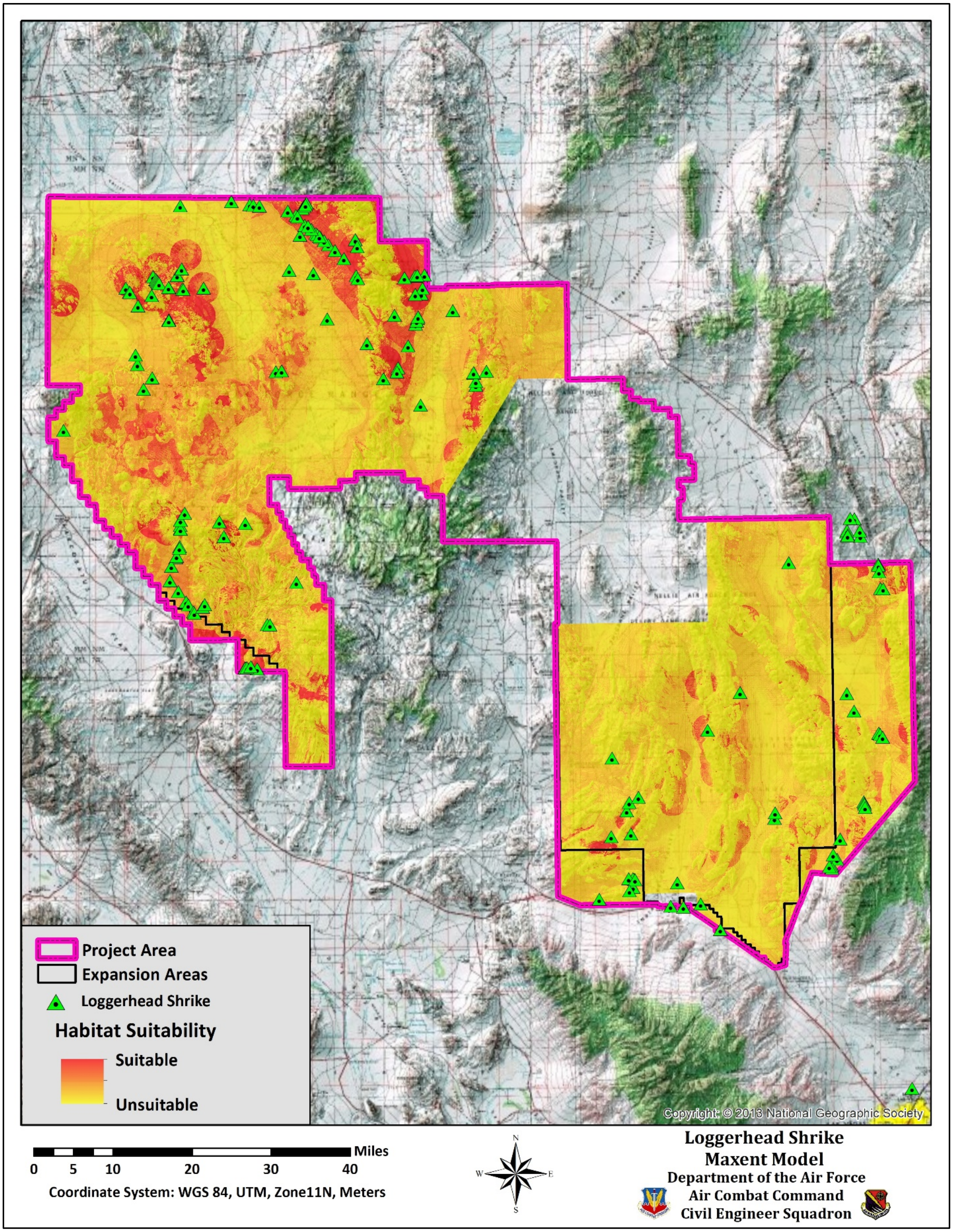


Figure 33. Habitat range of the loggerhead shrike as determined by the Maxent Model.

Greater Sage-grouse (*Centrocercus urophasianus*)

Greater sage-grouse are found throughout northern Nevada along with eight other western states and south-central Canada (Cornell Lab of Ornithology, 2016). They depend on a variety of shrub steppe habitats throughout their life cycle, and are considered obligate users of several species of sagebrush, including *Artemisia tridentata* and *A. nova* (Baker, Eng, Gashwiler, Schroeder, & Braun, 1976). Meadows, riparian areas, irrigated hay fields, and other moist areas within or adjacent to sagebrush habitat provide summer foraging areas.

Greater Sage-grouse (copyright Bureau of Land Management)

Only 3 observations of greater sage-grouse have been made on the study area. A map depicting greater sage-grouse habitat was previously developed using a combination of plant community data and observation points (Figure 34). Detailed information on this species is provided in a separate report (U.S. Air Force, 2017).

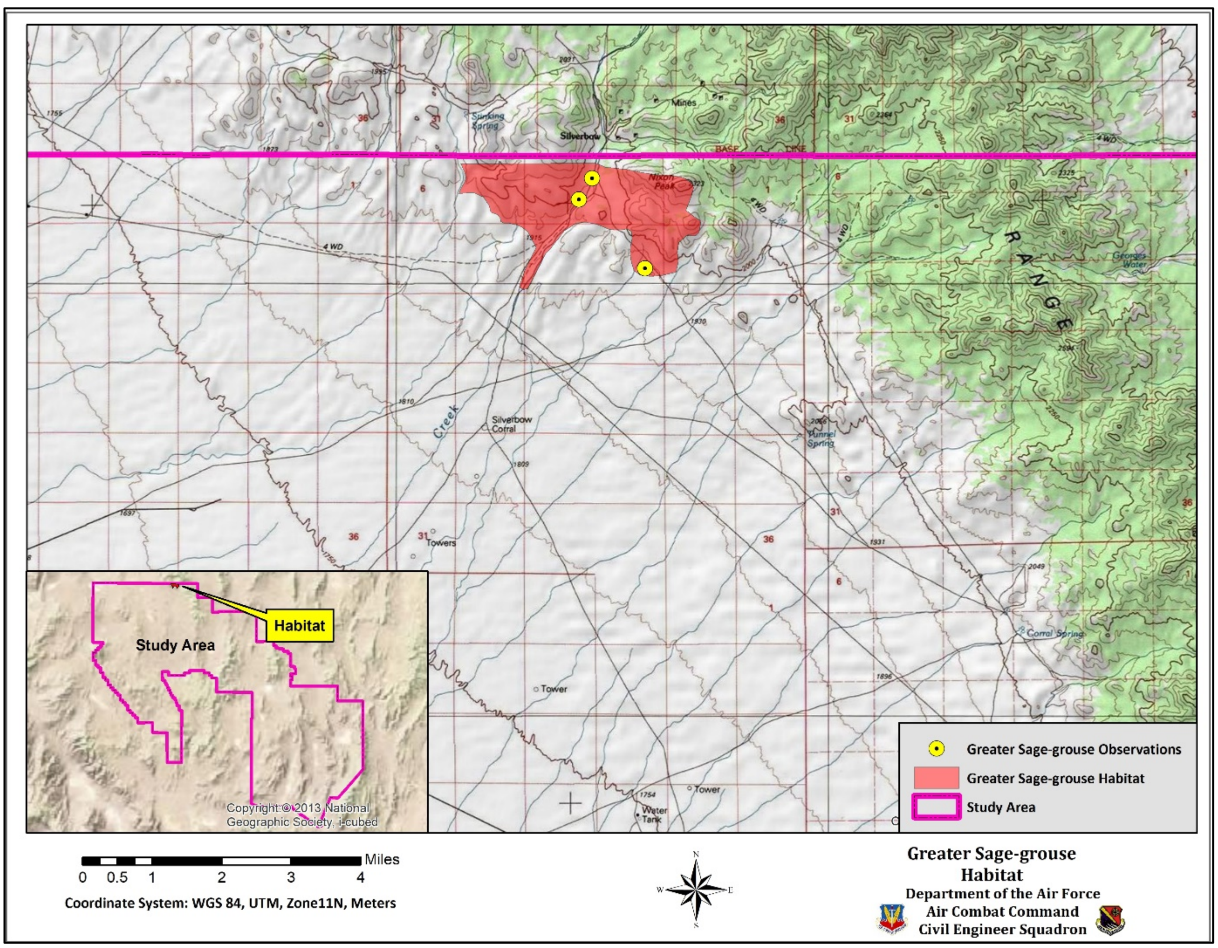


Figure 34. Greater sage-grouse habitat found on the North Range Study Area (U.S. Air Force, 2017).

MAMMALS

Dark Kangaroo Mouse (*Microdipodops megacephalus*)

The dark kangaroo mouse is endemic to the western United States including Nevada (Verts & Carraway, 1998). The diet of the dark kangaroo mouse is mostly comprised of small seeds (Burnie, 2001), but may also include small insects (Rafferty, 2011) such as beetles and butterfly larvae (Verts & Carraway, 1998), and small amounts of green vegetation (Verts & Carraway, 1998). Water is apparently not required for survival of the dark kangaroo mouse (Burnie, 2001) because the species obtains water from its food and reduces water loss by efficient removal of water from urine and feces (Rafferty, 2011).

Dark Kangaroo Mouse (copyright Aaron Ambos)

The dark kangaroo mouse requires fine sand, or at least wind-blown silt structurally supported by the roots of vegetation for construction of its burrow. The burrow is used for protection from predators, raising young, and storing seed. The species is highly dependent on soil texture and, within the study area, appears to be restricted to sandy or silty desert valleys of Lincoln County within elevations of 4,700 to 5,300 ft. MSL (Hall & Durrant, A New Kangaroo Mouse (Microdipodops) of Utah and Nevada, 1937; O'Farrel & Blaustein, 1974)

The parameters used to prepare the Habitat Suitability Model for the dark kangaroo mouse were the following:

- Elevation: 3,900 – 8,000 ft. MSL (Hall & Durrant, 1937; O'Farrel & Blaustein, 1974). This parameter was not weighted (weighting factor of 1) and not inclusive.
- Slope: Nearly Level to Strongly Sloping (Based on its preference to desert valleys). This parameter was not weighted and not inclusive.
- Aspect: Not a limiting factor
- Water: Not a limiting factor
- Geology: Probably limiting, but no layers are available that provide the required information.
- Key Habitat (Not weighted and not inclusive):
    - Mojave Warm Desert and Mixed Desert Scrub
    - Sand Dunes and Badlands
    - Intermountain Cold Desert Scrub
    - Sagebrush
- Soil Associations: (Weight factor of 2; not inclusive). Included the following associations based on the fact that they are found in sandy areas:
    - ST. THOMAS-ROCK OUTCROP-KYLER (NV204)
    - CIRAC-NUYOBE-RUSTIGATE (NV521)
    - TENCEE-WEISER-COLOROCK (NV202)
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities (Verts & Carraway, 1998): (Weight factor of 1, not inclusive)
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A1044 *Chilopsis linearis - Psorothamnus spinosus* Desert Wash Scrub Alliance
    - A3195 *Chrysothamnus viscidiflorus* Steppe & Shrubland Alliance
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
    - A3219 *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance

- A3222 *Artemisia nova* Steppe & Shrubland Alliance
- CEGL001315 *Atriplex confertifolia / Tetradymia glabrata* Shrubland
- CEGL001452 *Picrothamnus desertorum* Shrubland

Only four observations of the species were found on the study area, two in the Kawich Valley and two on the northeast side of Groom Lake outside of the area being modeled. According to the Habitat Suitability Model, the best habitat for this species was in the deep sandy soils around the dry lakes in the North Range Study Area (Figure 35). Other lower potential habitat was located throughout the basins of the North Range Study Area and in the upper bajadas around the playas of the South Range Study Area. Maxent was not run for this species due to an insufficient number of observations on the study area.

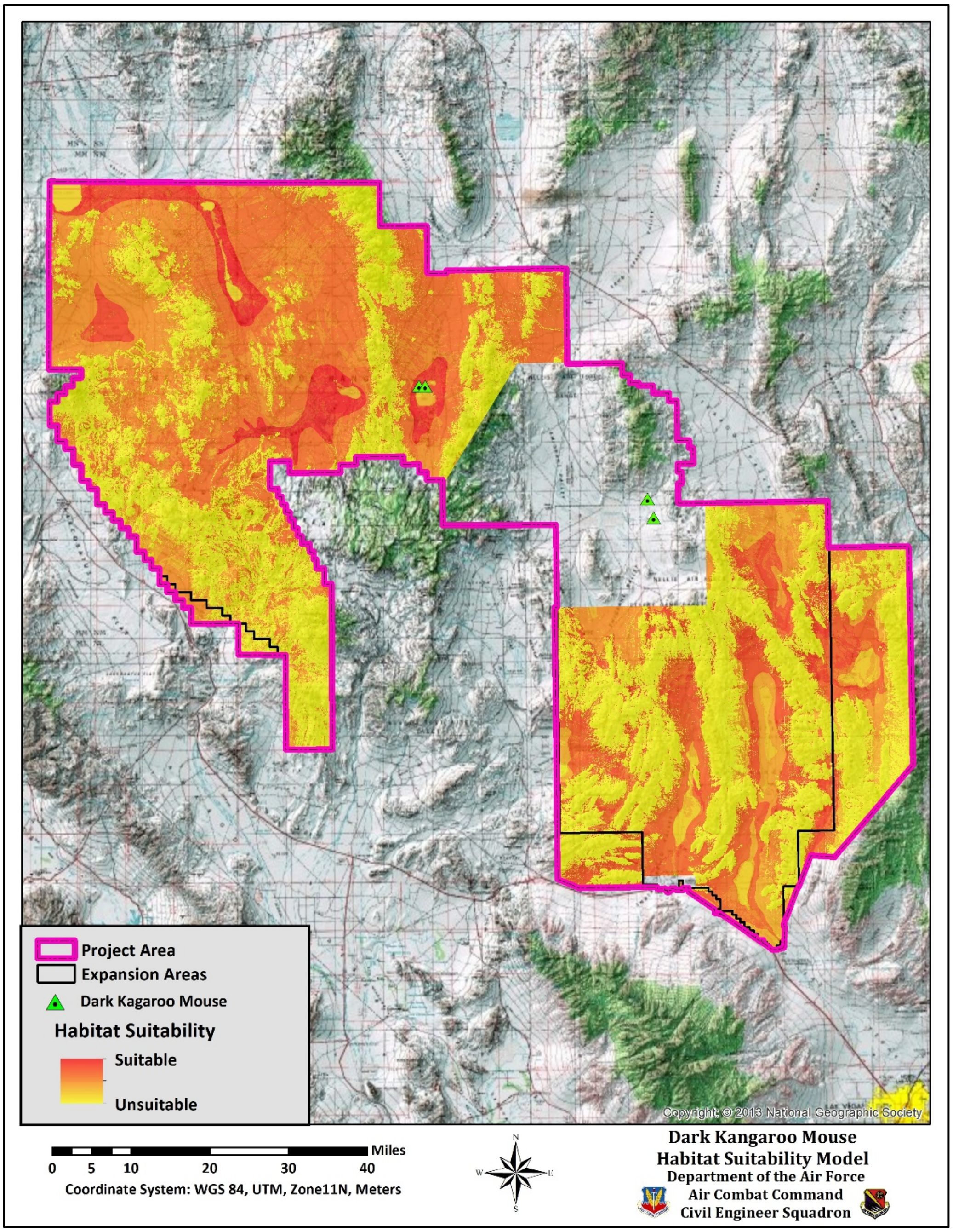


Figure 35. Habitat range of the dark kangaroo mouse as determined by the Habitat Suitability Model.

Desert Pocket Mouse (*Chaetodipus penicillatus*)


Desert Pocket Mouse

The desert pocket mouse has been found in Nevada and other areas of the southwestern U.S. usually in dunes and other sandy habitats (RECON, 2000; Linzey, Timm, Alvarez-Castaneda, Castro-Arellano, & Lacher, 2016). Similar to the dark kangaroo mouse, the desert pocket mouse prefers sparsely-vegetated, sandy desert floors. The species appears to prefer rock-free bottomland soils along rivers and streams (Hall E. R., Mammals of Nevada, 1946; Ingles, 1965). The diet of the desert pocket mouse is mostly seeds with a preference for seeds from Mesquite (*Prosopis* spp.) and creosote bush (NatureServe, 2016). This diet may be occasionally supplemented with insects. Preferred habitat of the desert pocket mouse overlies fine-grained sandy soils that can be easily excavated for burrows and forage. Within the study area, the species prefers desert washes and uplands at elevations ranging from 2,000 ft. to 5,200 ft. MSL (Jorgensen, Demarais, Sell, & Lerich, 1998). Because it prefers creosote seed, all plant communities that are dominated by creosote bush were included as a factor in the model (NatureServe, 2016).

The parameters used to prepare the Habitat Suitability Model for the desert pocket mouse were the following:

- Elevation: 2,000 – 5,200 ft. MSL (Jorgensen, Demarais, Sell, & Lerich, 1998) (Not weighted and not inclusive).
- Slope: Nearly Level to Moderately Sloping (Based on its preference to desert valleys). This parameter was not weighted and not inclusive.
- Aspect: Not a limiting factor
- Water: Not a limiting factor
- Geology: Probably limiting, but no layers are available that provide the required information.
- Key Habitat (Wildlife Action Plan Team, 2013): (Weighting factor of 2; not inclusive)
  - Mojave/Sonoran Warm Desert Scrub
  - Mesquite Bosques and Desert Washes
  - Sand Dunes and Badlands
- Soil Associations (Weighting factor of 2; not inclusive): Included the following associations based on the fact that they contain sandy soils:
  - ST. THOMAS-ROCK OUTCROP-KYLER (NV204)
  - CIRAC-NUYOBE-RUSTIGATE (NV521)
  - TENCEE-WEISER-COLOROCK (NV202)
- Mountains were excluded.
- Valleys were not excluded.
- Plant communities (Weighting factor of 3; inclusive). Based on preference for creosotebush seed (NatureServe, 2016):
  - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
  - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
  - A3147 *Yucca schidigera* Scrub Alliance

The Habitat Suitability Model showed that suitable habitat for the desert pocket mouse is found in the bajadas around the playas and dry lakes of the South Range Study Area where plant communities are dominated by creosote bush (Figure 36). Small areas of medium potential habitat were found on the North Range Study Area in the north end of Alternative 3A and scattered creosote bush communities on the east side of Sarcobatus Flats. Maxent was not run for this species due to lack of sufficient observations.

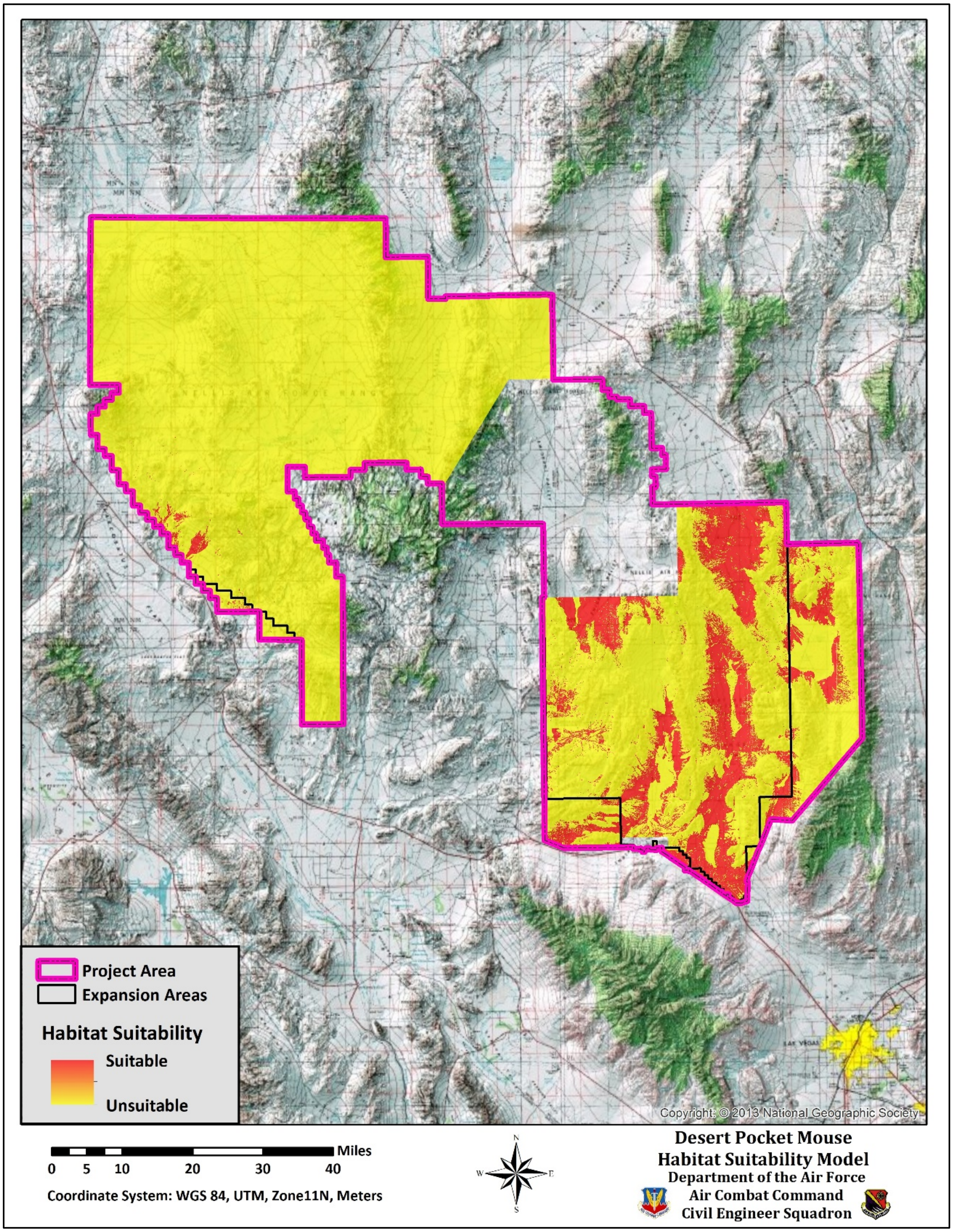


Figure 36. Habitat range of the desert pocket mouse as determined by the Habitat Suitability Model.

Pale Kangaroo Mouse (*Microdipodops pallidus*)

Pale kangaroo mouse

This small, sand-obligate mouse is endemic to the Great Basin Desert of western North America (Hafner & Hafner, 1998). Pale kangaroo mouse habitat is restricted to areas of fine sand which support some plant growth (Bartholomew & MacMillen, 1961). Within the study area, it appears to prefer Intermountain Cold Desert Scrub key habitat, and is typically found in sandy soils from 3,900 to 6,000 ft. MSL (Hafner, Upham, Reddington, & Torres, 2008). Microhabitats include alkaline sinks and desert scrub dominated by various species of shadscale or big sagebrush. It usually prefers soft, windblown sand piled at bases of shrubs for burrow sites and is less commonly found in gravelly soil (Wildlife Action Plan Team, 2013). This species is primarily granivorous but a portion of its diet consists of insects and green vegetation (Hall E. R., 1946). Free water is not required for this species as its water requirements are obtained through seeds and an efficient kidney function (Woods, 1990). The Nellis Natural Resources Program (NNRP) has only found this species within the vicinity of sand dunes, stabilized dunes, or sandy soils, but the number of surveys conducted is somewhat limited (U.S. Air Force, 2017).

The parameters used to prepare the Habitat Suitability Model for the pale kangaroo mouse were the following:

- Elevation: 3,900 – 6,000 ft. MSL (Hafner, Upham, Reddington, & Torres, 2008) (Not weighted and not inclusive)
- Slope: Flat to moderately sloping, no weighting factor. Based on the preference for valley basins.
- Aspect: Not a limiting factor
- Water: Not a limiting factor
- Geology: Probably limiting, but no layers are available that provide the required information.
- Key Habitat (Wildlife Action Plan Team, 2013): (Weighting factor of 2; Not inclusive)
    - Intermountain Cold Desert Scrub
    - Majave/Sonoran Warm Desert Scrub
    - Sagebrush
    - Sand Dunes and Badlands
- Soil Associations (Weighting factor of 2; not inclusive): Included the following associations based on the fact that they contain sandy soils:
    - ST. THOMAS-ROCK OUTCROP-KYLER (NV204)
    - CIRAC-NUYOBE-RUSTIGATE (NV521)
    - TENCEE-WEISER-COLOROCK (NV202)
- Mountains were excluded.
- Valleys were not excluded.
- Plant communities (Weighting factor of 3; not inclusive). Based on preference for shadscale and big sagebrush habitat (Wildlife Action Plan Team, 2013) and sandy soils:
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A1044 *Chilopsis linearis - Psorothamnus spinosus* Desert Wash Scrub Alliance
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
    - CEGL001315 *Atriplex confertifolia / Tetradymia glabrata* Shrubland
    - CEGL001452 *Picrothamnus desertorum* Shrubland

- *Sarcobatus baileyi* Shrubland Alliance (Peterson, 2008)

According to the NNHP database (Nevada Natural Heritage Program, 2016), in 1921, four populations of pale kangaroo mice were found south of the Groom Range in Emigrant Valley. In 1931, several pale kangaroo mice were observed in the basins on the east and west side of the Kawich Range. Two of the species were trapped in Stonewall Flats on the North Range Study Area in 2003 and 2005. In 2006, traps were set at the Kawich Dunes and sandy soils located north of Lamb's Pond in the North Range Study Area. During these trapping events, twenty-one females and thirteen males were captured. Six pale kangaroo mice (three females, three males) were captured in sandy soils located on the east side of Mud Lake in 2009. In 2013, three females and six males were captured in stabilized dunes located near the Cactus Range. These results indicate that pale kangaroo mice are present and inhabit sandy soils on the North Range Study Area. Note that seven of the observation points were located out of the area that was modeled (Groom Lake, Sand Spring Valley, and just north of Mud Lake).

The Habitat Suitability Model weighted vegetation, soils, and key habitat relatively high with no weighting on elevation and slope (Table 8). The Habitat Suitability Model showed the potential for pale kangaroo mouse to be relatively widespread on basins of the North Range Study Area, especially in areas located between the mountains and the dry lakes (Figure 37). On the South Range Study Area, suitable habitat appeared to be located on the upper bajadas. The model appeared to be fairly accurate based on the observation points available.

The Maxent model results placed significant importance on vegetation and soils. The Maxent model showed a similar distribution of the species, but was much more conservative showing less suitable habitat than the Habitat Suitability Model (Figure 38). This resulted in some of the observation points being located in habitat that was moderately suitable according to the model. Because of the lack of observations on the South Range Study Area, Maxent showed small patches of suitable habitat in that area. Additional surveys should be conducted in the South Range Study Area to confirm the lack of suitable habitat as mapped by Maxent in that area.

Table 8. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the pale kangaroo mouse models.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	36.3	30
Geology	3.4	0
Soil Association	40.7	20
Key Habitat	0.4	20
Temp. Water Source	0.1	0
Permanent Water Source	5.7	0
Mountains	0.0	0
Valleys	0.0	10
Mines	0.0	0
Slope	5.1	10
Elevation	8.4	10
Aspect	0.0	0

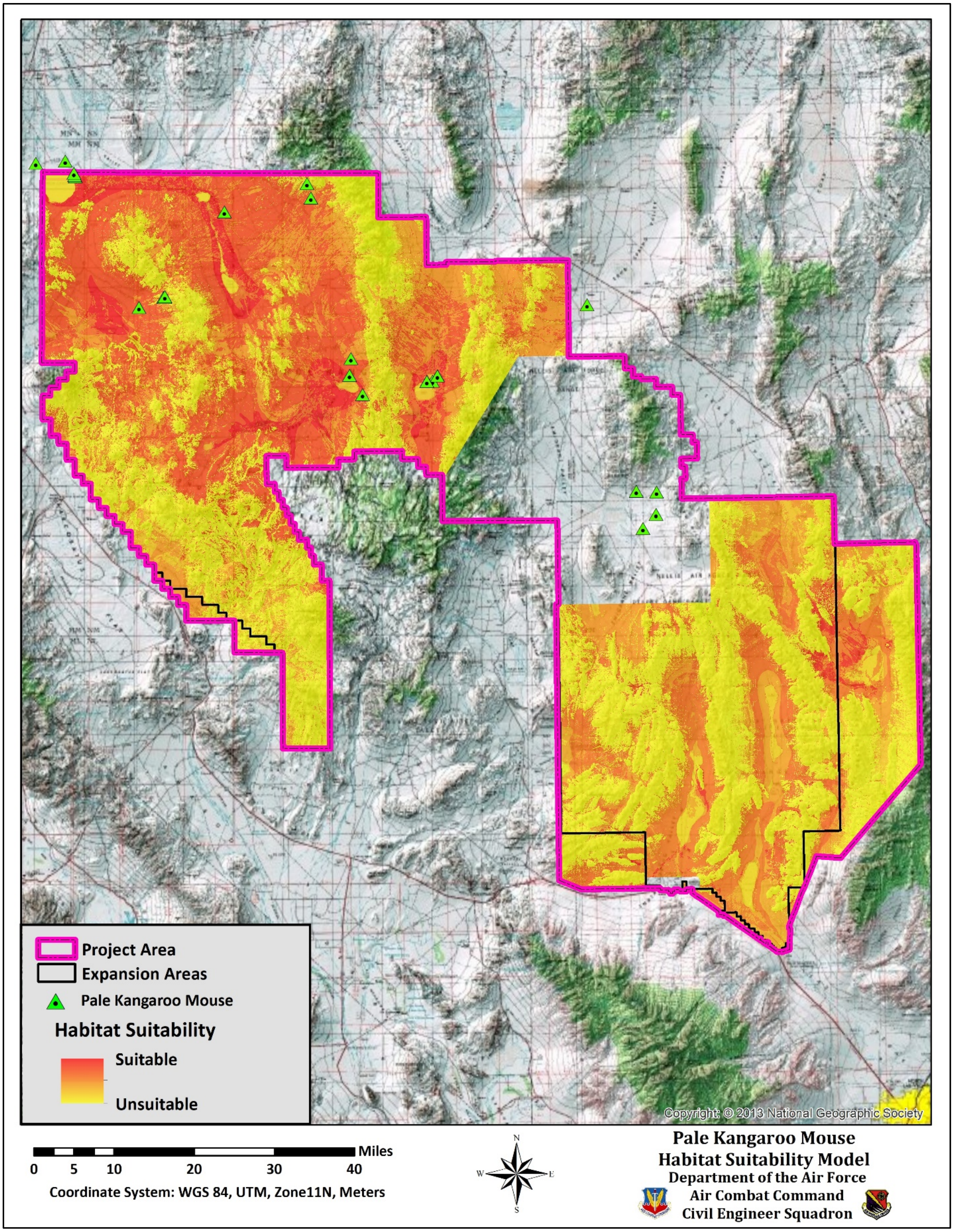


Figure 37. Habitat range of the pale kangaroo mouse as determined by the Habitat Suitability Model.

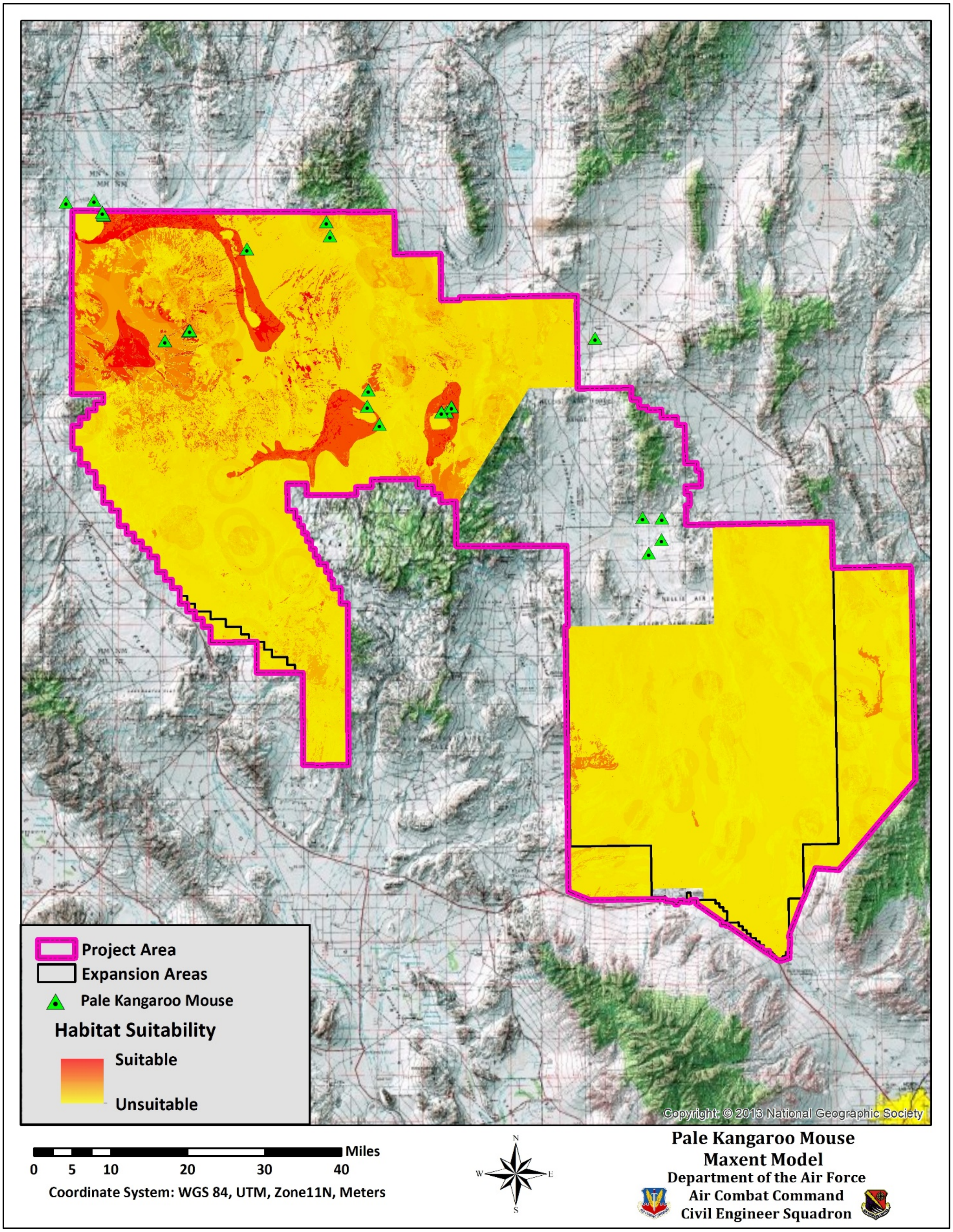


Figure 38. Habitat range of the pale kangaroo mouse as determined by the Maxent Model.

Pahranagat Valley Montane Vole (*Microtus montanus fucosus*)

Pahranagat Valley Montane Vole (copyright U.S. Fish and Wildlife Service)

The Pahranagat Valley montane vole is found in alpine meadows in the southern part of its range, which includes Nevada. These small mammals appear to be endemic to less than 40 square miles in White River Valley, NV (Wildlife Action Plan Team, 2013). The only known population appears to be a subspecies isolated to the springs in Pahranagat Valley with one population identified at Pahranagat Creek (Bureau of Land Management, 2013A). The vole is susceptible to changes in the water table and surface moisture, which may be an important factor affecting its survival. They rely on the grass-filled wet meadows near fences, ponds and streams to forage and excavate shallow burrows for cover (Wildlife Action Plan Team, 2013). Typically, the vole forages on grasses, sedges, and forbs (Wildlife Action Plan Team, 2013). The Pahranagat Valley montane vole has not been observed in or around the study area recently or historically. Because it is isolated to the perennial waters in the Pahranagat Valley, this species probably does not occur within the study area. The habitat was not modeled, but the habitat range as depicted by Cassola (2016) is shown in Figure 39. This habitat range shows some habitat in the northeast corner of the South Range Study Area around the Pahranagat Range.

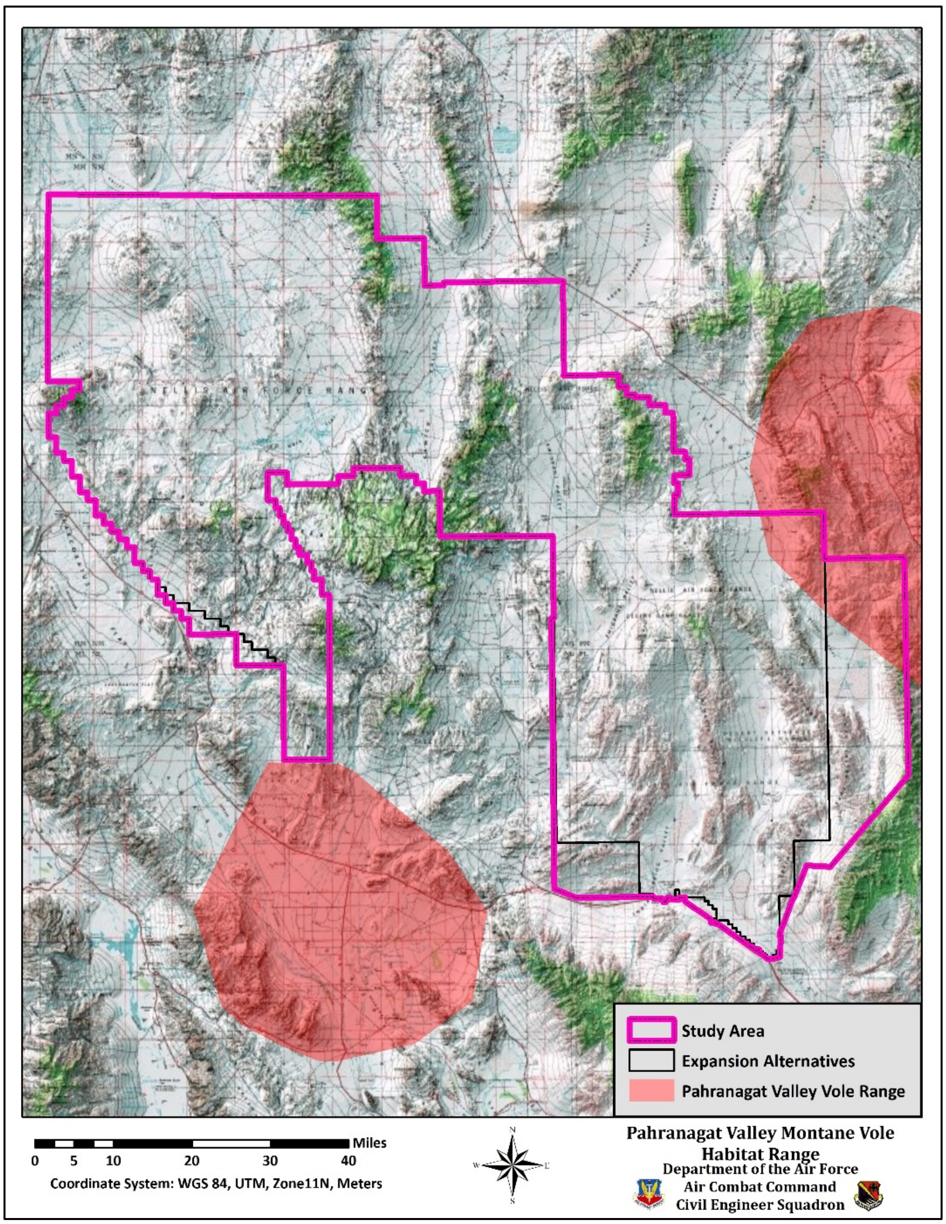


Figure 39. Habitat range of the Pahranagat Valley vole (Cassola, 2016).

Fringed Myotis (*Myotis thysanodes*)

Fringed Myotis

The fringed myotis occurs in western North America, from British Colombia to southern Mexico (O'Farrell & Studier, 1980). They are widely distributed in Nevada, but are considered uncommon. Habitats in which this species has been identified include oak, pinyon, and juniper woodlands or ponderosa pine forest at mid-elevations. Oak and pinyon woodlands interspersed with open areas of grassland or desert appear to be the preferred plant community (Roest, 1951; Keinath D. A., 2004). The bats have been observed in deserts, grasslands, and other types of woodlands to a lesser degree. Current information indicates that the fringed myotis is mostly found in dry habitats where open areas (e.g., grasslands and deserts) are interspersed with mature forests (usually ponderosa pine, pinyon-juniper, or oak), creating complex mosaics with ample edges and abundant snags (Keinath D. A., 2004). Several colonies have been observed in low desert-scrub habitat, usually within a one hour flight from forested or riparian areas. The fringed myotis ranges in elevation from 4,000 to 7,000 ft. MSL (O'Farrell & Studier, 1980). Fringed myotis populations tend to move to higher elevations in mountain ranges to avoid warm temperatures at lower elevations (Keinath D. A., 2004)

The parameters used to prepare the Habitat Suitability Model for the Fringed Myotis were the following:

- Elevation: 4,000 – 7,000 ft. MSL (Hafner, Upham, Reddington, & Torres, 2008) (Not weighted and not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Appears to require water (Weight factor of 3, but not inclusive because they also forage in widespread areas).
- Temporary Water: Forage for insects around temporary water sources (Not weighted and not inclusive).
- Geology: Not a limiting factor
- Key Habitat (Wildlife Action Plan Team, 2013): (Weighting factor of 2; not inclusive)
    - Sagebrush
    - Lower Montane Woodlands
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant communities: Not a limiting factor
- Mines: Used for roosting and nesting (Weight factor of 3; not inclusive)

One fringed myotis female was trapped on the NNSS in 2004 near East Tunnel Pond. Three acoustic files were also recorded at that time and a juvenile male was captured. In 2006, several recordings of fringed myotis were documented on the NNSS. Last, one female and three juveniles were captured on NNSS in 2009. On the North Range Study Area, ten fringed myotis were captured at Pillar Spring in 2010. In 2011, one bat was captured at Cactus Peak. Additionally, accoustic surveys detected fringed Myotis at several locations in 2009 (Pillar and Antelope Springs), 2010 (Pillar Springs), 2014 (Yellow Gold Mine, Monte Cristo Spring, and Antelope Mines #1 and #4), and 2015 (Tolicha Peak Area).

The Habitat Suitability Model placed importance on mines, permanent water sources, and key habitat. The Habitat Suitability Model indicated that suitable habitat was located mostly in the mountain ranges of the North Range Study Area, especially the Kawich Range, Belted Range, Cactus Range, Stonewall Mountain, and Pahute Mesa. Some habitat was located in the South Range Study Area but only around the springs and wildlife water developments located in the mountain ranges (Figure 40).

The Maxent Model showed results similar to the Habitat Suitability Model, but emphasized water sources to a greater extent (Figure 41). Additionally, the Maxent Model placed importance on vegetation and soils (Table 9). The resulting model showed suitable habitat in the upper elevations of the study area around permanent water sources. This was probably due to the fact that most trapping and acoustic surveys were conducted around water sources. Further surveys should be conducted across the study area to refine both of the models. Acoustic surveys would be especially useful to determine species in areas where mist netting is not successful because the bat populations are more widespread and not concentrated in specific areas such as water sources.

Table 9. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the fringed myotis model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	34.5	0
Geology	1.9	0
Soil Association	25.7	0
Key Habitat	0.0	17
Temp. Water Source	0.0	8
Permanent Water Source	37.3	25
Mountains	0.6	8
Valleys	0.0	8
Mines	0.0	25
Slope	0.0	0
Elevation	0.0	8
Aspect	0.0	0

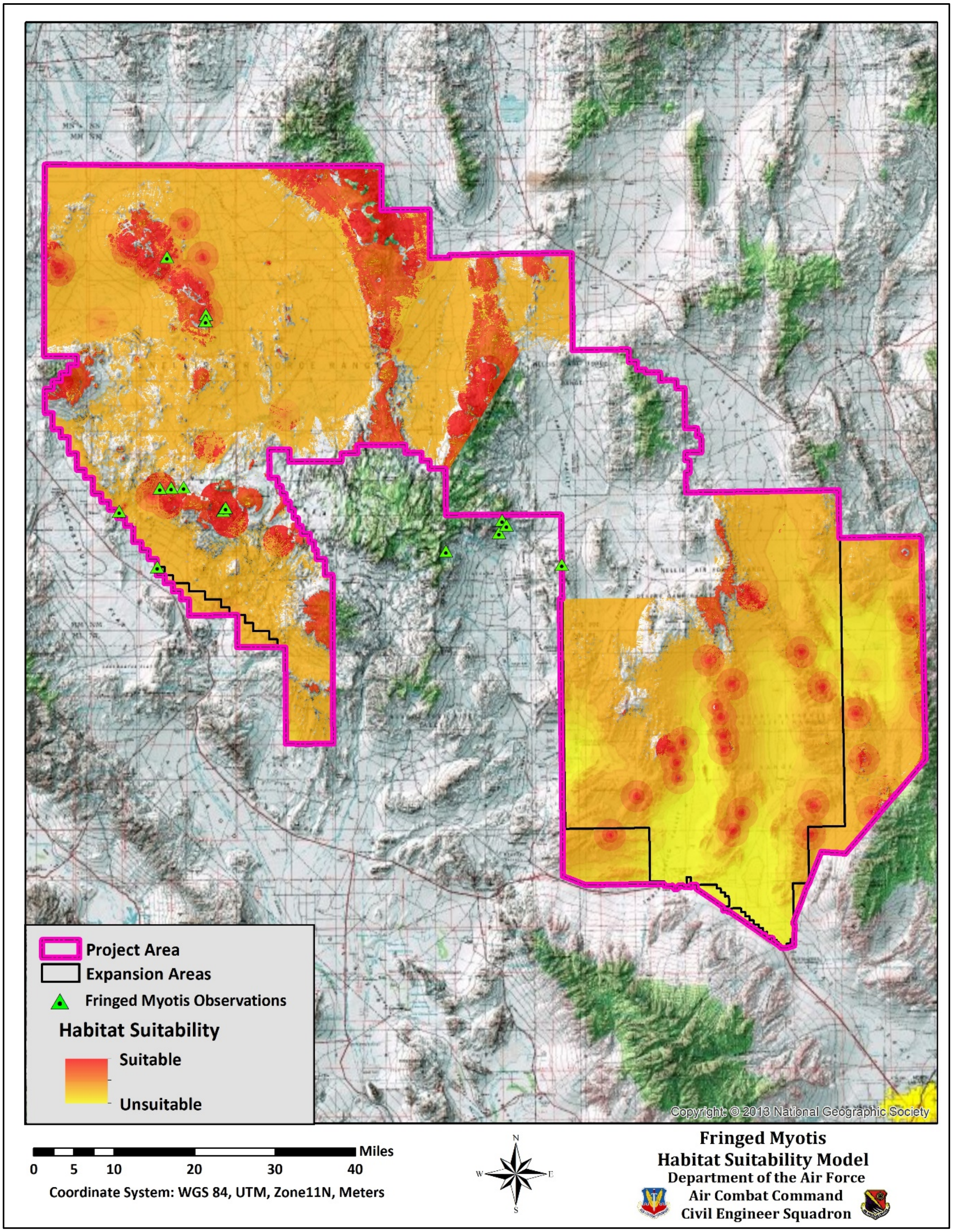


Figure 40. Habitat range of the fringed myotis as determined by the Habitat Suitability Model.

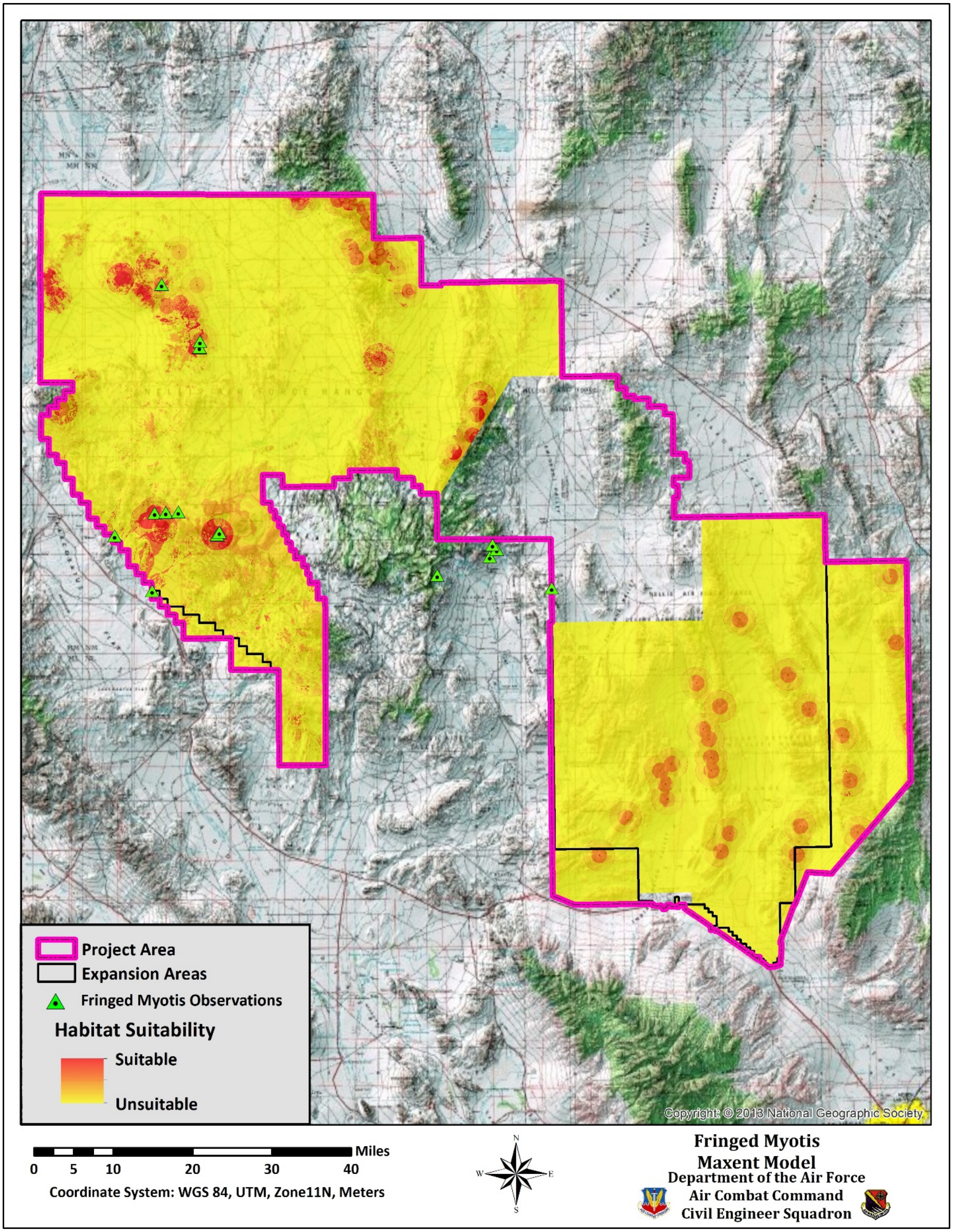


Figure 41. Habitat range of the fringed myotis as determined by the Maxent Model.

Mexican free-tailed Bat (*Tadarida brasiliensis*)

Mexican free-tailed Bat (copyright U.S. Fish and Wildlife Service/ Ann Froschauer)

The Mexican free-tailed bat is one of the most widely distributed bat species in the western hemisphere. It ranges from southern North America in its summer ranges to a wide distribution throughout South America during winter (Schwartz, et al., 2007). The Mexican free-tailed bat is also known as the Brazilian free-tailed bat, and may be found in habitats ranging from lowland deserts to pine/oak forests throughout North and South America. Roosting sites of the Mexican free-tailed bat include caves, mine tunnels, old wells, and hollow trees (Feldhamer, Thompson, & Chapman, 2003). Small colonies will roost in buildings or hollow trees (Bat Conservation International, 2017; Wildlife Action Plan Team, 2013). The caves, buildings and bridges are used for roosts because unobstructed space is required below the roost to allow the bat to drop when taking flight (Schmidly, 2004). The diet of this bat is comprised of moths and beetles, varying with the season. Beetles appear to be a preferred food (Wildlife Action Plan Team, 2013). Other food items include flying ants, true bugs, wasps and bees, termites, grasshoppers, spiders, lice, and mites (McWilliams, 2005). These bats require open water to drink, yet can conserve the water within their bodies depending on the climate with arid habitats requiring more frequent visits to the water source (Wilkins, 1989). The Mexican free-tailed bat is associated with dry, lower elevations, but may occur up to 9,800 ft. MSL. They are most often associated with desert scrub plant communities within Nevada. Habitat models are difficult for this species because of its general and widespread habitat preferences.

The parameters used to prepare the Habitat Suitability Model for the Mexican free-tailed bat were the following:

- Elevation: This will not be used as a parameter because it would include the entire study area.
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Appears to require water (Weight factor of 3, but not inclusive because they also forage in widespread areas).
- Temporary Water: Forage for insects around temporary water sources (Weight factor of 1; not inclusive).
- Geology: Not a limiting factor
- Key Habitat: Not weighted
    - Intermountain Cold Desert Scrub
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant communities: Not a limiting factor
- Mines: Used for roosting and nesting (Weight factor of 5; not inclusive)

Historically, the Mexican free-tailed bat has been identified as early as 1929 and 1934 near Indian Springs, Nevada (U.S. Air Force, 2017). In 1965, the species was observed six miles north of Beatty along the

Amargosa River. In 1996, a sighting of the species was made on the NNSS in East Yucca Flat. Although the Mexican free-tailed bat has not been captured by the NNRP, it has been detected by Anabat surveys at several locations across the North Range Study Area.

The Habitat Suitability Model emphasized mines and water sources for suitable habitat (Figure 42). According to the model, higher quality habitat was located on mountain ranges around water sources and mines, as would be expected. Additionally, fair to good habitat was found in the foothills and bajadas. Most of the observation points in this model occurred on fair to excellent suitability of habitat. Overall, the Habitat Suitability Model showed much more suitable habitat in the study area than the Maxent Model.

Maxent found geology and temporary water sources to be of high importance, which resulted in excluding most habitat in the South Range Study Area except for the five natural springs (Figure 43 and Table 10). This would be expected because no observation points were located within the bounds of the South Range Study Area. For the North Range Study Area, the Maxent Model was similar to the Habitat Suitability Model, but showed much less suitable habitat in that area. Maxent showed most of the habitat in the mountain ranges and Thirsty Canyon. Some of the observation points were not in suitable habitat according to the model. Overall, the Habitat Suitability Model should be used for management of Mexican free-tailed bat until further surveys can be conducted to obtain more observation points or refine GIS layers used in the models.

Table 10. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the Mexican free-tailed bat model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	3.0	0
Geology	74.6	0
Soil Association	3.4	0
Key Habitat	0.0	8
Temp. Water Source	19.0	8
Permanent Water Source	0.0	25
Mountains	0.0	8
Valleys	0.0	8
Mines	0.0	43
Slope	0.0	0
Elevation	0.0	0
Aspect	0.0	0

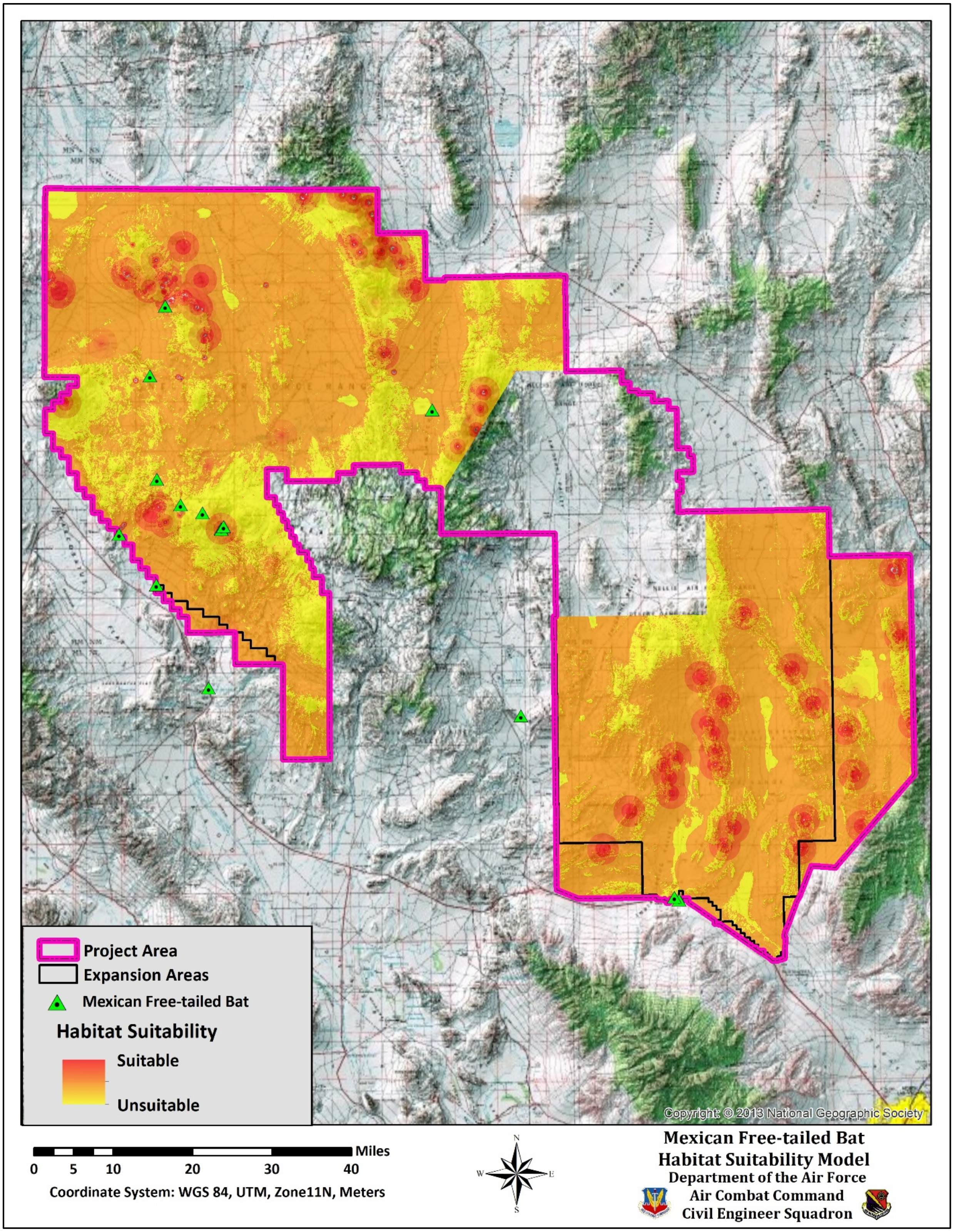


Figure 42. Habitat range of the Mexican free-tailed bat as determined by the Habitat Suitability Model.

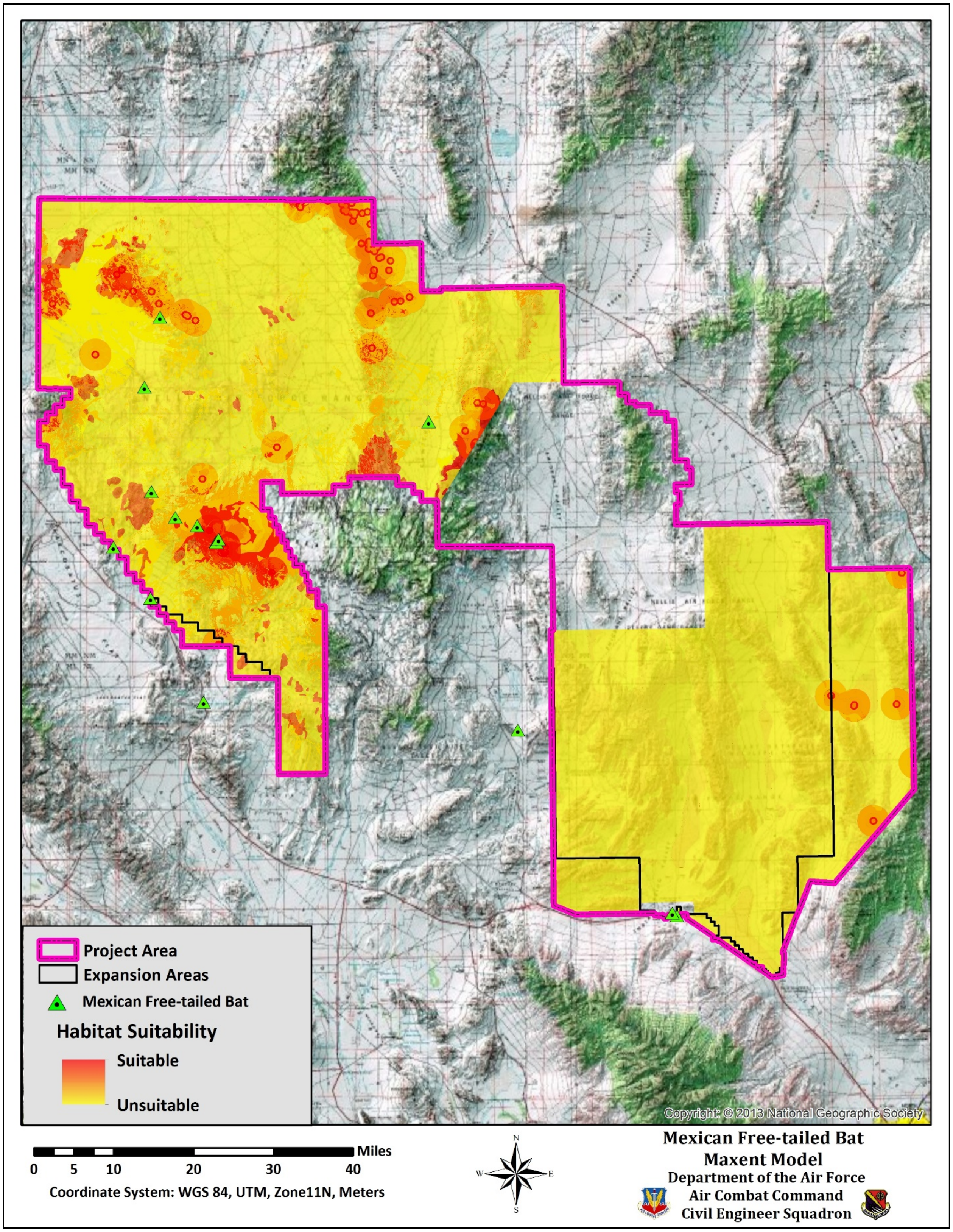


Figure 43. Habitat range of the Mexican free-tailed bat as determined by the Maxent Model.

Pallid Bat (*Antrozous pallidus*)


Pallid Bat

Geographically, the pallid bat is found from British Columbia to Mexico, especially in canyon landscapes, rugged terrain, and the deserts and grasslands of the southwest. It is usually found in the vicinity of rocky outcrops and dry canyonlands (Orr R. , 1954). They are most abundant in xeric ecosytems, such as the Great Basin, Mojave and Sonoran Deserts (Sherwin & Rambaldini, 2005).

This bat is a terrestrial forager that prefers insects, but occasionally eats small lizards. It commonly forages on the ground or by flying low over vegetation (Schmidly, 2004). Prey species preferred by the pallid bat include flightless arthropods, ground crickets, ground beetles, grasshoppers, praying mantis, and sphingid moths (Hermanson & Altenbach, 1983). It is also known to eat Jerusalem crickets and scorpions within its Nevada range (Schmidly, 2004).

Pallid bat habitat includes woody plant species such as *Purshia tridentata*, *Artemisia* spp., *Chrysothamnus* spp., and *Pinus ponderosa* (van Zyll de Jong, 1985). The primary habitat preferences of this species within the study area include a source of water and presence of roosting sites such as caves and mines. It commonly roosts in rock crevices, caves, mines, attics of houses, as well as hollow trees (Orr R. , 1954). Throughout its range the pallid bat is generally found in elevations below 6,000 ft. MSL. It prefers hot and dry areas, especially in shrub-steppe or open forest habitats (Orr R. , 1954).

The parameters used to prepare the Habitat Suitability Model for the pallid bat were the following:

- Elevation: 2,000 – 6,000 Ft. MSL (Not weighted; not inclusive) (Orr R. , 1954)
- Slope: Prefers cliffs and canyons (Orr R. , 1954), Slope range: 70° - 90° (Not weighted and not inclusive)
- Aspect: Not a limiting factor
- Permanent Water (Tuttle, Chambers, & Theimer, 2006): Appears to require water (Weight factor of 5, but not inclusive because they also forage in widespread areas).
- Temporary Water (Tuttle, Chambers, & Theimer, 2006): Forage for insects around temporary water sources (Weight factor of 2; not inclusive).
- Geology: Cc, CZq, MDs, Oc, Ts2, Ts3, Zqs (O'Shea & Vaughan, 1977) (Weight factor of 1; not inclu-sive)
- Key Habitat (Bat Conservation International, 2017) : (Weight factor of 1; not inclusive)
    - Cliffs and Canyons
    - Mesquite Bosques and Desert Washes
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Intermountain Cold Desert Scrub
    - Lower Montane Woodlands
    - Mojave Rivers and Streams
    - Mojave/Sonoran Warm Desert Scrub
    - Sagebrush
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant communities (van Zyll de Jong, 1985): (Weight factor of 3; not inclusive)

- o A0833 *Purshia stansburiana* Scrub Alliance
- o A3219 *Artemisia arbuscula ssp. arbuscula* Steppe & Shrubland Alliance
- o A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
- o A3222 *Artemisia nova* Steppe & Shrubland Alliance
- o A3195 *Chrysothamnus viscidiflorus* Steppe & Shrubland Alliance
- o A3196 *Ericameria nauseosa* Steppe & Shrubland Alliance
- Mines: Used for roosting and nesting (Weight factor of 5; not inclusive)

The USGS has documented the occurrence of the pallid bat in several counties in Nevada (U.S. Air Force, 2017). Specifically, it has been found in Clark, Lincoln, and Nye Counties, but no observations of the pallid bat within the NTTR prior to 2008 have been recorded. The pallid bat has been trapped and identified on the NNSS. In 1928-1930, several pallid bat observations were recorded in the Indian Springs area (Nevada Natural Heritage Program, 2016). In 2008, 13 pallid bats were trapped in mist nets near Sandia Pond on the North Range Study Area (U.S. Air Force, 2017). Mist net traps at Cactus Spring near Cactus Peak on the North Range Study Area trapped ten pallid bats in 2010 and three in 2011. Accoustic Surveys on various locations on the North Range Study Area detected two pallid bats in 2010, five bats in 2014, and four bats in 2015.

The Habitat Suitability Model placed importance on permanent water sources and mines for suitable habitat, with some influence from temporary water sources and vegetation (Table 11 and Figure 44). According to this model, high quality suitable habitat was found in the upper elevations of the mountain ranges of the North Range Study Area especially around mines and permanent water sources. Good habitat was also delineated in the South Range Study Area on the upper elevations of mountain ranges, especially the Pintwater Range, Spotted Range, Desert Range, and Sheep Range. Again, the more suitable habitat centered around natural springs and wildlife water developments. Overall, the map appeared to be fairly accurate with only two points occurring in fair suitability of habitat with most other points occurring in good to excellent suitability of habitat.

The Maxent Model emphasized permanent water sources and geology (Table 11). The Maxent model was much more conservative than the Habitat Suitability Model and indicated minimal habitat in the South Range Study Area because no observations were recorded in that study area (Figure 45). In the North Range Study Area, high suitability habitat for the pallid bat appeared to be concentrated in the Cactus Range and Kawich Range with scattered occurrences in the Belted Range and Pahute Mesa. Several of the observation points were located in poor to fair habitat. More than likely, the number of observation points was not sufficient to provide an accurate map for this model. However, areas of good to excellent habitat in the North Range Study Area as mapped by Maxent agreed with those mapped by the Habitat Suitability Model.

Table 11. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the pallid bat model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	8.7	14
Geology	34.6	5
Soil Association	3.3	0
Key Habitat	2.1	5
Temp. Water Source	4.2	10
Permanent Water Source	44.8	23
Mountains	0.0	5

Valleys	0.0	5
Mines	0.0	23
Slope	0.0	5
Elevation	2.4	5
Aspect	0.0	0

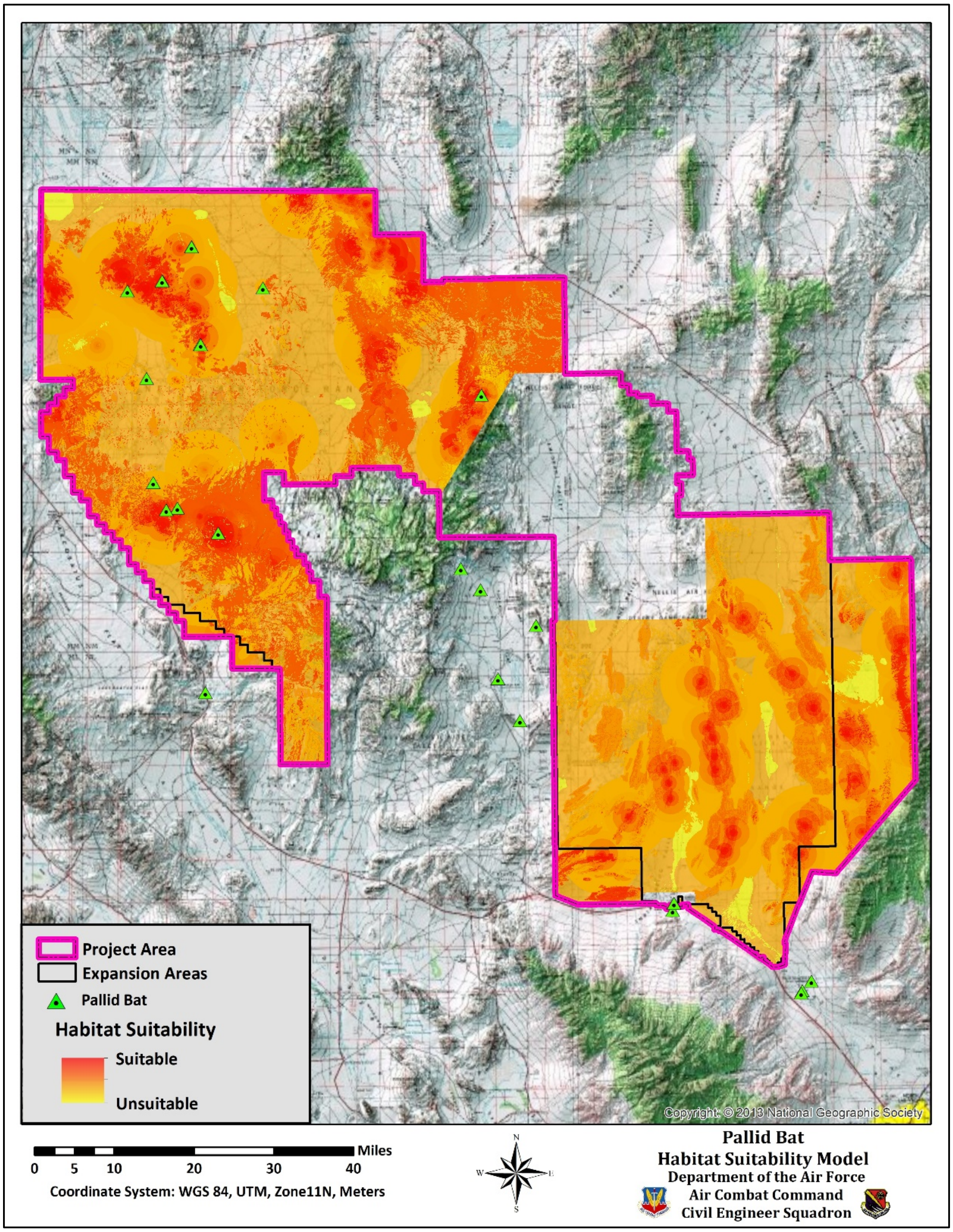


Figure 44. Habitat range of the pallid bat as determined by the Habitat Suitability Model.

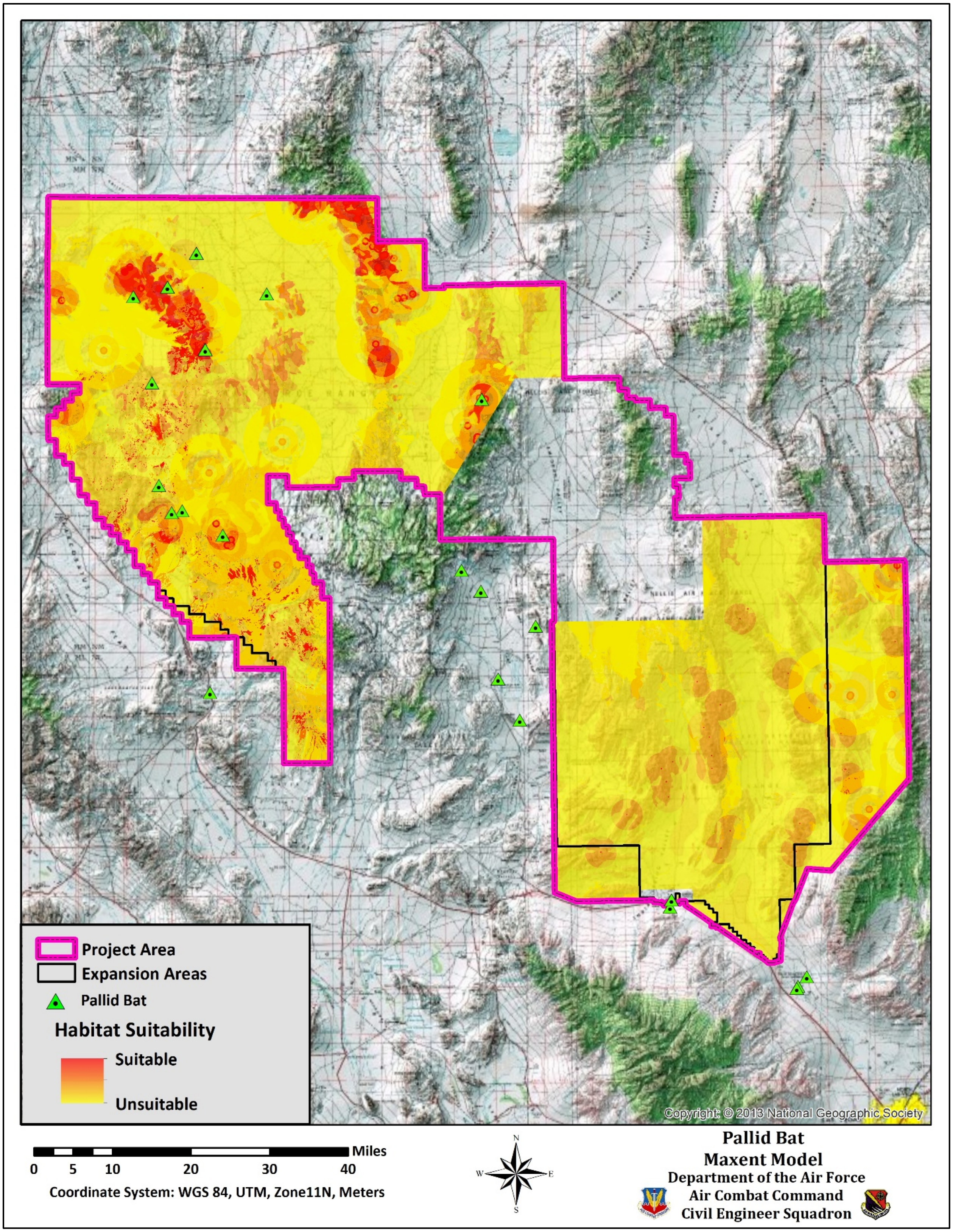


Figure 45. Habitat range of the pallid bat as determined by the Maxent Model.

Townsend's Big-eared Bat (*Corynorhinus townsendii*)

Townsend's big-eared bat is found throughout most of western North America and is a resident of Nevada (RECON, 2000). The bat is usually found at elevations between 700 and 11,500 ft. MSL in pinyon-juniper-mahogany, white fir, blackbrush, sagebrush, salt desert scrub, agricultural, and occasionally urban habitats (Nevada Natural Heritage Program, 2016; Nowak, 1999). The bat avoids open grasslands (Dobkin, Gettinger, & Gerdes, 1995). Townsend's big-eared bats are strong and nimble fliers, foraging predominantly on moths and other Lepidoptera species (Dobkin, Gettinger, & Gerdes, 1995). They will forage around bushes or trees, following the edges of the vegetation in a variety of habitats along streams adjacent to and within wooded habitats (Nevada Natural Heritage Program, 2016).

Townsend's Big-eared Bat

This bat requires caves and mines to roost (Bat Conservation International, 2017; Wildlife Action Plan Team, 2013) , but, unlike most bat species, the Townsend's big-eared bat also roosts in open areas on rock faces and not in cracks and crevices. Maternity and hibernation colonies typically are found in caves and mine tunnels. Hibernacula are generally in relatively cold places, often near cave or mine entrances and in well-ventilated areas (Nevada Natural Heritage Program, 2016). In Nevada, all known roost sites have been established in abandoned mines (Nevada Natural Heritage Program, 2016).

The parameters used to prepare the Habitat Suitability Model for the Townsend's big-eared bat were the following:

- Elevation: Not a limiting factor
- Slope: Prefers cliffs and canyons, slope range: 70° - 90° (Weight factor of 2; not inclusive)
- Aspect: Not a limiting factor
- Permanent Water (Nevada Natural Heritage Program, 2016): Appears to forage around water, but not require it (Weight factor of 2, but not inclusive).
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat (Wildlife Action Plan Team, 2013): (Weight factor of 1; not inclusive)
  - Intermountain Cold Desert Scrub
  - Lower Montane Woodlands
  - Mojave Mid-Elevation Mixed Desert Scrub
  - Mojave/Sonoran Warm Desert Scrub
  - Sagebrush
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities (Nevada Natural Heritage Program, 2016; Nowak, 1999).: (Weight factor of 3; not inclusive)
  - A3219 *Artemisia arbuscula ssp. arbuscula* Steppe & Shrubland Alliance
  - A3222 *Artemisia nova* Steppe & Shrubland Alliance
  - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
  - A0869 *Atriplex canescens* Scrub Alliance

- A0870 *Atriplex confertifolia* Scrub Alliance
    - A3144 *Coleogyne ramosissima* Mojave Desert Scrub Alliance
    - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - A3202 *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance
    - A2108 *Pinus monophylla - Juniperus osteosperma /* Shrub Understory Woodland Alliance
    - CEGL000825 *Pinus monophylla* Woodland
    - CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland
- Mines: Used for roosting and nesting (Weight factor of 5; not inclusive)

Only four observations of Townsend's big-eared bats have been recorded historically for the study area. These occurred from 1933 to 1963 in Nye County near Beatty and on the NNSS (Nevada Natural Heritage Program, 2016). The NNRP made several observations of the species via mist netting and Anabat surveys from 2009 to 2015 (U.S. Air Force, 2017).

The Habitat Suitability Model emphasized mines with secondary importance of vegetation, slope, and permanent water sources (Figure 46 and Table 12). The resulting model showed suitable habitat across the mountain ranges and mesas of the North Range Study Area. The map appeared to be fairly accurate with the most points occurring on good quality suitable habitat. According to this model, good quality suitable habitat is also found in the mountain ranges of the South Range Study Area. Good habitat was also mapped around Desert Lake and in the southern bajadas of Alternative 3C.

The Maxent Model gave a significant level of importance to soils and less importance to mountains (Table 12 and Figure 47). As with models for other bats presented in this report, minimal habitat was shown in the South Range Study Area around permanent water sources because of the lack of observations in that area. In the North Range Study Area, good quality habitat appeared to be restricted to the upper elevations of the Cactus Range, Kawich Range, Belted Range, Stonewall Mountain, and Pahute Mesa.

Table 12. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the Townsend's big-eared bat model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	0.0	20
Geology	0.0	0
Soil Association	66.3	0
Key Habitat	0.0	7
Temp. Water Source	7.2	0
Permanent Water Source	6.0	13
Mountains	20.5	7
Valleys	0.0	7
Mines	0.0	33
Slope	0.0	13
Elevation	0.0	0
Aspect	0.0	0

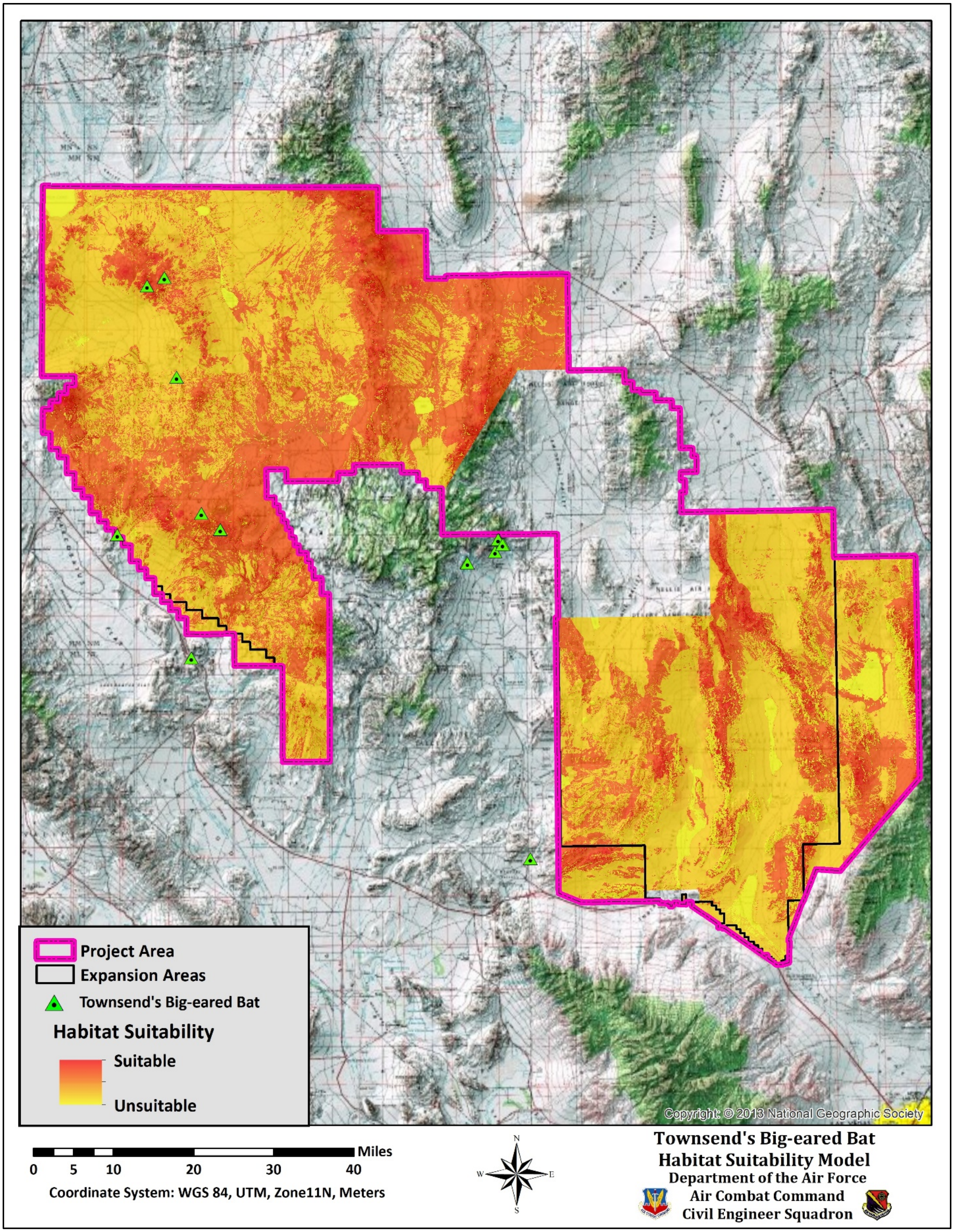


Figure 46. Habitat range of the Townsend's big-eared bat as determined by the Habitat Suitability Model.

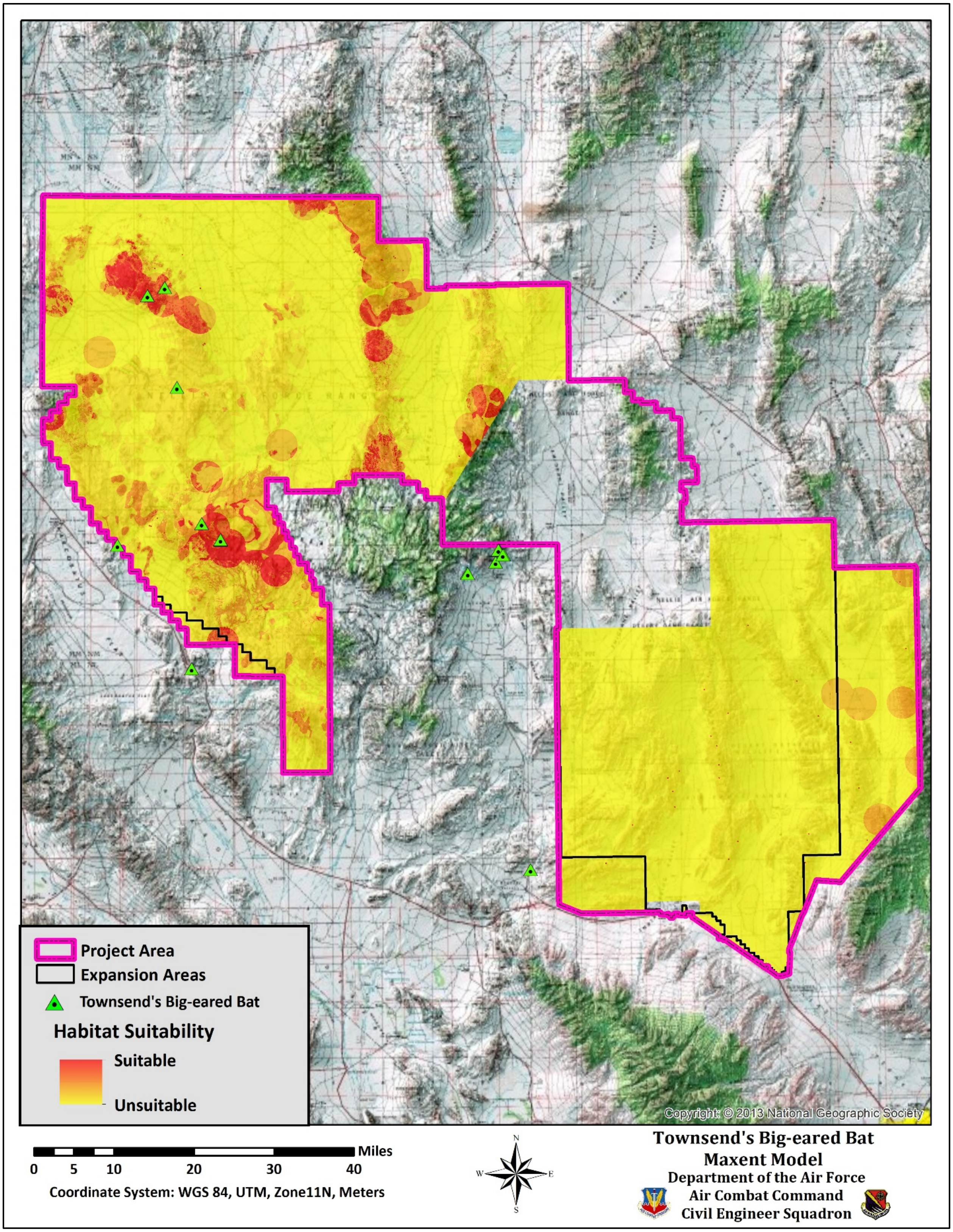


Figure 47. Habitat range of the Townsend's big-eared bat as determined by the Maxent Model.

Spotted bat (*Euderma maculatum*)

Spotted Bat (copyright Paul Cryan)

The spotted bat (*Euderma maculatum*) was initially thought to be a rare species, but now it is known to inhabit cliffs and canyons throughout central and western North America (Bat Conservation International, 2017). Spotted bats inhabit a variety of habitat types from low elevation, arid ecosystems to high elevation, coniferous mountain ecosystems. They have been observed at elevations from 1,770 ft. to 7,000 ft. MSL (Bradley, O'Farrell, Williams, & Newmark, 2006; Wildlife Action Plan Team, 2013).

Spotted bats consume primarily moths and prefer to hunt in open areas, such as rivers, streams, meadows, and forest edges (Bradley, O'Farrell, Williams, & Newmark, 2006; Wildlife Action Plan Team, 2013). Spotted bats prefer to roost alone or, less frequently, in small groups. They frequently use the same roost for several days. Spotted bats can climb and may move higher within crevices of tall cliffs (Leonard & Fenton, 1983). One research study found females preferred south-facing roosts, while males were indifferent to roost aspects (Chambers, et al., 2011).

The parameters used to prepare the Habitat Suitability Model for the spotted bat were the following:

- Elevation: 1,770 ft. – 7,000 ft. MSL (Bradley, O'Farrell, Williams, & Newmark, 2006; Wildlife Action Plan Team, 2013) (Not weighted; not inclusive)
- Slope: Prefers cliffs and canyons (Leonard & Fenton, 1983); Slope range: 70° - 90° (Weight factor of 2; not inclusive)
- Aspect: Factor for roosting females. South Aspect. (Not Weighted; not inclusive)
- Permanent Water: Forages around water sources (Weight factor of 4, but not inclusive) (Stebbins, 2003; Wildlife Action Plan Team, 2013).
- Temporary Water (Stebbins, 2003; Wildlife Action Plan Team, 2013): Forages around water sources (Weight factor of 2, but not inclusive).
- Geology: Not a limiting factor
- Key Habitat: No preferred habitat--generalist
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Generalist—no preferences
- Mines: Used for roosting and nesting (Weight factor of 3; not inclusive)

The spotted bat has a scattered distribution throughout Nevada, including Las Vegas in Clark County and the Bare Mountains in Nye County (Bradley, O'Farrell, Williams, & Newmark, 2006). In 1996, four adult males were captured on the Nevada Test Site (Geluso, 2000). Spotted bats have not been captured in mist-nets on NTTR, but one was recorded on an acoustic recording device in 2014 near the Antelope Mine in the Cactus Range (U.S. Air Force, 2017).

Maxent could not be run on this model because only one observation point was available for the study area. The Habitat Suitability Model placed high importance on mines and permanent water sources with lesser importance placed on slope and temporary water sources (Figure 48). Thus, potential occurrence of the species was centered around mines and water sources on the mountain ranges of the study area.

The North Range Study Area showed a larger area of high potential because of the presence of mines, especially in the Cactus Range and Kawich Range.

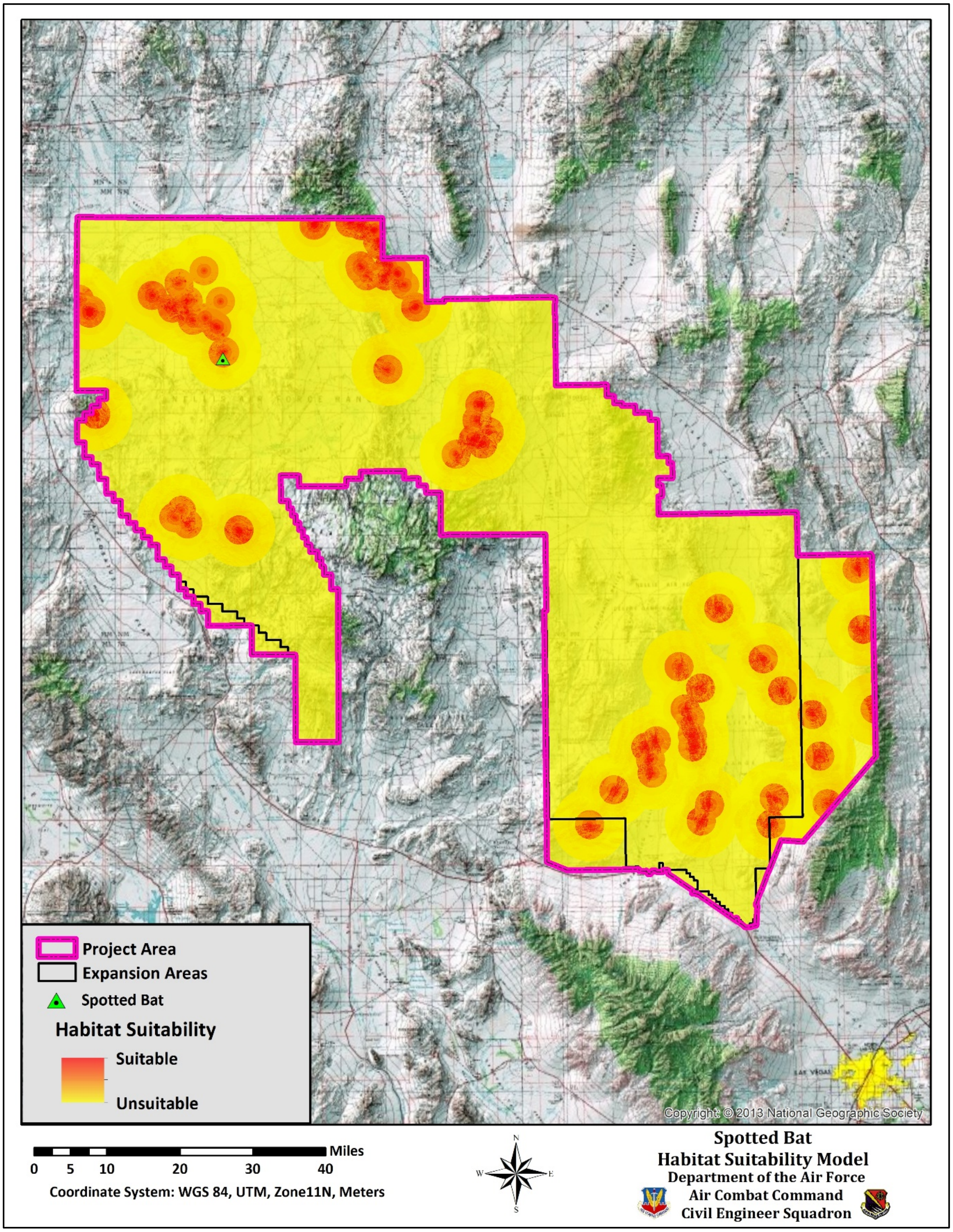


Figure 48. Habitat range of the spotted bat as determined by the Habitat Suitability Model.

Pygmy Rabbit (*Brachylagus idahoensis*)

Pygmy Rabbit

The pygmy rabbit is the smallest of all the North American rabbits (Orr R. , 1940). This rabbit inhabits shrub-grasslands where suitable sagebrush cover and soils for burrowing are available (Montana Field Guide, 2010). The pygmy rabbit requires dense stands of big sagebrush growing on deep, friable soils (Weiss & Verts, 1984). The likelihood of pygmy rabbit occupancy at a site increases with the following factors: increasing sagebrush cover, decreasing understory stem density, absence of cottontails, absence of reddish soils, absence of cheatgrass, and absence of rodent burrows (Brussard & Larrucea, 2008).

The parameters used to prepare the Habitat Suitability Model for the pygmy rabbit were the following:

- Elevation: Not a limiting factor
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Weight factor of 1, but not inclusive
- Temporary Water Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 2, not inclusive
    - Grasslands and Meadows
    - Sagebrush
    - Wet Meadows
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 3, not inclusive:
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance

Pygmy rabbit scat and burrows were observed at George's Water on the east side of the Kawich Range in EC East during surveys conducted between 2005 and 2007. Wildlife cameras have been placed in 23 locations throughout NTTR, since 2009 and four of these locations were in pygmy rabbit habitat. Two to six cameras were placed in each location. The remote cameras captured multiple photos of small rabbits that appeared to be pygmy rabbits. Additionally, in 2010 a pygmy rabbit was captured and photographed during a survey at George's Water.

The Habitat Suitability Model placed the most importance on plant communities (big sagebrush) and key habitat, which was predominantly Sagebrush. As would be expected, suitable habitat was shown to be located on foothills and mountainous areas supporting big sagebrush plant communities (Figure 49). This model probably shows a more wide-spread occurrence of suitable habitat than would be expected for the species. More than likely, populations of the species would be restricted to the foothills of the Kawich range. The only observation of pygmy rabbit is not shown to be in habitat, but that area of habitat is an isolated population of big sagebrush in a valley of the Kawich Range that is minimal in size and was not mapped as sagebrush in the vegetation or key habitat layers. From a management perspective, areas mapped as suitable habitat should be surveyed for pygmy rabbit prior to any soil disturbing activities. Maxent was not run for this species due to lack of a sufficient number of observations.

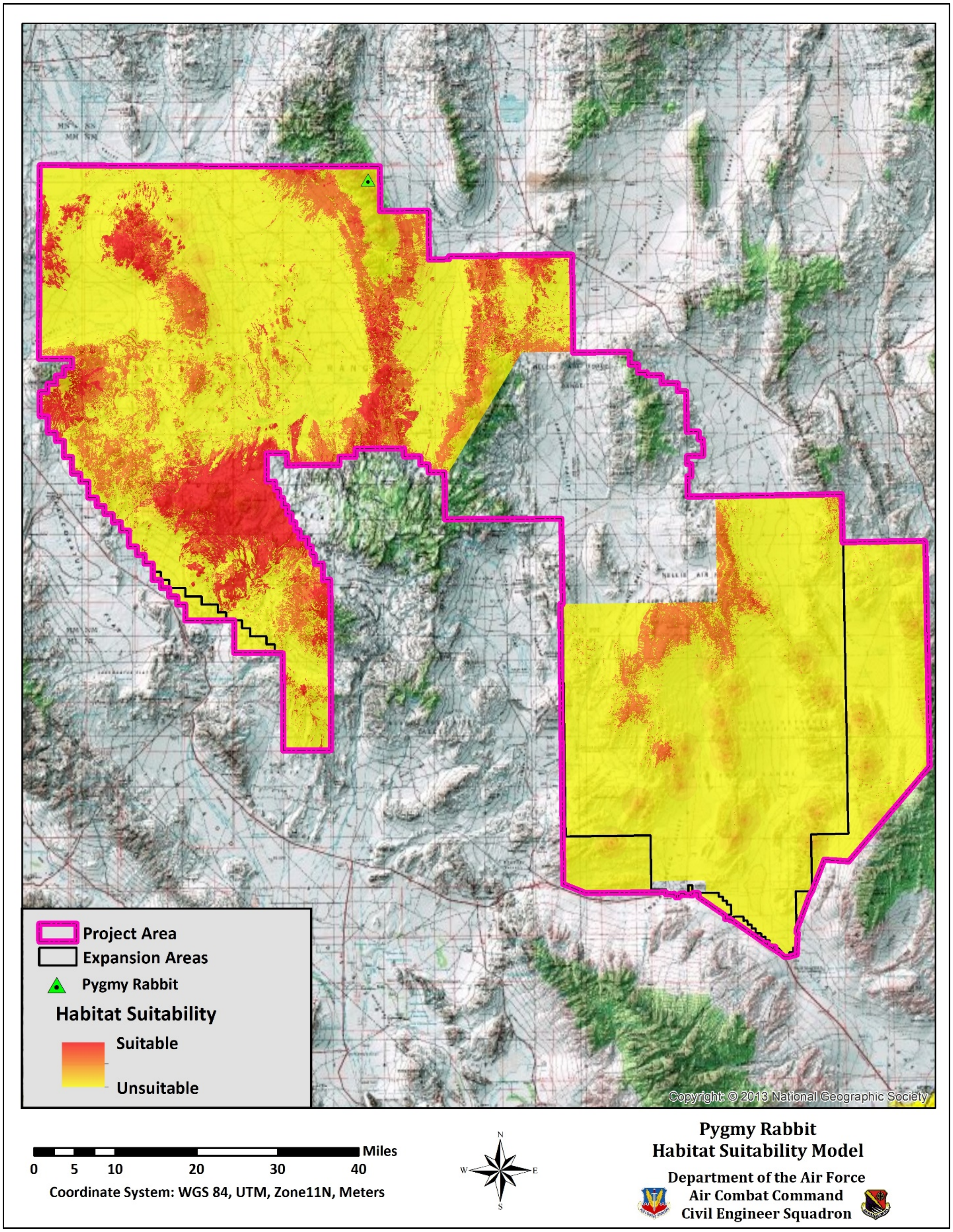


Figure 49. Habitat range of the pygmy rabbit as determined by the Habitat Suitability Model.

BRYOPHYTES

Planoconvex Cordmoss (*Entosthodon planoconvexus*)

The Planoconvex cordmoss is an ephemeral moss only known from three locations worldwide and those locations are in southern Nevada, southwestern Utah, and Arizona (NatureServe Explorer, 2016; Rare Plant Committee, 2005). It grows in canyons and desert washes in moderate to high elevations (greater than 3,790 ft. MSL) (Miller & Miller, 2007). It requires pockets of moisture, since it does not have the typical tissues to transport water and nutrients through roots and leaves (Betchel Nevada, 2005). This moss will grow on aspects that infrequently receive direct sunlight in sandy soils (Betchel Nevada, 2005; Miller & Miller, 2007). It is often found intermixed with liverworts (Nevada Department of Natural Resources and Conservation, 2016) including a rare species of liverwort (*Targionia* spp.) (NatureServe, 2016).

The parameters used to prepare the Habitat Suitability Model for planoconvex cordmoss were the following:

- Elevation: >3,790 ft. MSL (Not weighted; not inclusive)
- Slope: 70°-90° Weighting factor of 2; not inclusive
- Aspect: North; Weighting factor of 2; not inclusive
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Rhyolitic flows; Not weighted; not inclusive
    - Tr2--Rhyolitic flows and shallow intrusive rocks
    - Tr3--Rhyolitic flows and shallow intrusive rocks
- Key Habitat: Weighting factor of 2; not inclusive
    - Cliffs and Canyons
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Not a limiting factor

The only sighting of this moss in the vicinity of the study area was on the NNSS in Mercury Valley/Rock Valley in the north-facing foothills of the Specter Mountains. The Habitat Suitability Model indicated a low to medium potential for occurrence of this species in the cliffs and canyons of the mountain ranges on the South Range Study Area (Figure 50). Scattered occurrences were also found on mountains of the North Range Study Area. Maxent was not run on the species due to the fact that there were no observation points for this species on the study area.

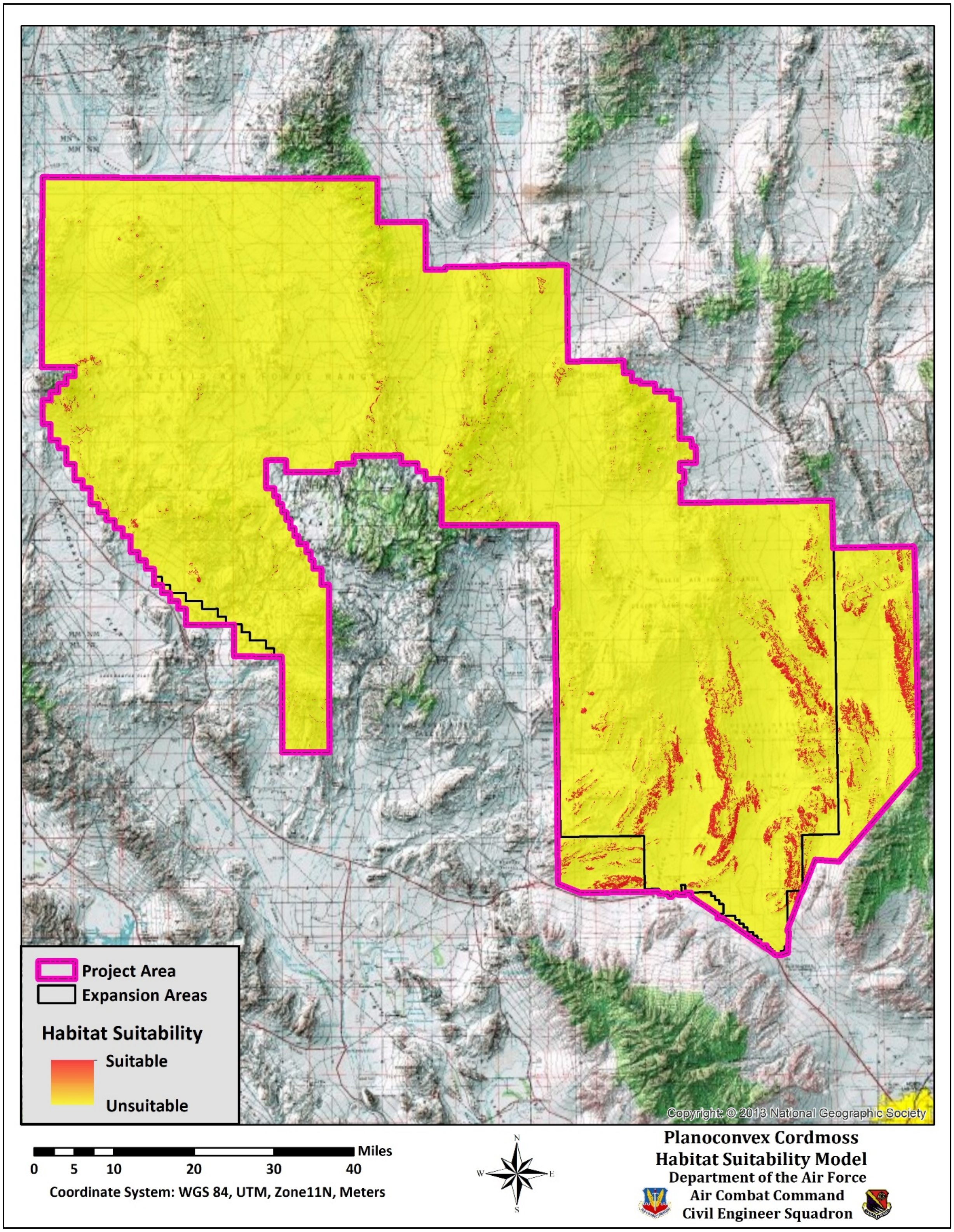


Figure 50. Habitat range of planoconvex cordmoss as determined by the Habitat Suitability Model.

PLANTS

Pintwater Rabbitbrush (*Chrysothamnus eremobius*)

Pintwater rabbitbrush by Teri Knight (Knight, Smith, & Pritchett, 1997).

Pintwater rabbitbrush is endemic to a small area in Lincoln and Clark counties of southern Nevada (NatureServe Explorer, 2016). The total population in Nevada is estimated at over 131 plants over a range dimension of 26.1 miles in Clark and Lincoln Counties (Nevada Natural Heritage Program, 2001). Documented information is minimal for this plant because it is rare and difficult to access. Pintwater rabbitbrush is often found within crevices or rubble of north-facing carbonate cliffs in and just below pinyon-juniper-Artemisia plant community at elevations from 4,600-7,000 ft. MSL (Nevada Natural Heritage Program, 2001; Anderson L. C., 1983; Knight, Smith, & Pritchett, 1997; Nevada Natural Heritage Program, 2016). The plant is usually found in association with *Cercocarpus intricatus*, *Hecastocleis shockleyi, Ephedra torreyana*, *Ericameria nauseosa*, *Rhus trilobata*, *Perityle intricata*, *Penstemon petiolatus*, and *Ephedra viridis* (Knight, Smith, & Pritchett, 1997; Anderson L. C., 1983; Nevada Natural Heritage Program, 2001).

The parameters used to prepare the Habitat Suitability Model for Pintwater rabbitbrush were the following:

- Elevation: 4,600 –7,000 ft. MSL (Not weighted; not inclusive)
- Slope: Cliff faces (70° - 90°) (Weighting Factor of 3; not inclusive)
- Aspect: North (Weighting factor of 3; not inclusive)
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Prefers limestone formations (Not weighted; not inclusive)
  - Cc--Limestone and dolomite, locally thick sequences of shale and siltstone
  - Dc-- Dolomite, limestone, and minor amounts of sandstone and quartzite
  - MDs— Shale, siltstone, sandstone, chert-pebble, conglomerate and limestone
  - Oc—Limestone, dolomite, shale and quartzite
  - Sc—Dolomite
  - SOc—Dolomite
  - TKs-- Continental sedimentary rocks
- Key Habitat: Weighting factor of 2, inclusive (Anderson L. C., 1983; Nevada Natural Heritage Program, 2001)
  - Cliffs and Canyons
  - Mojave Mid-Elevation Mixed Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were excluded.

- Plant Communities: Weighting factor of 3; not inclusive
    - A2572 *Ephedra torreyana* Shrubland Alliance
    - A858 *Ephedra viridis* Shrubland Alliance
    - A3196 *Ericameria nauseosa* Steppe & Shrubland Alliance
    - A3259 *Fallugia paradoxa* Desert Wash Scrub Alliance
    - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - A4185 *Prunus fasciculata - Salazaria mexicana* Northern Mojave Desert Wash Scrub Alliance
    - A0833 *Purshia stansburiana* Scrub Alliance

Five different populations of Pintwater rabbitbrush were observed on the South Range Study Area on the west side of the Pintwater Mountain Range east of Indian Springs Valley in 1979, 1993, and 1995. The population exists near Sand Spring between 4,400 and 5,800 feet elevation. This population was confirmed in 1993. Additional observations were made by the NNHP just outside of the eastern boundary of the study area within the Sheep Mountain Range in 1979. One of the populations was located southwest of Lamb's Spring and the other population was located in Grapevine Canyon at Grapevine Spring (Nevada Natural Heritage Program, 2016). No recent observations of the species have been made on the study area as of 2016.

The Habitat Suitability Model shows potential for this species on all of the mountain ranges on the South Range Study Area and the Yucca Mountains, Timber Mountains, Pahute Mesa, and Stonewall Mountain on the North Range Study Area (Figure 51). Scattered incidences of potential occurrence of the species was also mapped on the Cactus Range, Belted Range, and Kawich Range. Maxent was not run on this species due to the lack of sufficient number of observation points.

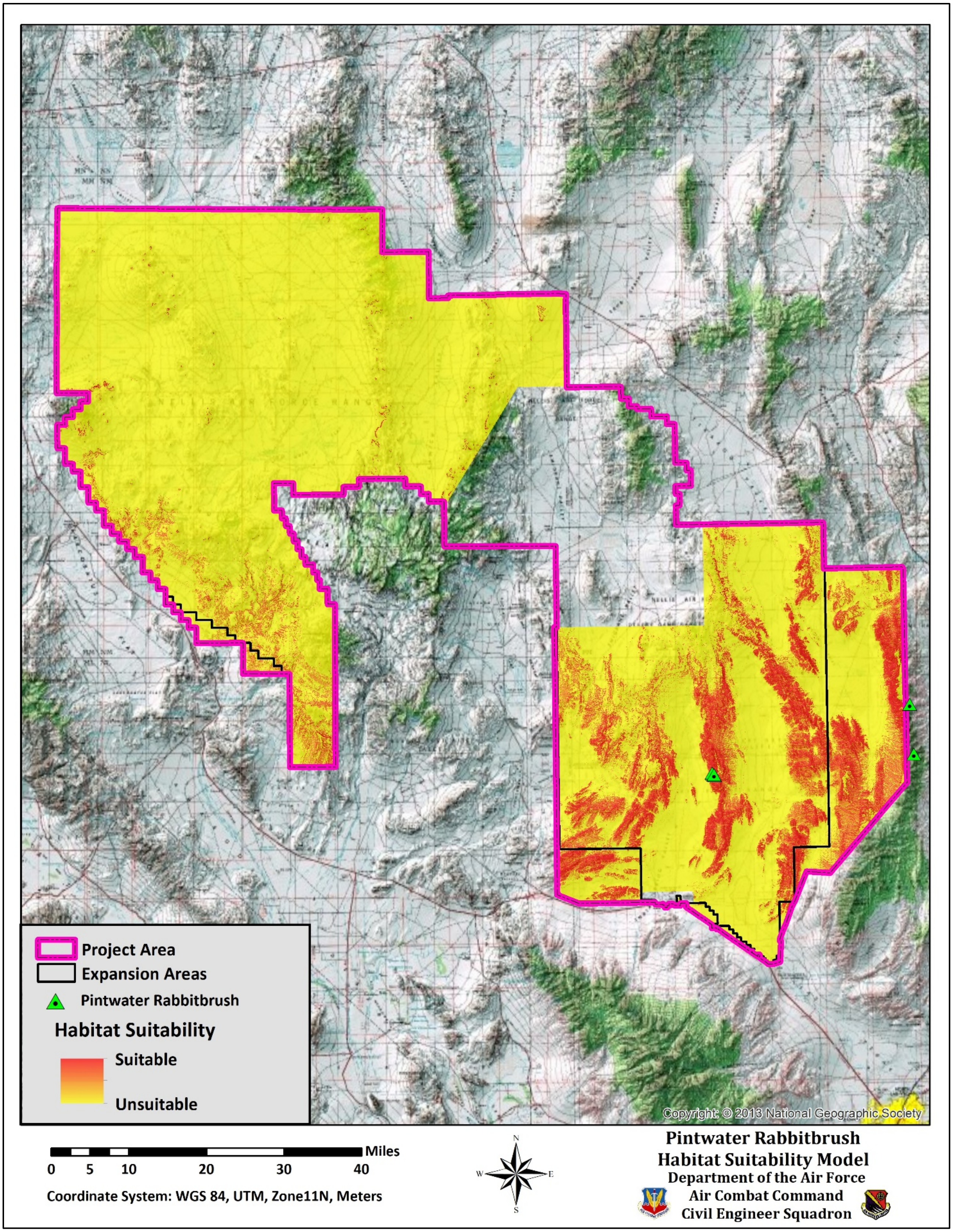


Figure 51. Habitat range of the Pintwater rabbitbrush as determined by the Habitat Suitability Model.

Ash Meadows Gumplant (*Grindelia fraxinopratensis*)

Ash Meadows Gumplant (copyright U.S. Fish and Wildlife Service)

Ash Meadows gumplant is a threatened perennial forb found only in Nye County, NV and Inyo County, CA. It is found mostly within the borders of the Ash Meadows National Wildlife Refuge in Nevada, in the Amargosa Desert (Soil Ecology and Research Group, 2004). Ash Meadows gumplant is most commonly found in open, flat, strongly alkaline clay soils in meadows along stream channels and associated shallow pools, and drainages near seeps and springs (Desert Renewable Energy Conservation Plan, 2012). In Nevada, it is considered wetland-dependent or aquatic (Nevada Natural Heritage Program, 2001). It can be found in the creosote-bursage and shadscale zones in ash-mesquite woodlands, shadscale shrub, or saltgrass meadows (Nevada Natural Heritage Program, 2001). Ash Meadows gumplant is found at elevations between 2,070 – 2,320 ft. MSL and generally prefers aspects with open sun exposure (Desert Renewable Energy Conservation Plan, 2012). This species is most abundant on silty clay loam soils with a pH slightly over 7.0 (Soil Ecology and Research Group, 2004).

The parameters used to prepare the Habitat Suitability Model for Ash Meadows gumplant were the following:

- Elevation: 2070 – 2,320 ft. MSL (Desert Renewable Energy Conservation Plan, 2012) (Not weighted; not inclusive)
- Slope: Flat Areas (0° - 5°) (Desert Renewable Energy Conservation Plan, 2012) (Not weighted; not inclusive)
- Aspect: Not a limiting factor
- Permanent Water: Weighting factor of 2; not inclusive (Nevada Natural Heritage Program, 2001)
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not a limiting factor
- Soil Associations: Based on soils at Ash Meadows wildlife Refuge (Weighting factor of 3; inclusive)
    - Nickel-Arizo-Blackmount
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; not inclusive
    - A0869 *Atriplex canescens* Scrub Alliance
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A3279 *Ambrosia dumosa* Desert Dwarf Scrub Alliance
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance

To date, no observations of Ash Meadows gumplant have been made within the study area. Due to the plant appearing to be restricted to the Ash Meadows Wildlife Refuge Area, it likely does not occur on the study area. However, a Habitat Suitability Model was run to determine the potential for the species to be present on the study area. That model indicated some suitable habitat for the species in dry lakes on the South Range Study Area where water may accumulate and soils may be moist for long periods of time (Figure 52). Although the model shows some potential for the species to be present, it likely does not occur in the study area and the potential for the species to be present the areas mapped as "suitable habitat" would be low. Maxent was not run for this species due to lack of sufficient observation points on the study area.

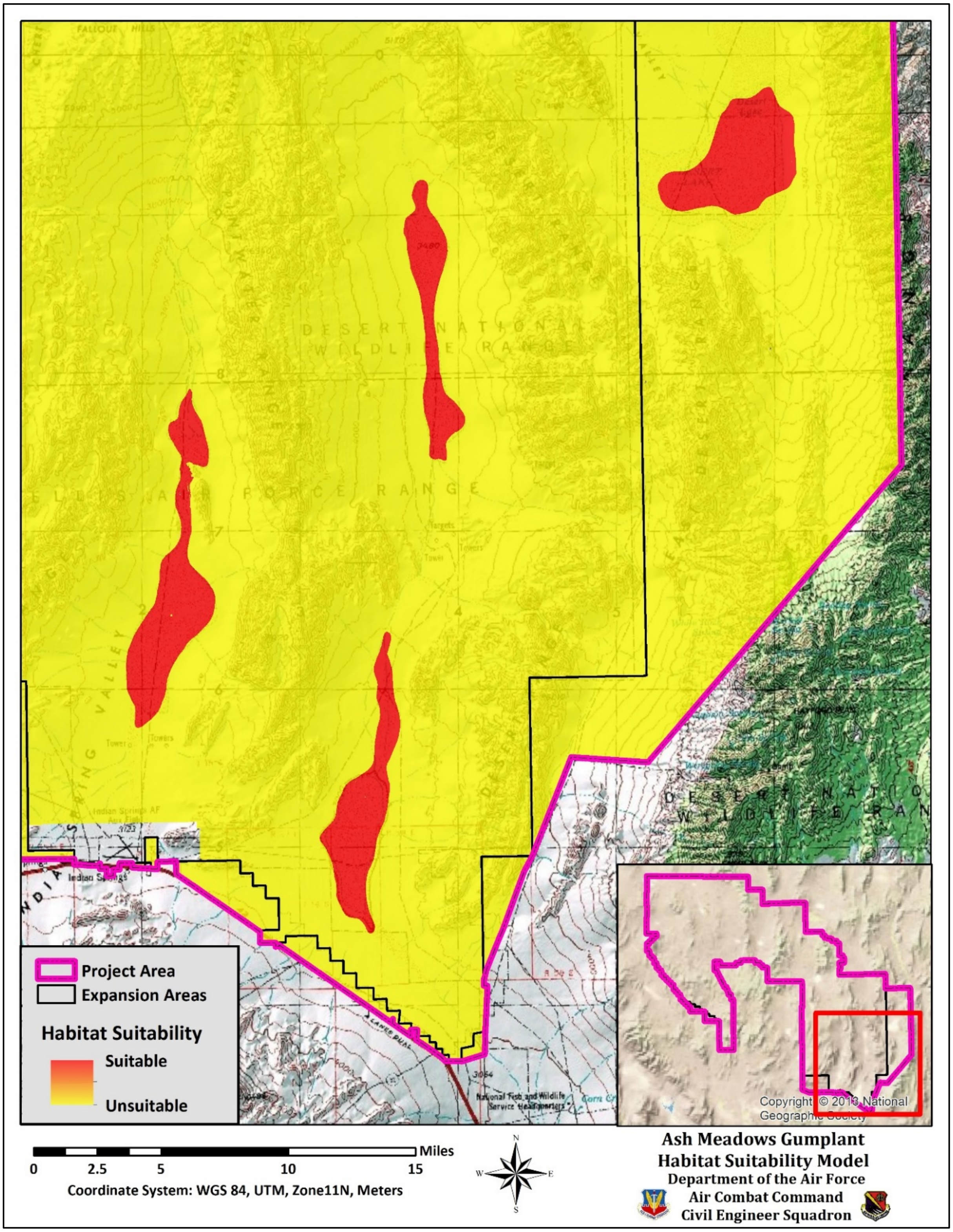


Figure 52. Habitat range of the Ash Meadows gumplant as determined by the Habitat Suitability Model.

William’s Combleaf (*Polyctenium williamsiae*)


William's Combleaf (copyright Gary Monroe, Nevada Native Plant Society)

The Williams’s combleaf is restricted to intermittent lake beds in western Nevada, east-central California, and southeastern Oregon (Holland & Morefield, 2002). These playas should be over volcanic bedrock in higher elevations, such as around sagebrush or pinyon-juniper habitats (Nevada Department of Natural Resources and Conservation, 2016). Primary habitat for the plant is in barren, sandy to sandy-clay or mud margins and bottoms of non-alkaline seasonal lakes and playas perched over siliceous volcanic bedrock. On the study area, it would likely be found in playas near sagebrush and juniper woodlands habitat between 4,200 – 9,000 ft. MSL, associated with big sagebrush (*Artemisia tridentata*) and spike rush (*Eleocharis spp.*) (Nevada Natural Heritage Program, 2016).

The parameters used to prepare the Habitat Suitability Model for William’s combleaf were the following:

- Elevation: 4,200 – 9,000 ft. MSL (Nevada Natural Heritage Program, 2016) (Not weighted; not inclusive)
- Slope: Flat Areas (0° - 5°) (Holland & Morefield, 2002) (Not weighted; not inclusive)
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 2; not inclusive
    - Desert Playas and Ephemeral Pools
- Soil Associations: Based on soils found in playas (Weighting factor of 3; Inclusive)
    - Playas-Wendane-Parran
    - Cirac-Nuyobe-Rustigate
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Those plant communities found in and around playas; Weighting factor of 2; not inclusive
    - A0869 *Atriplex canescens* Scrub Alliance
    - G570 Intermountain Basins Cliff, Scree & Badland Sparse Vegetation
    - Microphytic Playa Alliance (Peterson, 2008)
    - CEGL001991 *Suaeda moquinii* Wet Shrubland

William’s combleaf has been observed from Mineral County, Nevada, and Mono County, California, north to the California - Nevada line in Washoe County (Bureau of Land Management, 2016). It has also been reported from northeast California at Mud Flat and the Madeline Plains (Lassen County) and into south-eastern Oregon (Bureau of Land Management, 2016). To date, no observations of William’s combleaf have been made within the study area.

The Habitat Suitability Model shows potential for the plant to be found in and along the edges of the dry lakes of the North Range Study Area (Figure 53). Maxent was not run for this species due to a lack of sufficient observation points on the study area.

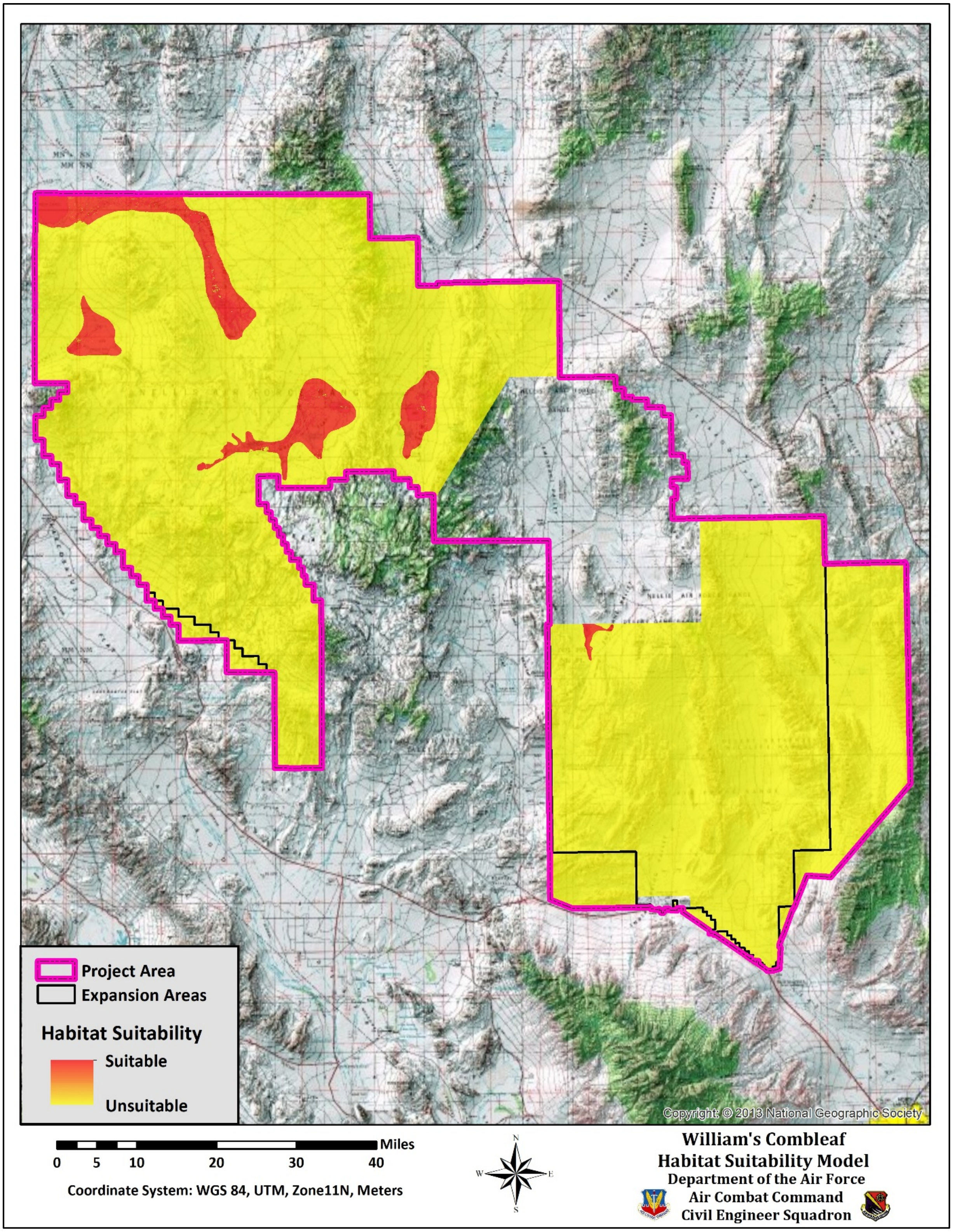


Figure 53. Habitat range of William's combleaf as determined by the Habitat Suitability Model.

Las Vegas Catseye (*Cryptantha insolita*)

The Las Vegas catseye is a small perennial forb that is endemic to Clark County, Nevada, considered by some to be extinct (Nevada Department of Natural Resources and Conservation, 2016; NatureServe, 2016). It is also known as Las Vegas Cryptantha or unusual catseye. Las Vegas catsye is found in alkaline clay soils within bajadas north of Las Vegas, Nevada (Nevada Department of Natural Resources and Conservation, 2016). More specifically, the species exists on light-colored, alkaline clay flats and low hills in the creosote bush plant communities from 1,000 – 2,000 ft. MSL elevation (Nevada Department of Natural Resources and Conservation, 2016). Because the study area is located at elevations greater than 3000 ft. MSL, the species is likely to not be found.

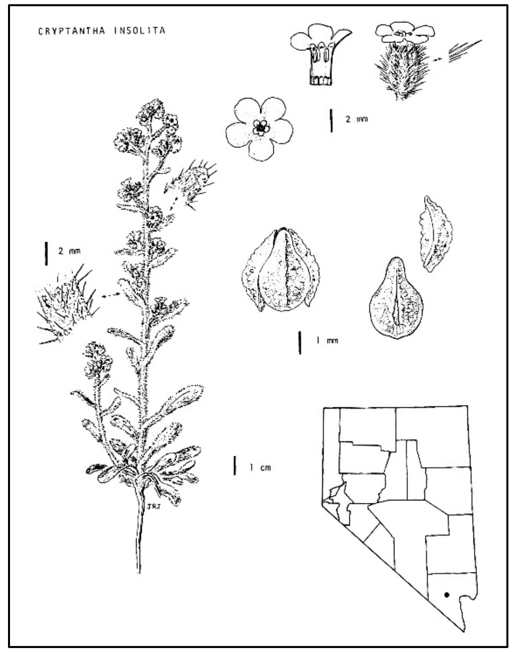


Illustration of Las Vegas catseye (Mozingo H. a., 1980).

The parameters used to prepare the Habitat Suitability Model for Las Vegas catseye were the following:

- Elevation: 1,000 – 2,000 ft. MSL (Not weighted; not inclusive)
- Slope: (0° - 20°) (Not weighted; not inclusive)
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not weighted; not inclusive
    - Mojave/Sonoran Warm Desert Scrub (NatureServe Explorer, 2016)
    - Mojave Mid-Elevation Mixed Desert Scrub
- Soil Associations: Based on soil associations dominated by clays (Not weighted; not inclusive)
    - Mokiak-Rock Outcrop-Breko
    - Motoqua-Gabbvally-Pioche
    - Gabbvally-Itca-Motoqua
    - Bellehelen-Squawtip-Rock Outcrop
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; inclusive
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - A3147 *Yucca schidigera* Scrub Alliance

To date, no observations of Las Vegas catseye have been made within the study area. The species is known from two collections, one from 1905, the other 1942. Since 1942, surveys have been conducted to search for this species without success and the species may now be extinct (NatureServe Explorer, 2016).

The Habitat Suitability Model showed potential for the species to occur on the Bajadas of the South Range Study Area and the bajadas of Sarcobatus Flats on the North Range Study Area (Figure 54). Maxent was not run for this species due to the lack of sufficient number of observation points on the study area.

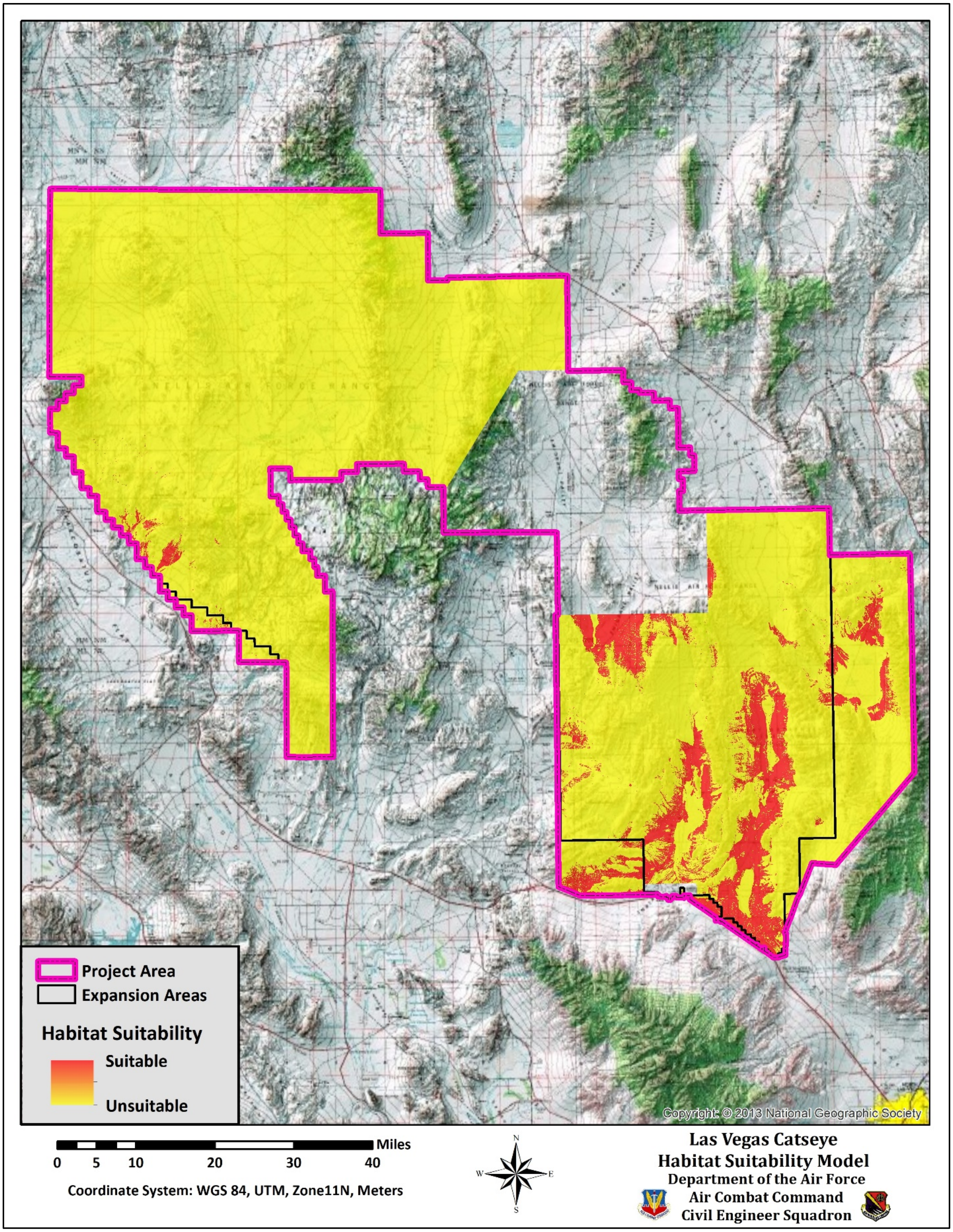


Figure 54. Habitat range of the Las Vegas catseye as determined by the Habitat Suitability Model.

Clokey's Pincushion (*Escobaria vivipara* var. *rosea*)

Clokey Pincushion

Clokey's pincushion has been found in San Bernadino County, California; Mohave County, Arizona; and Clark, Lincoln, Nye, Eureka, White Pine counties in Nevada (U.S. Department of Agriculture, 2017). This species variety is found on limestone slopes and gravelly areas in woodland or desert mountains at 5,000 – 9,000 feet elevation (Benson, 1969). It occurs in dry valleys, plains, foothills and on open, gentle to steep rocky slopes and flats, with sagebrush or conifer species and grasslands. Different varieties occur in grasslands, woodlands, montane forests, or deserts (Benson, 1982). The species can be found in two major vegetation communities: creosote bush scrub and pinyon-juniper woodland (Calflora, 2016).

The parameters used to prepare the Habitat Suitability Model for Clokey's pincushion were the following:

- Elevation: 5,000 – 9,000 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Weighting Factor of 2; not inclusive
    - Ths-- Horse spring formation
    - Qa—Alluvial deposits
    - Cc-- Limestone and dolomite, locally thick sequences of shale and siltstone
    - CZq-- Quartzite and minor amounts of conglomerate, phyllitic siltstone, limestone, and dolomite
    - Dc--Dolomite, limestone, and minor amounts of sandstone and quartzite
    - MDs-- Shale, siltstone, sandstone, chert-pebble, conglomerate and limestone
    - Oc-- Limestone, dolomite, shale and quartzite
    - Zqs-- Quartzite, phyllitic siltstone, conglomerate, limestone, dolomite
- Key Habitat: Not weighted; not inclusive
    - Mojave/Sonoran Warm Desert Scrub
    - Lower Montane Woodlands
    - Sagebrush
    - Mojave Mid-Elevation Mixed Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 3; inclusive
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
    - A3219 *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance
    - A3222 *Artemisia nova* Steppe & Shrubland Alliance
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - A3148 *Yucca brevifolia* Wooded Scrub Alliance
    - CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland
    - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
    - A3147 *Yucca schidigera* Scrub Alliance

- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
- CEGL000825 *Pinus monophylla* Woodland
- A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance

The Clokey's pincushion has been frequently observed within the study area. Several historic observations were made on the Groom Mountain Range and on the Nevada National Security Site (NNSS) around Yucca Flat, Pahute Mesa, and Timber Mountain. Most of the observations on the study area were made between 2008 to 2016 on the Spotted Range, Desert Range, and Sheep Range. One observation was made on the southern end of the Kawich Range.

The Habitat Suitability and Maxent Models showed comparable potential occurrence of the species on the study area (Figure 55 and Figure 56). The Habitat Suitability Model placed an emphasis on plant communities and made them inclusive, which excluded any other parameters outside of those boundaries. Vegetation important for Clokey's pincushion were centered around creosote bush, sagebrush, Joshua tree, and pinyon-juniper plant communities. Elevation, geology, and key habitat were also factors in the Habitat Suitability Model. The majority of suitable habitat in the South Range Study Area was found on the bajadas and foothills, while on the North Range Study Area most of the suitable habitat was on the foothills, mesas, and mountain ranges. Most of the North Range Study Area suitable habitat was found in sagebrush dominated plant communities.

Maxent placed high importance on soils and key habitat followed by slope (Table 13). Unlike the Habitat Suitability Model, vegetation was not an important factor for the Maxent Model. However, both models were comparable in showing significant suitable habitat in the South Range Study Area. The Maxent Model showed minimal habitat in the North Range Study Area due to the fact that only one observation point occurred in that area. In contrast, the Habitat Suitability model showed significant habitat in the North Range Study Area because it included sagebrush plant communities as a parameter. In contrast, Maxent did not emphasize sagebrush plant communities because only one of the observation points used by Maxent was in a sagebrush plant community. Both models appeared to show suitable habitat at most observation points. For management of Clokey's Pincushion, the Habitat Suitability Model should be used until further surveys in the North Range Study Area determine if the species is associated with sagebrush.

Table 13. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the Clokey's pincushion model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	3	34
Geology	3	22
Soil Association	32	0
Key Habitat	40	11
Temp. Water Source	1	0
Permanent Water Source	4	0
Mountains	0	0
Valleys	0	11
Mines	0	11
Slope	18	0
Elevation	0	11
Aspect	0	0

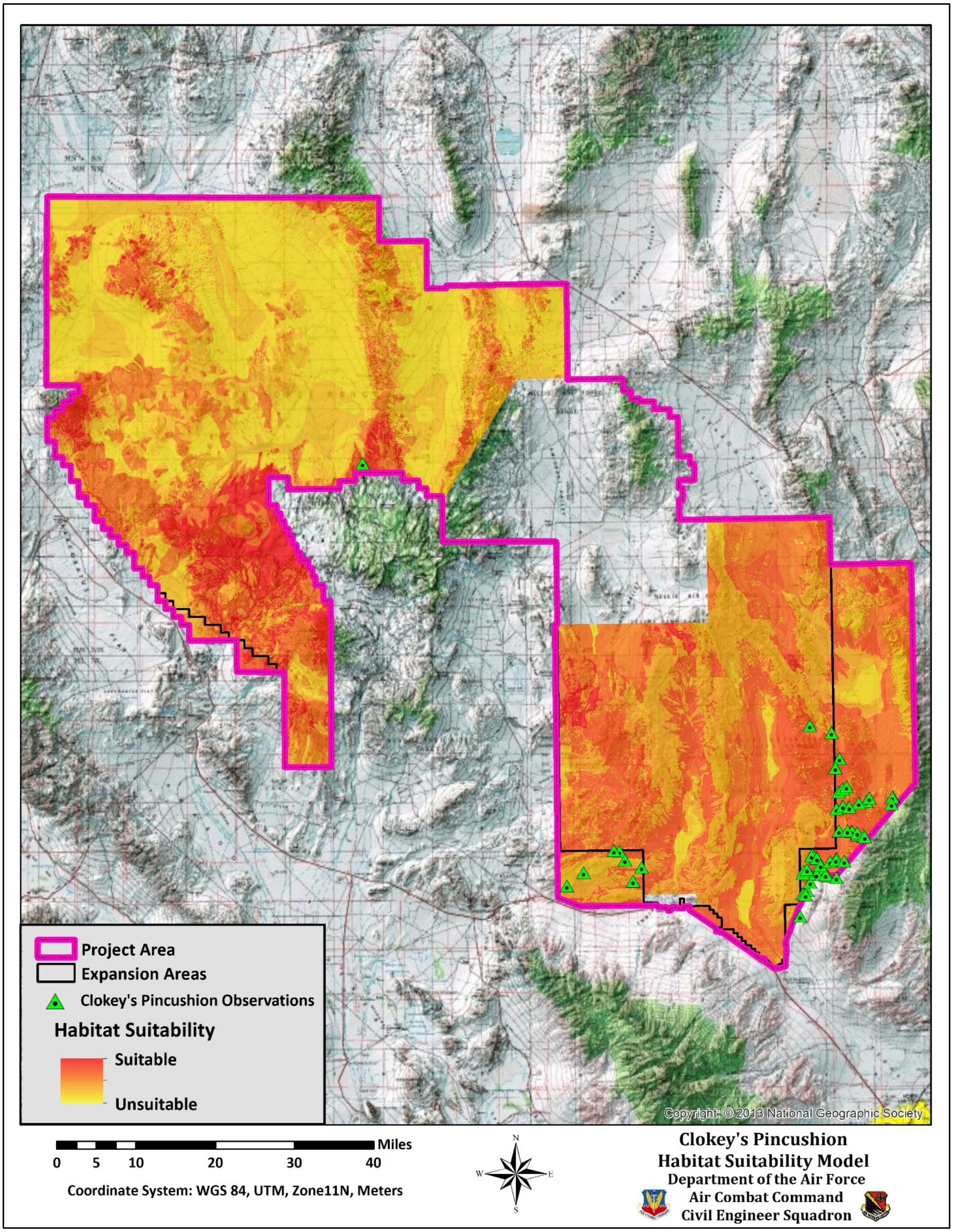


Figure 55. Habitat range of the Clokey pincushion as determined by the Habitat Suitability Model.

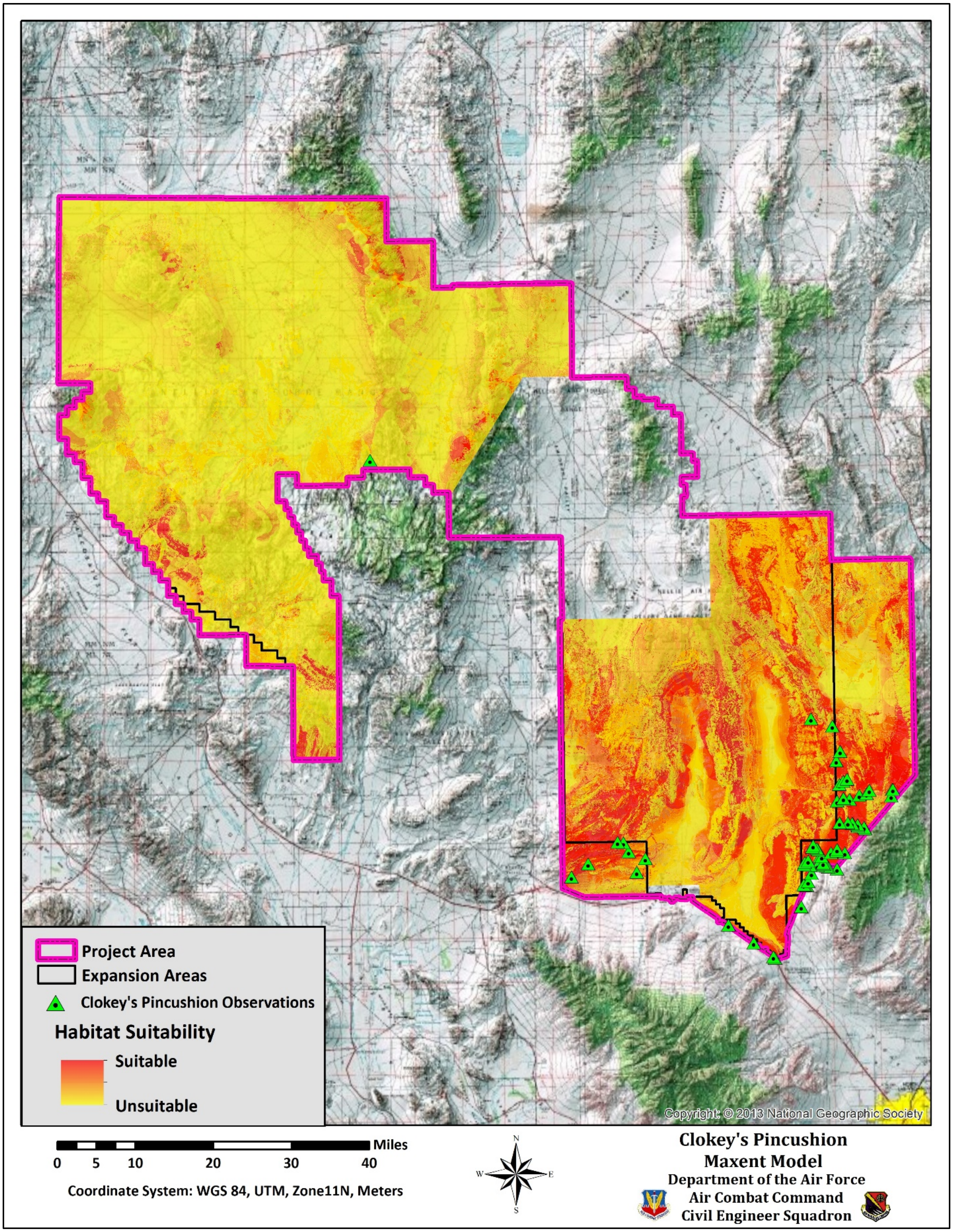


Figure 56. Habitat range of the Clokey pincushion as determined by the Maxent Model.

Armored Hedgehog Cactus (*Echinocereus engelmannii* var. *armatus)*

The armored hedgehog cactus is found throughout arid lands in the southwestern United States from California to Utah and Arizona, and into Mexico (U.S. Department of Agriculture, 2017). The only location for this subspecies in Nevada is in Nye County. This species can be found on gravel, sand, and rocky hills in creosote bush scrub, pinyon juniper woodland, and Joshua tree woodlands from 3,000 to 4,000 ft. MSL elevation (LLifle, 2016). However, the observations that have been made on the study area and NNSS were at 5,800 ft. to 6,000 ft. MSL. The only observation on the study area was found in the Big Sagebrush *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance and it was added to the model parameters. Like other cacti, armored hedgehog cactus prefers well-drained gravelly or sandy soils (NatureServe Explorer, 2016).

Armored Hedgehog Cactus (copyright NPS/ Robb Hannawacker)

The parameters used to prepare the Habitat Suitability Model for armored hedgehog cactus were the following:

- Elevation: 3,000 – 6,000 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Granite parent material. Weighting factor of 2; not inclusive
    - Tr3-- Rhyolitic flows and shallow intrusive rocks (Value at observation)
    - Tt3-- Welded and nonwelded silicic ash-flow tuffs (Value at observation)
    - Tgr--Granitic rocks
    - Tr3-- Rhyolitic flows and shallow intrusive rocks
    - Tmi--Intrusive rocks of mafic and intermediate composition
    - Tri--Intrusive rocks
- Key Habitat: Not weighted; not inclusive
    - Mojave/Sonoran Warm Desert Scrub
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Lower Montane Woodlands
    - Sagebrush
- Soil Associations: Sands and gravels. Not weighted; not inclusive
    - Tencee-Weiser-Colorock
    - St. Thomas-Rock Outcrop-Kyler
    - Stewval-Rock Outcrop-Gabbvally
    - Bellehelen-Ravenswood-Mohocken
    - Bellehelen-Squawtip-Rock Outcrop
    - Cirac-Nuyobe-Rustigate
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 3; not inclusive
    - A2108 *Pinus monophylla - Juniperus osteosperma /* Shrub Understory Woodland Alliance
    - A3148 *Yucca brevifolia* Wooded Scrub Alliance

- A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
- A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
- CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland
- CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland

This species variety was solely recorded by the NNHP in 1976 on the southwestern portion of the study area along the Pahute Mesa southeast of Black Mountain. A second sighting was made on the NNSS in the upper reaches of East Thirsty Canyon south of Trail Ridge (Nevada Natural Heritage Program, 2016).

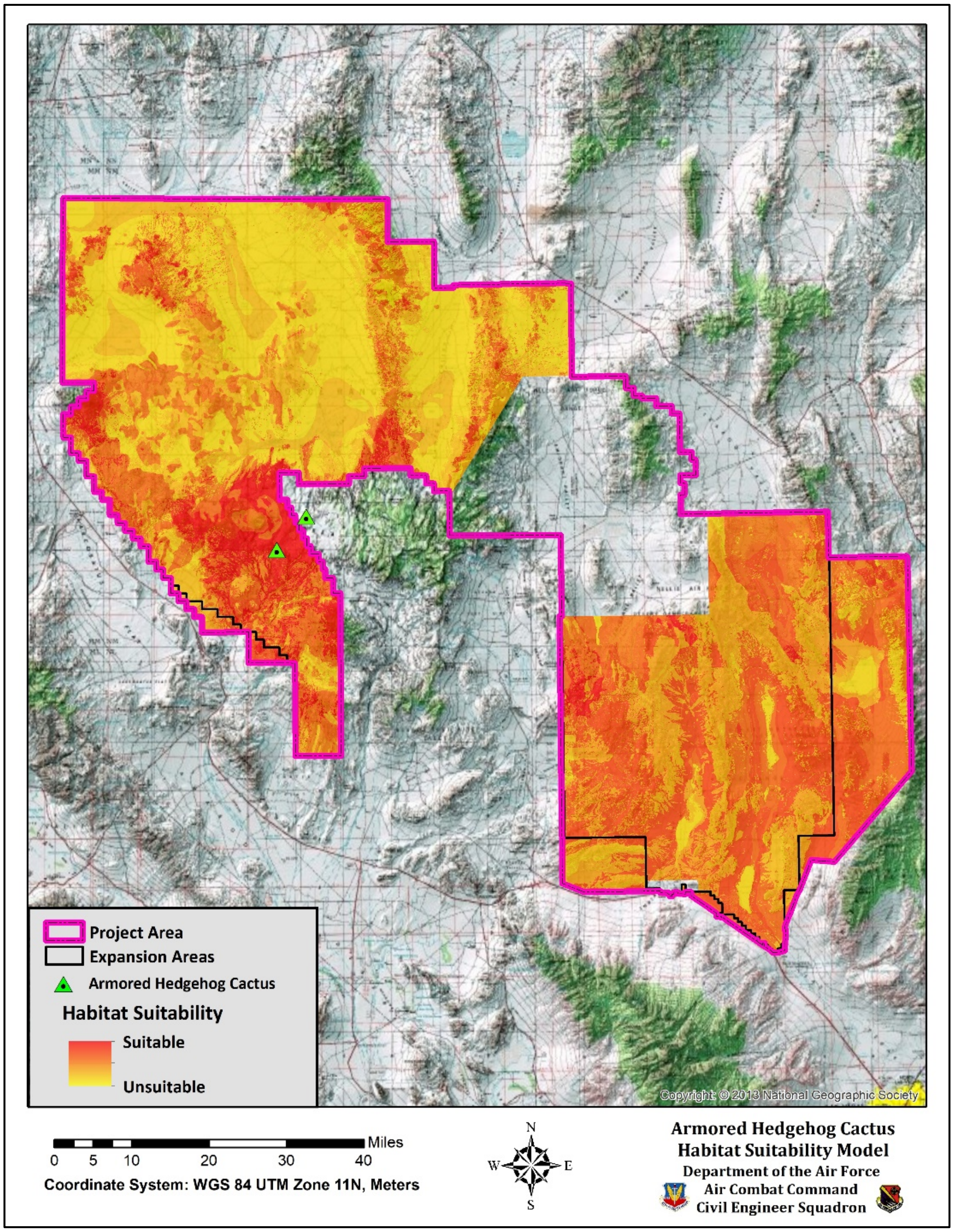


Figure 57. Habitat range of armored hedgehog cactus as determined by the Habitat Suitability Model.

The Habitat Suitability Model showed suitable habitat for the species to occur in the bajadas of the South Range Study Area. Suitable habitat was also found in the North Range Study Area especially in Thirsty Canyon, the southern Kawich Range, Belted Range, Cactus Range, and Stonewall Mountain (Figure 57). Maxent was not run for this species due to the lack of sufficient number of observation points on the study area.

Hermit Cactus (*Sclerocactus polyancistrus*)

Hermit Cactus

Hermit cactus occurs within Esmeralda, Mineral, and Nye Counties in Nevada (Mozingo & Williams, 1980). It is known to occur outside of Nevada in California (Nevada Natural Heritage Program, 2001; Mozingo & Williams, 1980; Porter J. M., 2011) and possibly in Arizona (Mozingo & Williams, 1980). The cactus often grows in rocky, alluvial, often alkaline soils, within the Mojave Desert scrub community between 1,640 – 8,200 ft. MSL (Flora of North America, 2016) but may be found at elevations as low as 2,000 ft. MSL (Mozingo & Williams, 1980). However, the populations existing in Nevada usually occur between 3,400 and 6,220 ft. MSL (Nevada Natural Heritage Program, 2001). Hermit cactus is known to occur outside of Nevada on basaltic and limestone hills. It can also be found on desert pavement (Nevada Natural Heritage Program, 2001). It appears to prefer the southern and southwestern slopes of hillsides (Nevada Natural Heritage Program, 2001), as well as canyons and alluvial slopes (Porter J. M., 2011).

Hermit cactus grows in many vegetation communities including creosote bush scrub, Joshua tree woodland, and pinyon-juniper woodland (Mozingo & Williams, 1980; Porter J. M., 2011). It often grows in conjunction with shadscale saltbush (*Atriplex confertifolia*), winterfat (*Krascheninnikovia lanata*), big sagebrush (*Artemisia tridentata*), and spinystar (*Escobaria vivipara var. rosea*) (Mozingo & Williams, 1980).

The parameters used to prepare the Habitat Suitability Model for hermit cactus were the following:

- Elevation: 3,400 – 8,200 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Weighting factor of 3, not inclusive. South and west aspects
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 2; not inclusive
  - Mojave Mid-Elevation Mixed Desert Scrub
  - Lower Montane Woodlands
  - Sagebrush
  - Intermountain Cold Desert Scrub
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 3; not inclusive
  - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
  - A3148 *Yucca brevifolia* Wooded Scrub Alliance
  - CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland
  - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland
  - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance

- A3202 *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance
- A0870 *Atriplex confertifolia* Scrub Alliance
- A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance

Hermit cactus is widespread in and around the study area. Populations were recorded on the northwestern area of Pahute Mesa and on the southern portion of Gold Flat during the 1970s (Beatley, 1976). It was also reported to occur throughout the NTTR as early as 1980 (Mozingo & Williams, 1980). Hermit cactus is widely distributed across the North Range Study Area as well as a few locations in the South Range Study Area.

The Habitat Suitability Model emphasized plant communities and aspect in its determination of potential occurrence of this species (Table 14). It also included elevation and key habitat in the analysis. This model indicated that a majority of the study area contained a high potential for suitable habitat for hermit cactus as is supported by the observation points (Figure 58). Most of the areas showing no potential for the species were found in basins and dry lakes.

The Maxent Model placed most of the importance on plant communities (Table 14). Aspect was also a minor, component in this model. The Maxent model showed a much more conservative determination of potential occurrence of hermit cactus with most of the occurrences being in the North Range Study Area (Figure 59). Between the two models, the Habitat Suitability Model contained almost all observation points within suitable habitat. Maxent was fairly accurate in the North Range Study Area, but in the South Range it indicated minimal habitat and most observation points were not in suitable habitat. Observations and models indicate that this species is widespread across the study area.

Table 14. Permutation importance values computed by the Maxent model and importance based on weighting factors for the Habitat Suitability Model for each of the environmental variables in the hermit cactus model.

Environmental Variable	Maxent Permutation Importance (%)	Habitat Suitability Model Importance (%)
Vegetation	98	27
Geology	0	0
Soil Association	0	0
Key Habitat	0	19
Temp. Water Source	0	0
Permanent Water Source	0	0
Mountains	0	9
Valleys	0	9
Mines	0	0
Slope	0	0
Elevation	0	9
Aspect	2	27

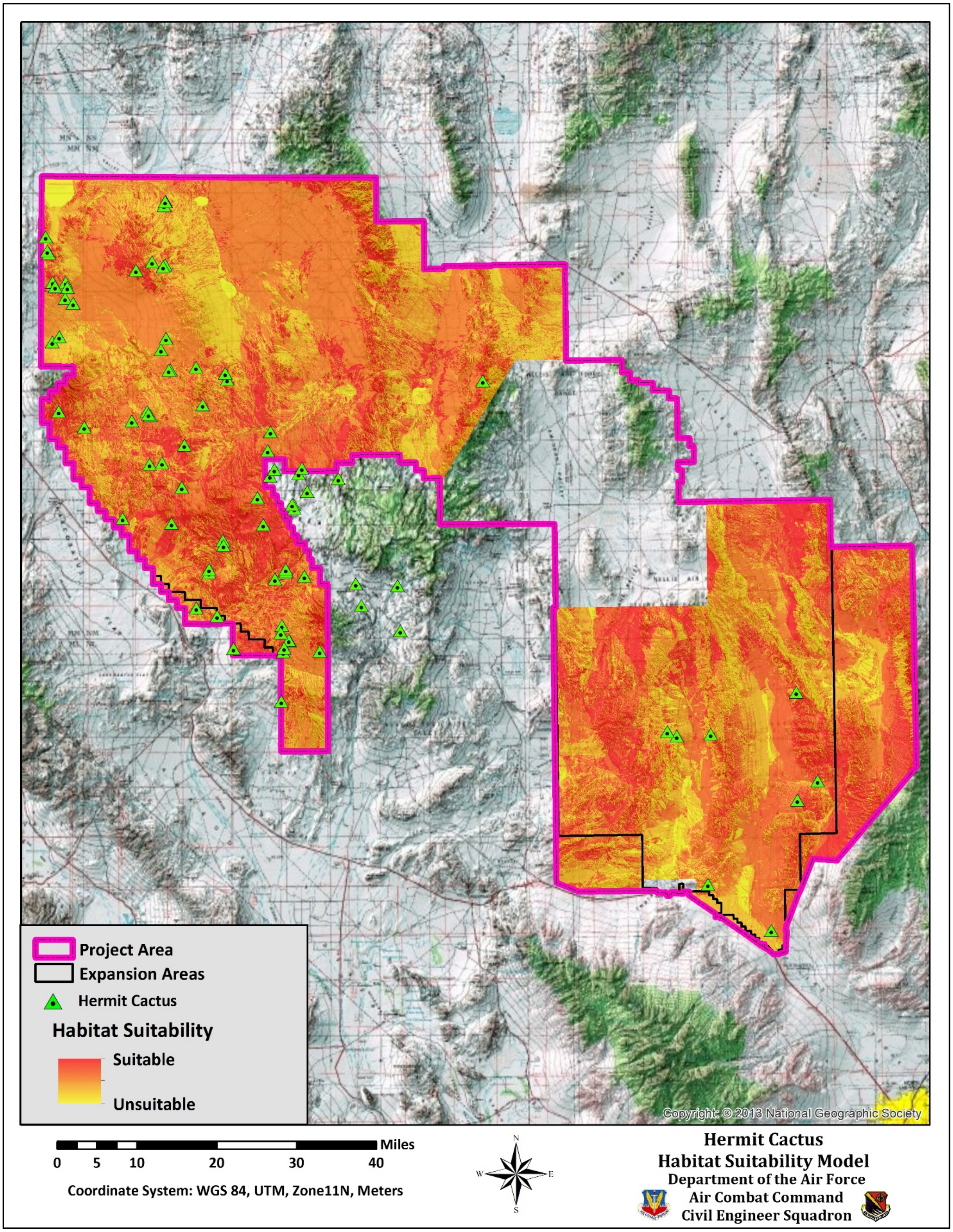


Figure 58. Habitat range of the hermit cactus as determined by the Habitat Suitability Model.

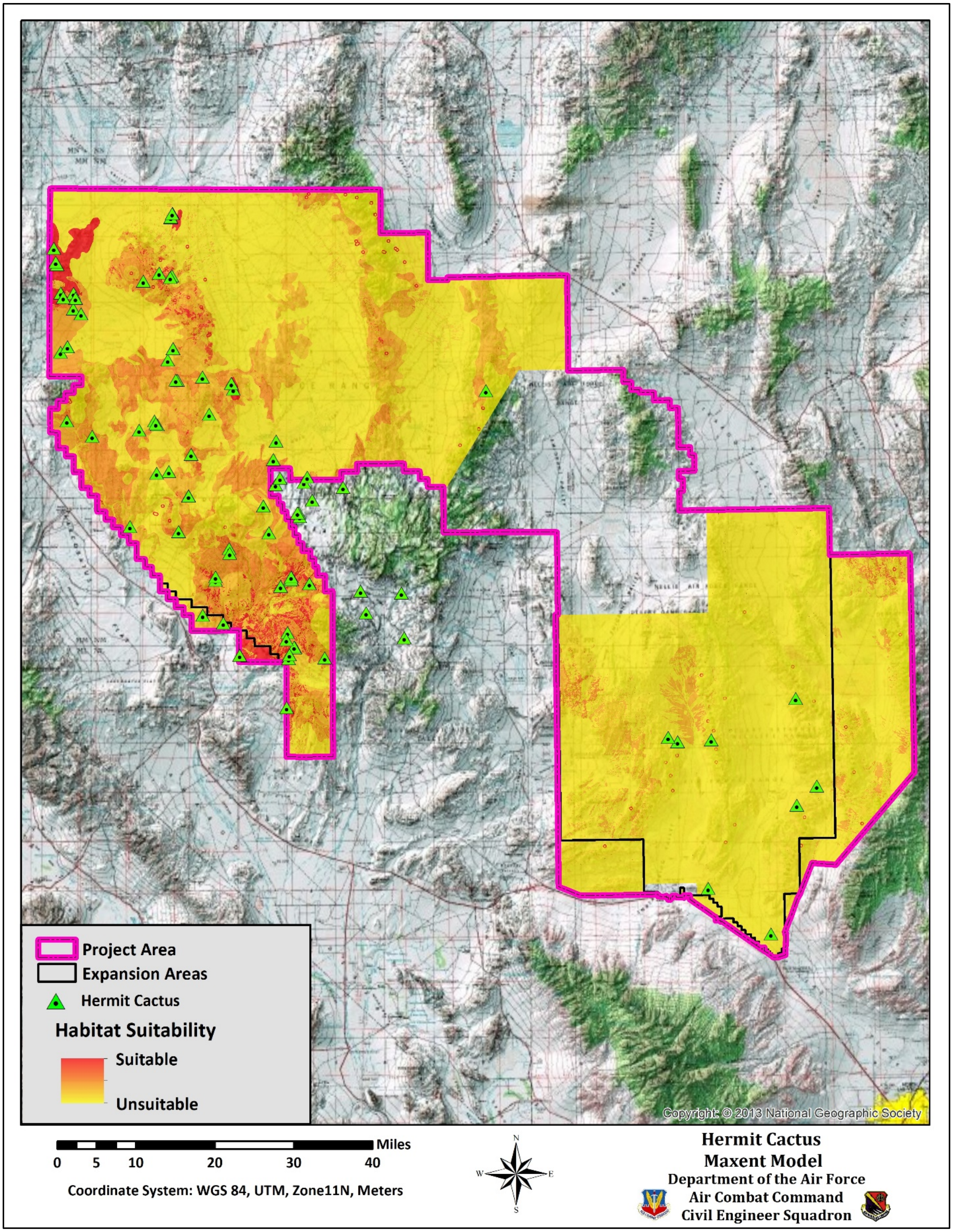


Figure 59. Habitat range of the hermit cactus as determined by the Maxent Model.

Threecorner Milkvetch (*Astragalus geyeri* var. *triquetrus*)

This critically endangered forb is localized along the Muddy, Virgin, Colorado Rivers and Lake Mead areas of Clark and Lincoln Counties, Nevada and Mohave County, Arizona (U.S. Bureau of Reclamation, 2016). It requires a higher than average rainfall event before seeds sprout (U.S. Bureau of Reclamation, 2016). Three-corner milkvetch is found on the Mojave Desert, on wind-blown sandy soils originating from sedimentary formations, especially those adjacent to Lake Mead and its tributary valleys (RECON, 2000). The species prefers open, deep sandy soil or dunes, generally stabilized by vegetation and/or a gravel veneer and can be found in Nevada at elevations of 1,100-2,400 feet MSL (Nevada Natural Heritage Program, 2016).

Threecorner Milkvetch (copyright Jim Andre, Sweeny Granite Mountains Desert Research Center and California Native Plant Society)

The parameters used to prepare the Habitat Suitability Model for threecorner milkvetch were the following:

- Elevation: 1,100 – 2,400 ft. MSL (Weighting factor of 1; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 2; inclusive
    - Sand Dunes and Badlands
    - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Weighting factor of 1; not inclusive
    - Tencee-Weiser-Colorock
    - St. Thomas-Rock Outcrop-Kyler
    - Cirac-Nuyobe-Rustigate
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; not inclusive
    - *Achnatherum hymenoides* Vegetation Alliance (Proposed)
    - A1044 *Chilopsis linearis - Psorothamnus spinosus* Desert Wash Scrub Alliance
    - Microphytic Playa Alliance (Peterson, 2008)
    - CEGL001315 *Atriplex confertifolia / Tetradymia glabrata* Shrubland

To date, no observations of three-corner milkvetch have been made within the study area. For this species, the Habitat Suitability Model placed higher importance on plant communities, key habitat, and elevation than on soils. The model showed that this species has potential to occur in the South Range Study Area (Figure 60). Potential habitat lies mostly in the bajadas surrounding dry lakes. Highest quality suitable habitat was found in areas immediately adjacent to dry lakes. Suitable habitat was also shown on the west side of Sarcobatus Flats in and around Alternative 3A. The Maxent Model was not run for this species due to a lack of sufficient numbers of observation points on the study area.

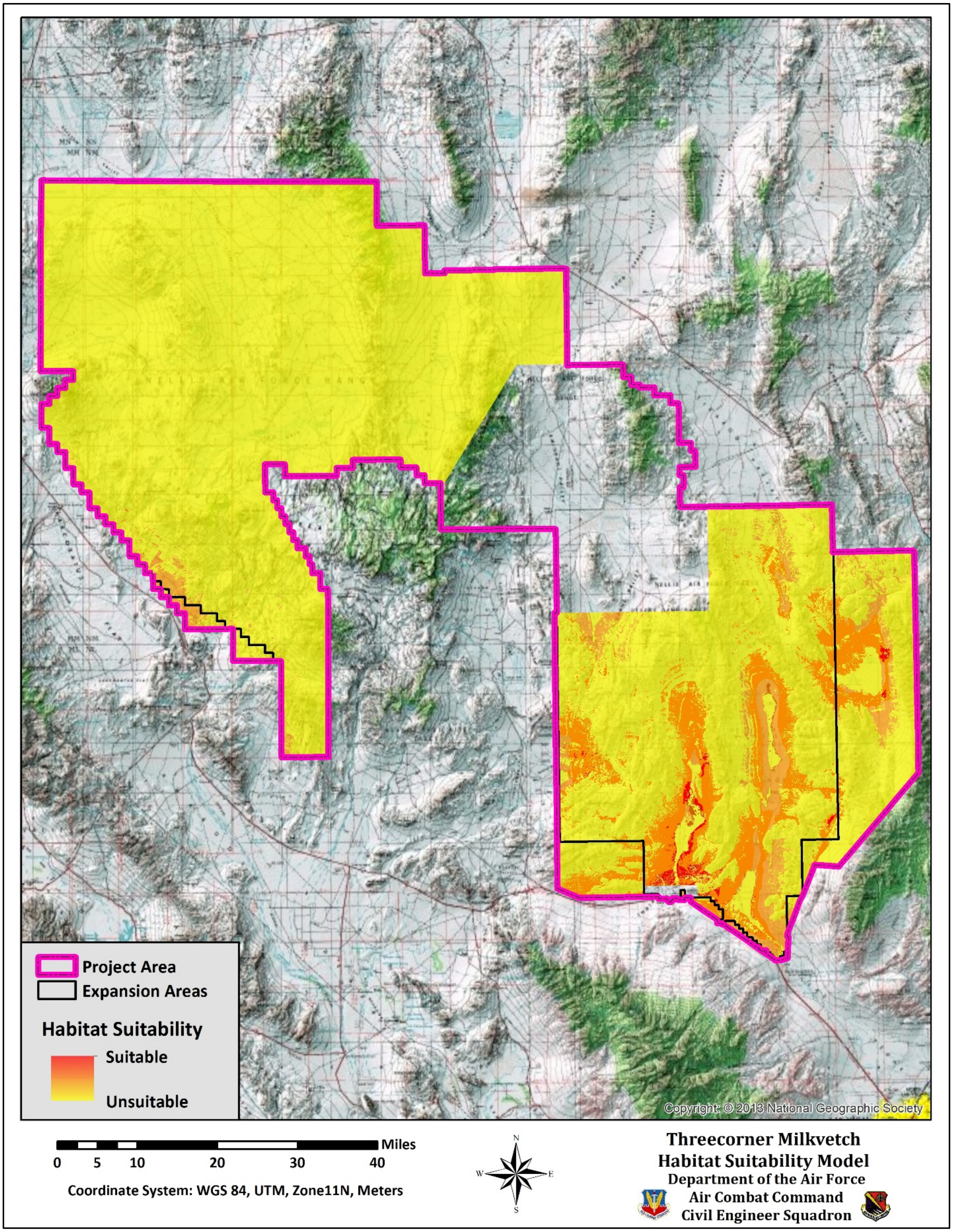


Figure 60. Habitat range of the threecorner milkvetch as determined by the Habitat Suitability Model.

Gilman's Milkvetch (*Astragalus gilmanii*)


Gilman's Milkvetch

Gilman's milkvetch is found on tuffaceous hillsides in Lincoln and Nye Counties in Nevada (U.S. Department of Agriculture, 2017; Nevada Natural Heritage Program, 2001). Surveys performed in 1985 identified four sites supporting the species in the Groom Range (The Nature Conservancy, 1997). Later surveys have not led to the discovery of other populations, but the Belted Range, as well as areas of the Groom Range, are considered potential locations (The Nature Conservancy, 1997). The Nevada Natural Heritage Program cites three occurrences with a total estimated population of 52 individuals (Nevada Natural Heritage Program, 2001). The plant is found in various habitats in higher elevations such as sagebrush scrub and conifer or juniper woodlands (Calflora, 2016). It has been found in gravelly areas among pinyon-juniper woodlands as well as light-colored volcanic slopes composed of volcanic tuff. It grows at elevations ranging from 5,300 to 6,200 feet (The Nature Conservancy, 1997; Nevada Natural Heritage Program, 2001; Wojciechowski, 2011).

The parameters used to prepare the Habitat Suitability Model for Gilman's milkvetch were the following:

- Elevation: 5,000 – 6,500 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Tuffaceous Formations; Weighting factor of 2; not inclusive
  - Ts2--Tuffaceous sedimentary rocks
  - Ts3—Tuffaceous sedimentary rocks
  - Tt2—Welded and nonwelded silicic ash-flow tuffs
  - Tt3—Welded and nonwelded silicic ash-flow tuffs
  - Tts--Ash-flow tuffs and tuffaceous sedimentary rocks
- Key Habitat: Not weighted; not inclusive
  - Lower Montane Woodlands
  - Sagebrush
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 3; not inclusive
  - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
  - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance

Gilman's milkvetch has been observed at three sites within the study area. Populations have been documented at a location north of the Timber Mountains between Thirsty Canyon and Parachute Canyon

(Nellis Air Force Base, 2016). Additional observations were made along Cedar Pass in the Kawich Mountain Range and across the Groom Mountain Range in multiple locations. The NNHP has three additional records in the Groom Mountain Range from as early as 1985 (Nevada Natural Heritage Program, 2016).

For this species, the Habitat Suitability Model emphasized plant communities and geology for determining potential occurrence. Also included was elevation and key habitat with valleys being excluded. The model indicated that the majority of potential habitat for this species lies in the North Range Study Area in and around most of the mountain ranges (Figure 61). The Sheep Range and mountain ranges in the northern part of the South Range Study Area showed a low to medium potential for this species. The Maxent Model was attempted for this species, but the number of observations (two total observations) found within the model area was not sufficient to provide an accurate model.

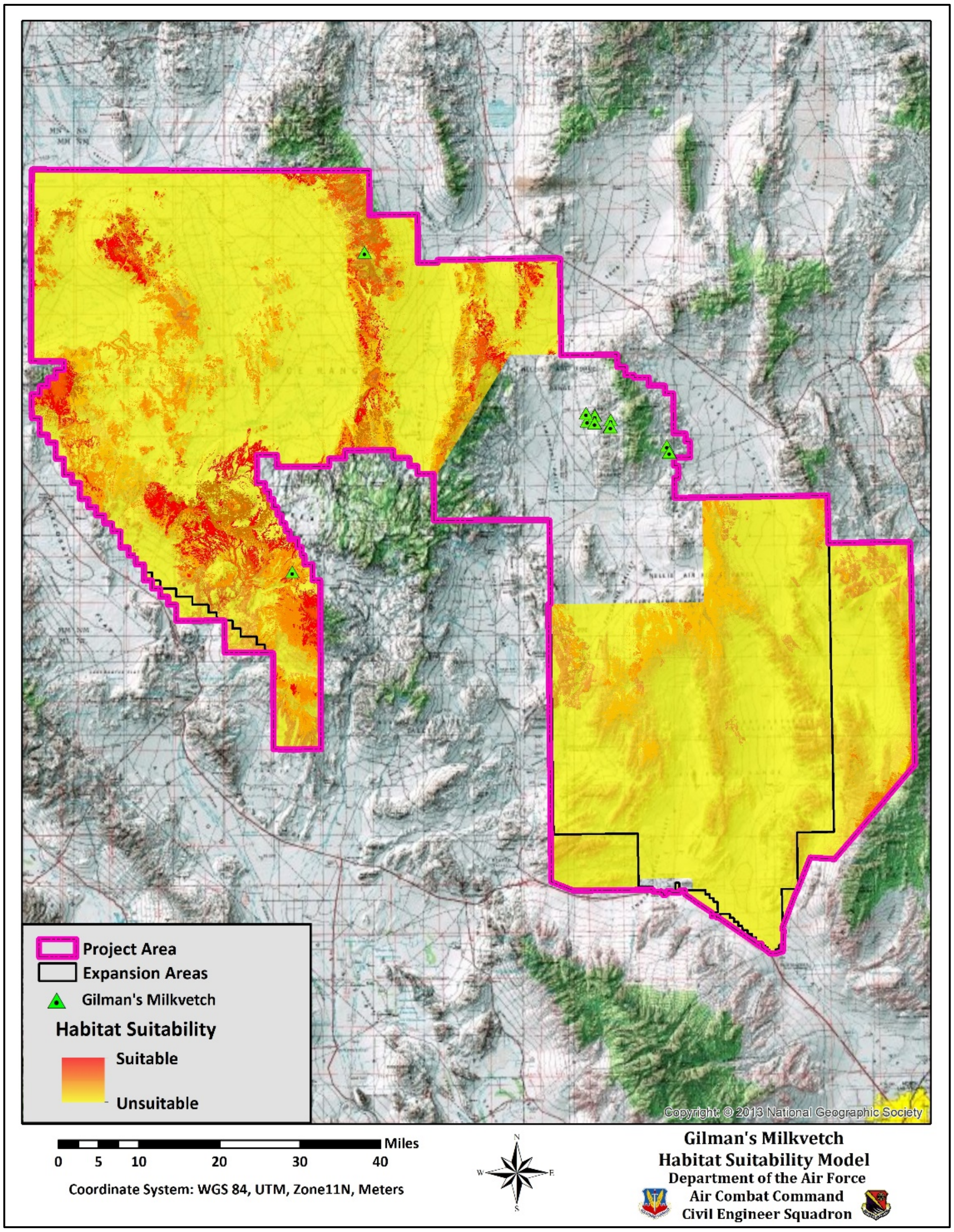


Figure 61. Habitat range of Gilman's milkvetch as determined by the Habitat Suitability Model.

Inyo Milkvetch (*Astragalus inyoensis*)

The Inyo milkvetch habitat range is limited to Inyo County, California and Nye and Lincoln Counties, Nevada. It is a low, mat-forming perennial that grows on sandy and gravelly soils that are comprised mostly of carbonate rock (Contu, 2012). The species is found in open pinyon-juniper woodlands associated with sagebrush (NatureServe Explorer, 2016). It occurs between 4,900 and 7,500 ft. elevation MSL (Contu, 2012) and is only known to exist on the Groom Mountain Range in Nevada within Lincoln County (Nevada Natural Heritage Program, 2016).

Inyo Milkvetch (copyright Jim Morefield, Nevada Native Plant Society)

The parameters used to prepare the Habitat Suitability Model for Inyo milkvetch were the following:

- Elevation: 4,900 – 7,500 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Carbonate Formations; Not weighted; not inclusive
    - Cc—Limestone and dolomite, locally thick sequences of shale and siltstone
    - CZq—Quartzite and minor amounts of conglomerate, phyllitic siltstone, limestone, and dolomite
    - Dc—Dolomite, limestone, and minor amounts of sandstone and quartzite
    - MDs—Shale, siltstone, sandstone, chert-pebble, conglomerate and limestone
    - Oc—Limestone, dolomite, shale and quartzite
    - Sc—Dolomite
    - SOc--Dolomite
- Key Habitat: Weighting factor of 2; not inclusive
    - Lower Montane Woodlands
    - Sagebrush
- Soil Associations: Sandy and gravelly soils; Weighting Factor of 2; inclusive
    - Stewval-Rock Outcrop-Gabbvally
- Mountains were not excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; not inclusive
    - A3222 *Artemisia nova* Steppe & Shrubland Alliance
    - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
    - CEGL000825 *Pinus monophylla* Woodland
    - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance

The NNHP lists the only recorded observation of this species which occurred in 1985. The plant was located on the western slopes of the Groom Mountain Range near Cattle Spring at 6,400 ft. MSL. For this species, the Habitat Suitability Model emphasized plant communities, soils, and key habitat. Geology and elevation were minor considerations. The more suitable habitat was found on the mountain ranges on the North Range Study Area (Figure 62). Habitat suitability tended to decrease slightly in the upper elevations of the mountains. Little or no habitat was found in the basins of both the North Range Study Area and South Range Study Area. Habitat suitability was much less on the mountains in the South Range Study Area compared to the North Range Study Area. Maxent was not run for this species due to an insufficient number of observation points within the study area.

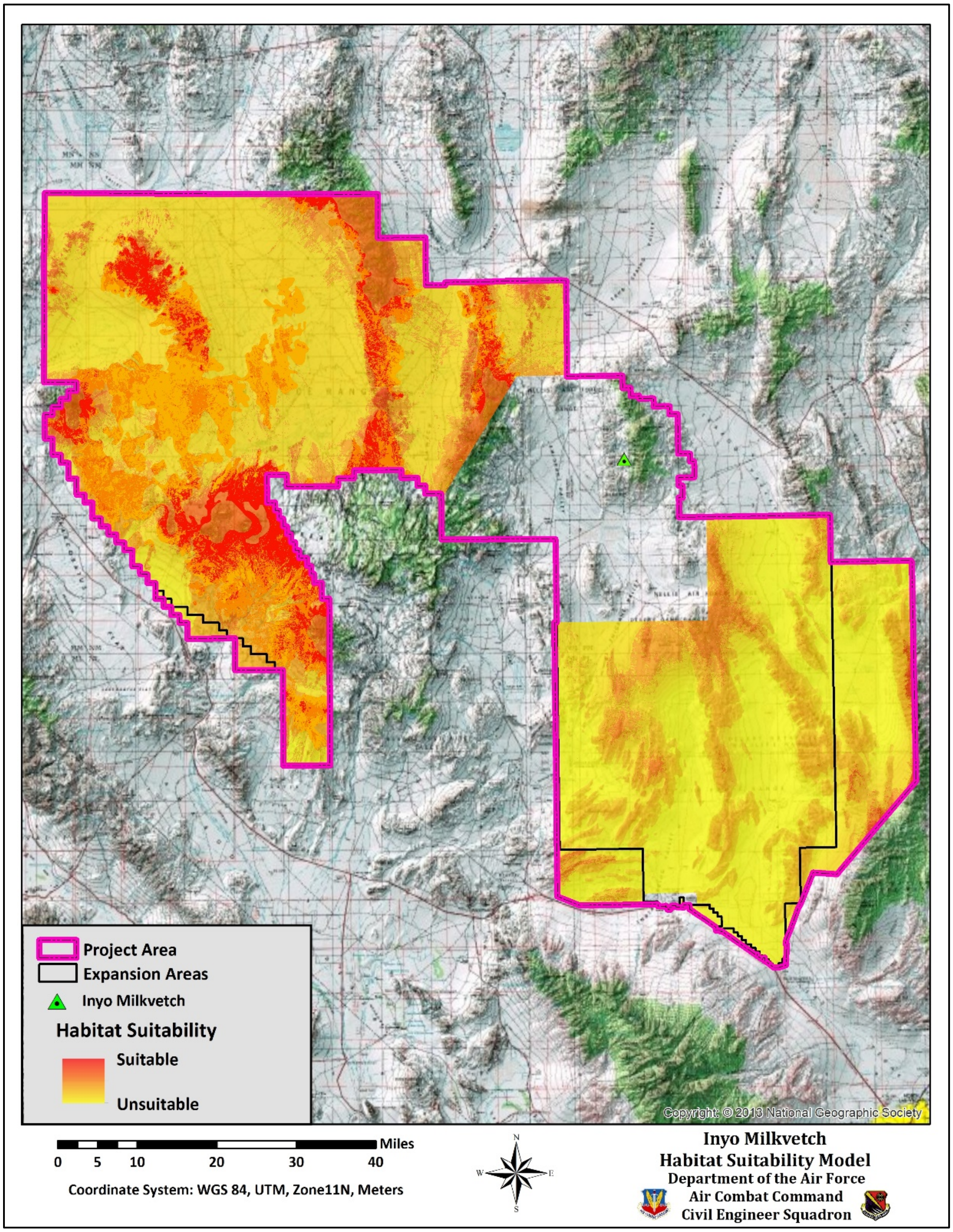


Figure 62. Habitat range of the Inyo milkvetch as determined by the Habitat Suitability Model.

Ash Meadows Blazing Star (*Mentzelia leucophylla*)

Ash Meadows Blazing Star (copyright U.S. Fish and Wildlife Service)

The Ash Meadows Blazing Star is endemic to the Ash Meadows National Wildlife Refuge in southern Nevada (U.S. Fish and Wildlife Service, 2016). This biennial forb grows near seeps and springs in sandy or salty-clay soil (Bureau of Land Management, 2013; Ackerman, 2001). Habitat has also been described as sandy to gravelly alkali soils in drainages and low bluffs and swales (Sada, 1990; Bureau of Land Management, 2013; Ackerman, 2001). It is commonly associated with salt desert scrubs, shadscale (Nevada Department of Natural Resources and Conservation, 2016), and other endemic plants including Ash Meadows milkvetch (*Astragalus phoenix*) and Ash Meadows sunray (*Enceliopsis nudicaulis*) (NatureServe Explorer, 2016; Bureau of Land Management, 2013; Ackerman, 2001). Frequently these plants are found on western slopes, and always in areas that have saturated soils during the winter months (Bureau of Land Management, 2013). Studies disagree on the dependence of the Ash Meadows blazing star on seeps and springs. The original plant description by James Reveal states that because the plant is always associated with dry soils, it is uninfluenced by seeps and springs (Sada, 1990). Later studies show that the plant is found on soils that are dry during summer months but saturated with water in the winter when the water table rises to near surface level. The Ash Meadows blazing star seems to be dependent on these seasonally saturated soils (Bureau of Land Management, 2013). The Ash Meadows blazing star has a narrow elevation range and is only found between 2,200-2,350 ft. MSL (Ackerman, 2001).

The parameters used to prepare the Habitat Suitability Model for Ash Meadows blazing star were the following:

- Elevation: 2,220 – 2,350 ft. MSL (Weighting factor of 3; not inclusive)
- Slope: Not a limiting factor
- Aspect: West; Not weighted; not inclusive
- Permanent Water: Weighting factor of 4; inclusive
- Temporary Water: Weighting factor of 4; inclusive
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 1; Not inclusive
    - Mesquite Bosques and Desert Washes
    - Desert Playas and Ephemeral Pools
    - Mojave/Sonoran Warm Desert Scrub
- Soil Associations: Sandy and gravelly soils; Not weighted; not inclusive
    - Cirac-Nuyobe-Rustigate
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; not inclusive
    - CEGL001991 *Suaeda moquinii* Wet Shrubland
    - A0869 *Atriplex canescens* Scrub Alliance
    - A0870 *Atriplex confertifolia* Scrub Alliance

To date, no observations of Ash Meadows blazing star have been made within the study area. The Habitat Suitability Model indicated that this species had a low potential for occurrence on the study area and suitable habitat was mostly in the bajadas and playas of the South Range Study Area (Figure 63). In the North Range Study Area, suitable habitat was found in the playas and in Sarcobatus Flats in Alternative 3A. It is important to note that the species is generally endemic to the Ash Meadows Wildlife Refuge and even though the model shows potential for the species to be present, its occurrence would be considered unlikely. For conservation of the species, it is recommended that surveys for the species only be conducted in areas impacted by military activities and occurring in sites shown to have suitable habitat for the species. Maxent was not run for this species due to an insufficient number of observation points within the study area.

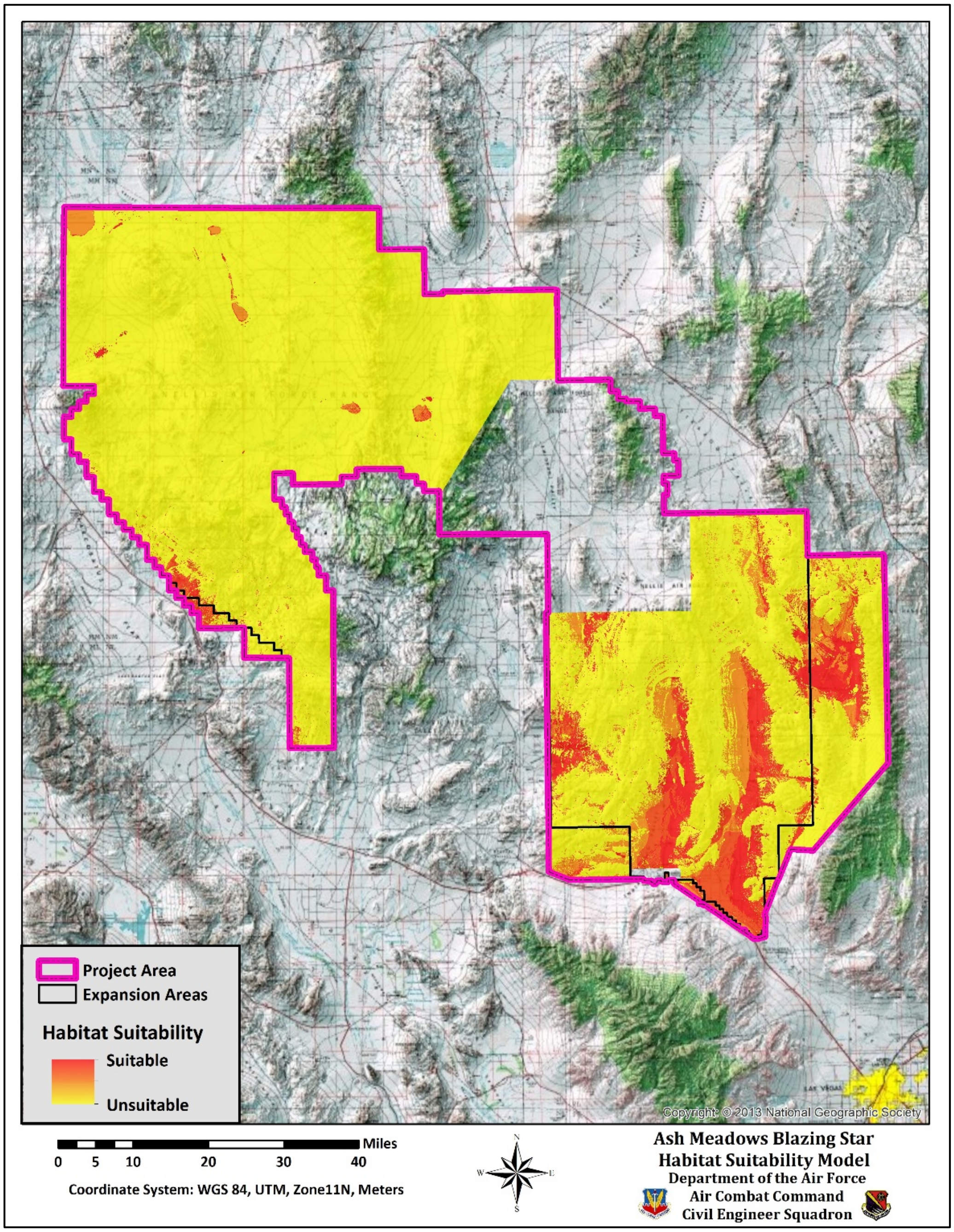


Figure 63. Habitat range of the Ash Meadows blazing star as determined by the Habitat Suitability Model.

Las Vegas Bearpoppy (*Arctomecon californica*)

Las Vegas Bearpoppy

The Las Vegas bearpoppy (LVBP) is endemic to southeastern Clark County, NV (RECON, 2000). It grows predominantly in gypsum-rich soil, yet some research suggests that the bear-poppy is not dependent on this soil type (Thompson & Smith, 1997). The habitat for the LVBP typically consists of "…dis-sected or hummocked soils with high gypsum contents" (Nevada Natural Heritage Program, 2016). Other features asso-ciated with LVBP include a well-developed soil crust, open soil surfaces with sparse populations of competing plants, and ele-vations ranging from 1,060 to 3,642 ft. MSL (Nevada Natural Heritage Program, 2016). The gypsiferous soil may actually ben-efit the LVBP by bringing water to the plant (Meyer, Garcia-Moya, & Lagunes-Espinoza, 1992). It is often found in areas of generally low relief, on all aspects and slopes, surrounded by *Larrea tridentata*, *Atriplex spp.*, and *Coleogyne ramosissima* as-sociations. On appropriate soil types, the species will often re-vegetate disturbed areas that have been allowed to recover if a seedbank remains (Nevada Natural Heritage Program, 2016).

While gypsiferous soil is preferred, it is not always required for the growth and survival of the plant (Childers, 2004). In a com-parison of location data from the BLM with soil data from Natural Resources Conservation Service (NRCS) and the USGS, 34.6% of the 2,575 plants were found to grow on a limestone, but not gypsiferous, soil (Childers, 2004). Furthermore, 28% of the plants in this study were found in locations that did not possess soils with a cryptogamic surface (Childers, 2004). Another study indicated the LVBP established popula-tions in rocky and hard pan areas (Sheldon, 1994). In general, the LVBP grows in locations that have few or no competing plants. This may be due to the high concentrations of nitrogen based soil constituents that prevent the growth of competing plants (Meyer, 1986). Soils supporting LVBP populations also tend to have high sulfur and salt concentrations (Sheldon, 1994). LVBP appears to have a greater tolerance to these soil constituents, which may provide an advantage for the plant over its competitors.

The parameters used to prepare the Habitat Suitability Model for LVBP were the following:

- Elevation: 1,000 – 4,000 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Gypsiferous formations are preferred, but this is not an attribute in the layer used for this model.
- Key Habitat: Not weighted; not inclusive
    - Sand Dunes and Badlands
- Soil Associations: Prefers gypsiferous soils, but this is not an attribute in the layer used for the model. However, the associations where LVBP was found on Nellis Air Force Base were used for this model. Weighting factor of 4; not inclusive.
    - Canutio-Cave-Weiser (NV385)
- Mountains were excluded.
- Valleys were not excluded.

- Plant Communities: Weighting factor of 2; inclusive
    - A0870 *Atriplex confertifolia* Scrub Alliance
    - A0869 *Atriplex canescens* Scrub Alliance
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - A3279 *Ambrosia dumosa* Desert Dwarf Scrub Alliance

To date, no observations of LVBP have been made within the study area. The Habitat Suitability Model placed most importance on soils and plant communities, concentrating on those where this species is commonly found. The model showed that potential habitat is restricted to the bajadas of the South Range Study Area with relatively high potential on the western slopes and bajadas of the Desert Range and some of the creosote bush plant community found in and around the southeastern end of Alternative 3B (Figure 64). Much of the bajadas supported habitat that was moderately suitable. Some habitat was indicated in scattered areas of the North Range Study Area, but would be considered poor habitat and well out of the documented range for the species. Maxent was not run on this species due to an insufficient number of observation points within the study area.

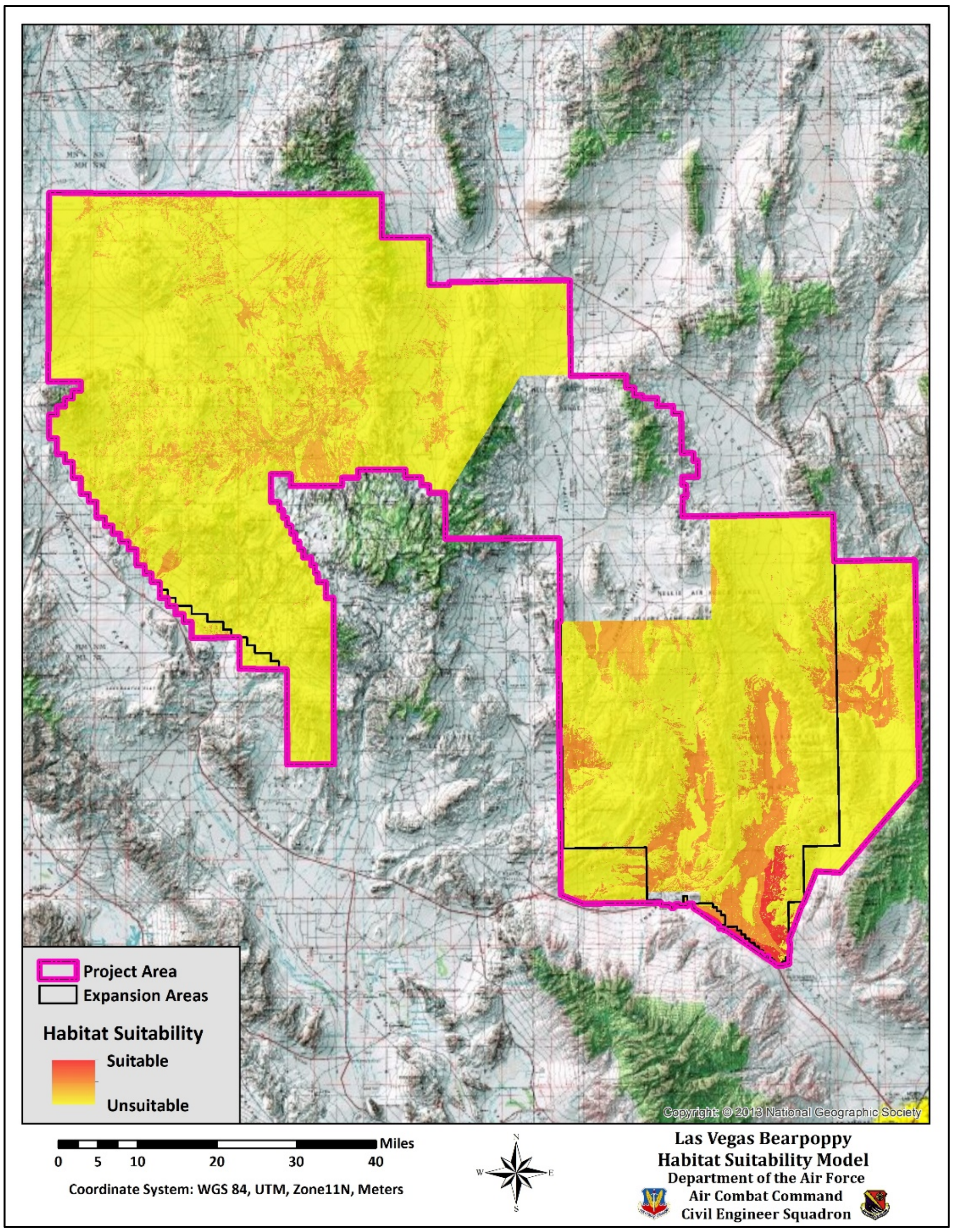


Figure 64. Habitat range of the Las Vegas bearpoppy as determined by the Habitat Suitability Model.

White-Margined Beardtongue (*Penstemon albomarginatus*)

White-Margined Beardtongue (copyright Jim Morefield)

The white-margined beardtongue is found in southern Nevada, western Arizona, and western areas of California and limited to the Mojave Desert (Etyemezian, et al., 2010). This herbaceous perennial prefers alkaline, deep, loose sands in washes (MacKay). The plant is highly dependent on this deep sand for establishment of populations (MacKay). It is most often found in shrub cover of less than 20% (Etyemezian, et al., 2010). White-margined beardtongue has been found in association with *Ambrosia* spp. and *Larrea tridentata* (Beatley, 1976), and Joshua tree (Heritage Data Management System, 2003). Other surveys indicated that the species is often found in association with *Pleuraphis rigida, Krascheninnikovia lanata,* and *Acamptopappus shockleyi,* but probably its association with *Krameria erecta, Larrea tridentata,* and *Ambrosia dumosa* was only by chance because of the common occurrence of those species in the area (Etyemezian, et al., 2010). As previously mentioned, the plant is dependent on deep sand for its long taproots (Nevada Natural Heritage Program, 2001). Thus, stabilized sand dunes and Mojave Desert scrub with alluvial sandy soils, comprise the suitable habitat for this species (Heritage Data Management System, 2003). Soil types include "volcanic derived soils and coarse sand with high amounts of silt" (Heritage Data Management System, 2003). Recorded elevations range from 1,520 ft. to 5,890 ft. MSL in Nevada (Nevada Natural Heritage Program, 2001; Blomquist, et al., 1995). Studies have shown the species to prefer slopes of 2-35% (Blomquist, et al., 1995; Etyemezian, et al., 2010) with a south or west aspect (Etyemezian, et al., 2010). In Nevada, these plants appear to prefer wind-blown sand and sand dunes at the base of hills and mountains and may also be found in deep sands in washes (MacKay).

The parameters used to prepare the Habitat Suitability Model for white-margined beardtongue were the following:

- Elevation: 2,750 – 5,890 ft. MSL (Not weighted; not inclusive)
- Slope: 1° - 12°; not weighted; not inclusive
- Aspect: South or West aspect; not weighted; not inclusive
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Alluvial deposits; not weighted; not inclusive
    - Qa--Alluvial deposits
    - Qp--Playa, marsh, and alluvial-flat deposits, locally eroded
- Key Habitat: Not weighted; inclusive
    - Mesquite Bosques and Desert Washes
    - Mojave Mid-Elevation Mixed Desert Scrub
    - Mojave/Sonoran Warm Desert Scrub
    - Sand Dunes and Badlands
- Soil Associations: Sandy soils; not weighted; not inclusive.
    - ST. THOMAS-ROCK OUTCROP-KYLER (NV204)
    - TENCEE-WEISER-COLOROCK (NV202)
    - CIRAC-NUYOBE-RUSTIGATE (NV521)
- Mountains were excluded.
- Valleys were not excluded.

- Plant Communities: Weighting factor of 3; not inclusive. These plant communities were selected because they potentially supported populations of species associated with white-margined beardtongue.
    - A3202 *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance
    - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
    - A3279 *Ambrosia dumosa* Desert Dwarf Scrub Alliance
    - A3147 *Yucca schidigera* Scrub Alliance
    - A3148 *Yucca brevifolia* Wooded Scrub Alliance
    - CEGL005777 *Yucca brevifolia / Larrea tridentata - Yucca schidigera / Pleuraphis rigida* Wooded Shrubland

To date, no observations of white-margined beardtongue have been made within the study area. The Habitat Suitability Model showed that there was medium to high potential for this species occurring on the bajadas of the South Range Study Area (Figure 65). Additionally, potential habitat was mapped along the northeastern bajadas of Sarcobatus Flat. Maxent was not run for this species due to an insufficient number of observation points within the study area.

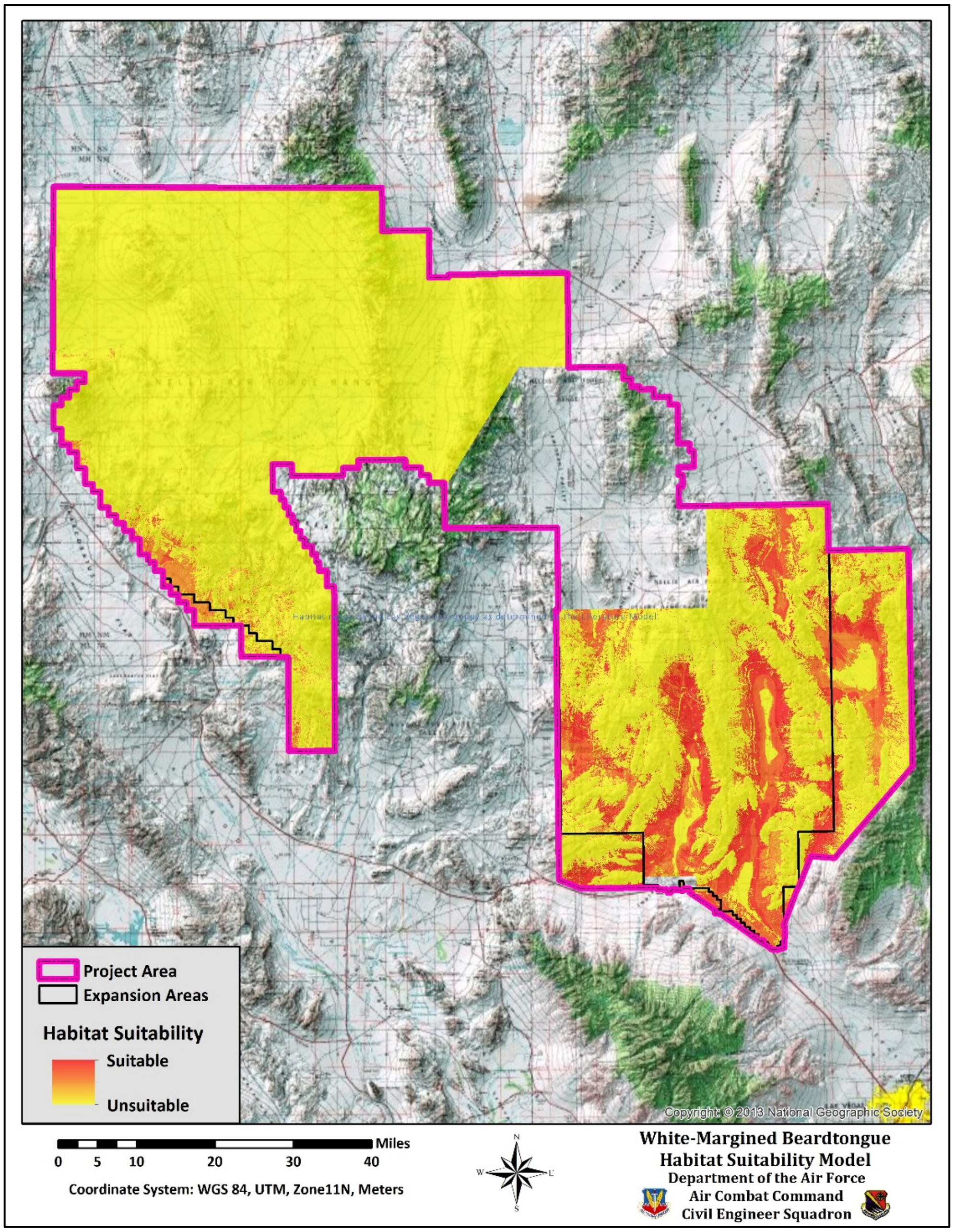
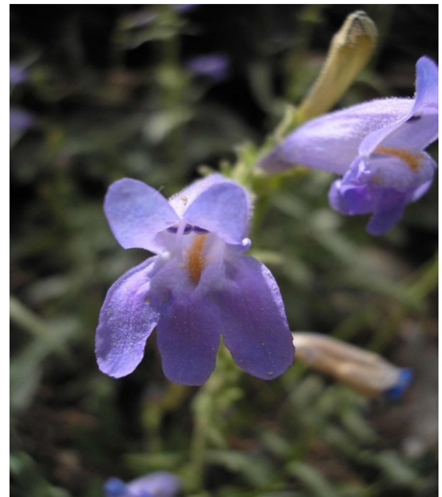


Figure 65. Habitat range of the white margined beardtongue as determined by the Habitat Suitability Model.

Bashful Beardtongue *(Penstemon pudicus)*



Bashful Beardtongue (copyright Kate Walker)

Bashful beardtongue is endemic to Nye County, Nevada, within the northern Kawich Range and is only known to occur in the north Kawich Range with fewer than 1,000 individuals total (NatureServe Explorer, 2016). Bashful beardtongue is found on steep protected slopes and drainage bottoms, with coarse rocky soils on outcrops and boulder piles (Nevada Natural Heritage Program, n.d.). The plant has been documented as occurring at elevations occurring between 7,500 – 9,000 ft. MSL (Nevada Natural Heritage Program, 2001). Plant populations often become established within crevices, soil pockets, and coarse rocky soils of felsic volcanic outcrops, boulder piles, steep protected slopes, and drainage bottoms. Its preferred habitat is upper pinyon-juniper zones, subalpine sagebrush, and mountain mahogany, particularly along shaded washes (Nevada Natural Heritage Program, 2001). This perennial herb is found mostly on north and east aspects of the habitat (NatureServe Explorer, 2016). This plant has a very narrow distribution and has been found only in a few locations within the Kawich mountains.

The parameters used to prepare the Habitat Suitability Model for bashful beardtongue were the following:

- Elevation: 7,500 – 9,000 ft. MSL (Weighting factor of 2; inclusive)
- Slope: Cliffs and rugged slopes; Weighting factor of 2; not inclusive
- Aspect: North and East aspect; Weighting factor of 2; not inclusive
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not weighted; not inclusive
  - Cliffs and Canyons
  - Lower Montane Woodlands
- Soil Associations: Associations that included outcrops; not weighted; not inclusive.
  - St. Thomas-Rock Outcrop-Kyler
  - Mokiak-Rock Outcrop-Breko
  - Stewval-Gabbvally-Rock Outcrop
  - Akela-Rock Outcrop-Dedas
  - Blacktop-Downeyville-Rock Outcrop
  - Stewval-Rock Outcrop-Gabbvally
  - Kyler-Theriot-Rock Outcrop
  - Rock Outcrop-St. Thomas-Tecopa
  - Downeyville-Rock Outcrop-Tokoper
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 4; inclusive
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
  - CEGL000825 *Pinus monophylla* Woodland

Bashful beardtongue was first discovered in 1971 by Janice Beatley at elevations between 7,612 and 9,022 ft. MSL on the Kawich Range in Nye County, Nevada (Mozingo & Williams, 1980). It is a Nevada endemic and only 5 populations have been found and they occupy three acres (Nevada Natural Heritage Program, 2001). To date, no observations of bashful beardtongue have been made within the study area. The Habitat Suitability Model indicated that the species could potentially occur on Stonewall Mountain, the Kawich Range, and the Belted Range in the North Range Study Area. Suitable habitat was also found on the Sheep Range in the South Range Study Area (Figure 66). Maxent was not run for this species due to insufficient number of observation points within the study area.

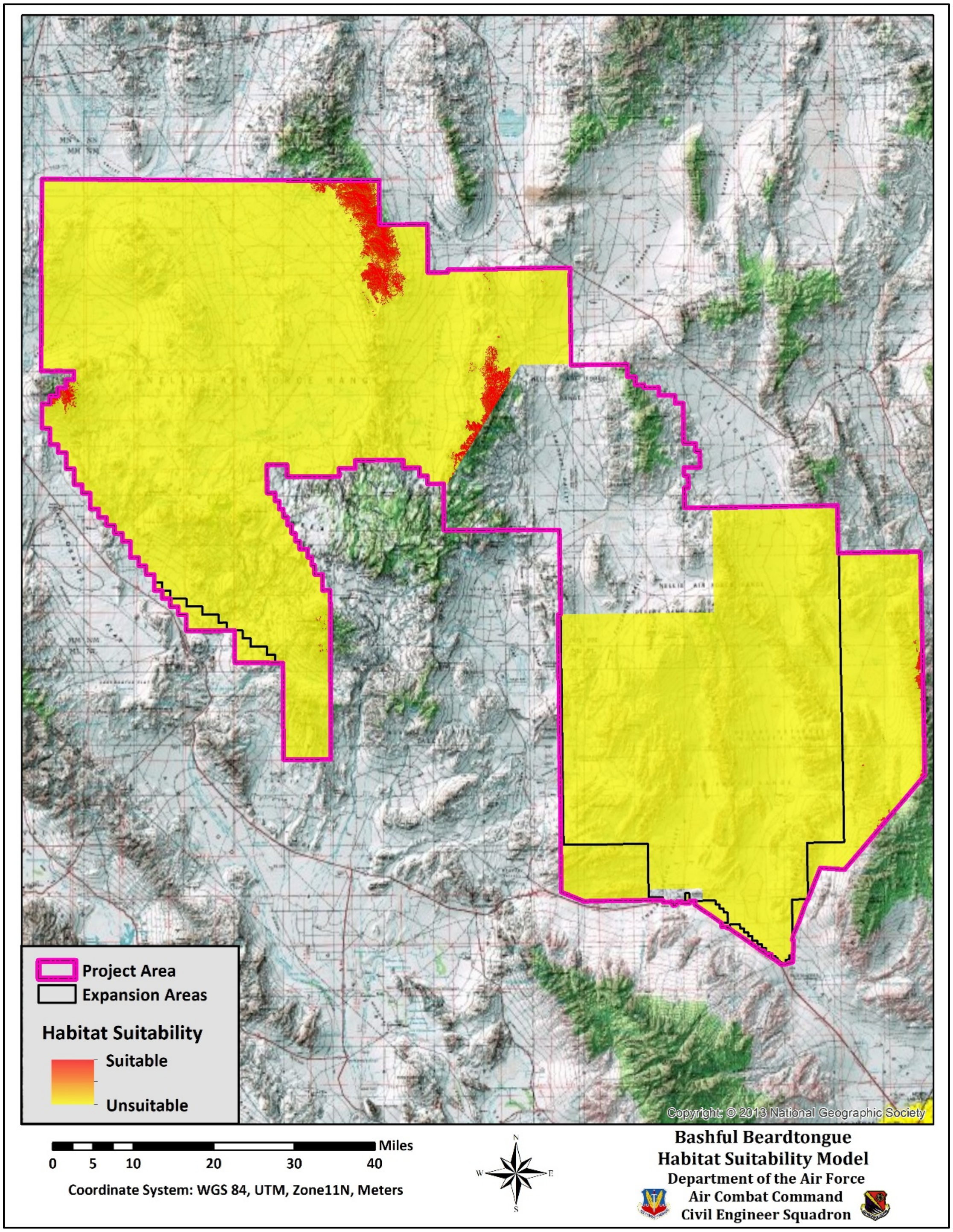


Figure 66. Habitat range of the bashful beardtongue as determined by the Habitat Suitability Model.

Las Vegas Buckwheat (*Eriogonum corymbosum* var. *nilesii*)

Las Vegas Buckwheat

Las Vegas buckwheat is native to Clark County and found within four locations: Las Vegas Valley, Gold Butte, and Muddy Mountains (U.S. Fish and Wildlife Service, 2000; Mrowka, 2008) and in the Coyote Springs area, north of Las Vegas (Morefield, 2007). The species populations are restricted to soils with high gypsum content in sparsely vegetated areas in the Mojave Desert below 4,000 feet (Tilley, 2012), similar to the Las Vegas bearpoppy. These species are often found together with Las Vegas buckwheat in washes and channels and Las Vegas bearpoppy on higher ground between the washes. This plant was originally classified as a gypsophile and only found on gypsum soils. Recent studies have shown that gypsum is still a strong predicting factor, but the perennial shrub also grows in clay or clay-gravel soils with a high calcium content (Baker, Fonnesbeck, & Boettinger, 2016). Las Vegas buckwheat is found on unusual substrates such as clay beds and high-boron shale, and deep soils. Typically, gypsum soil occupied by this species is sparsely vegetated with bare exposed soils often covered with a cryptogrammic soil crust. Nevada Natural Heritage Program also includes habitat on outcrops in washes and drainages, or in areas of generally low relief surrounded by *Ambrosia dumosa*, *Stanleya pinnata*, *Atriplex canescens*, *Ephedra torreyana*, *Larrea tridentata, Acacia greggii,* or *Psorothamnus fremontii*. (Nevada Natural Heritage Program, 2016). Elevation recorded for this species is from 1,900-3,839 ft. MSL (Nevada Natural Heritage Program, 2016).

The parameters used to prepare the Habitat Suitability Model for Las Vegas buckwheat were the following:

- Elevation: 1,000 – 4,000 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Gypsiferous formations are preferred, but this is not an attribute found in currently available in GIS layers.
- Key Habitat: Not weighted; not inclusive
  - Sand Dunes and Badlands
- Soil Associations: Prefers gypsiferous soils, but this is not an attribute in the layer used for the model. However, the associations where Las Vegas buckwheat was found on Nellis Air Force Base were used for this model. Weighting factor of 4; not inclusive.
  - Canutio-Cave-Weiser
- Mountains were excluded.
- Valleys were not excluded.
- Plant Communities: Weighting factor of 2; inclusive
  - A0869 *Atriplex canescens* Scrub Alliance
  - A0870 *Atriplex confertifolia* Scrub Alliance
  - A3277 *Larrea tridentata - Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance
  - A3279 *Ambrosia dumosa* Desert Dwarf Scrub Alliance

To date, no observations of Las Vegas Buckwheat have been made within the study area. The Habitat Suitability Model indicated that potential habitat for this species was widespread across the bajadas of the South Range Study Area (Figure 67). The best habitat was located on the southeastern side of Alternative 3B and the southwest side of the Desert Range. Low potential habitat was scattered throughout the North Range Study Area, but this is probably outside of the known range for the plant species. The habitat range created by this model was identical to that of Las Vegas bearpoppy. Maxent was not run for this species due to an insufficient number of observation points within the study area.

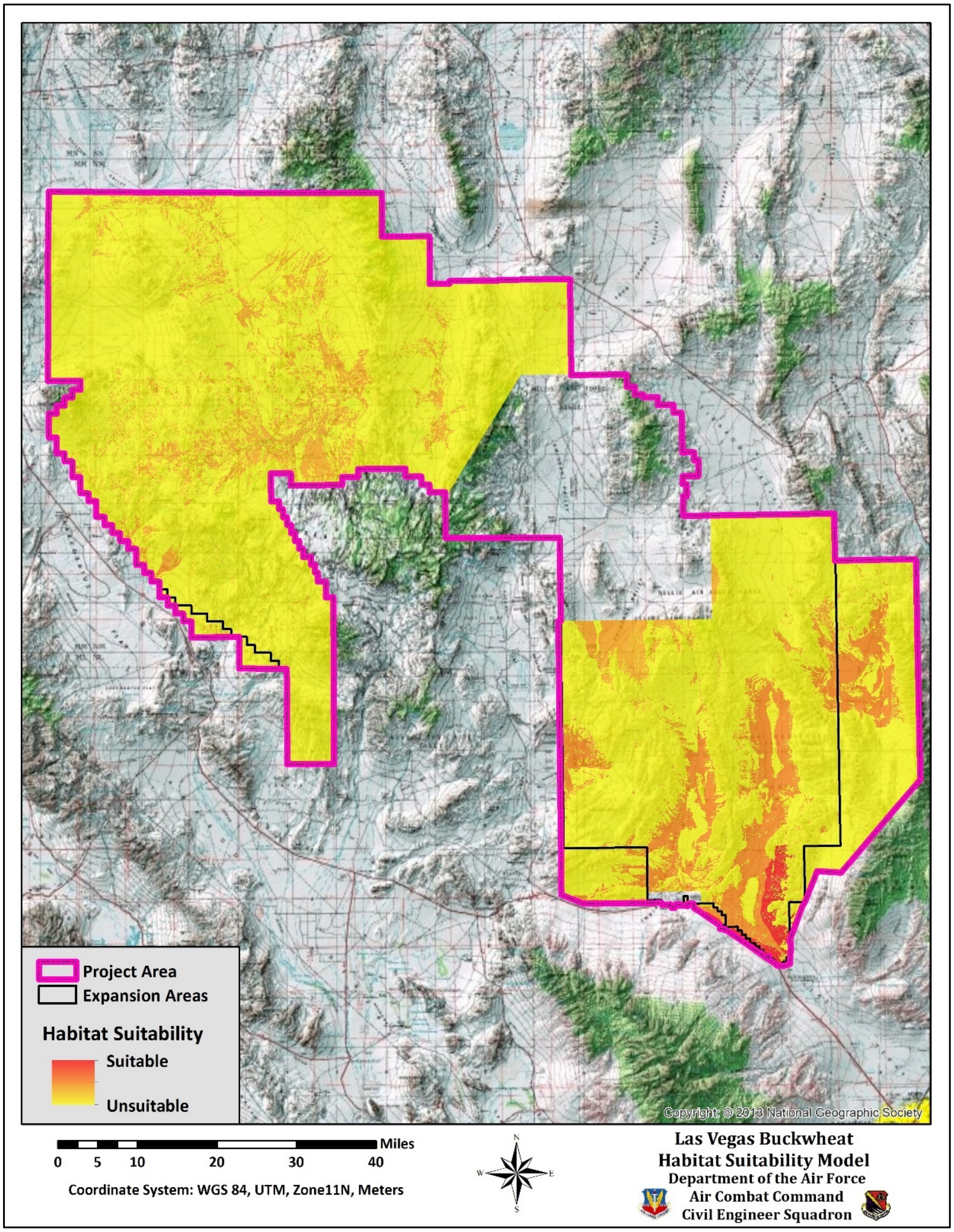


Figure 67. Habitat range of the Las Vegas buckwheat as determined by the Habitat Suitability Model.

Pinyon Mesa Buckwheat (*Eriogonum mensicola*)

Pinyon Mesa Buckwheat (copyright Steve Matson, CalPhotos)

Pinyon Mesa buckwheat is found in limited areas in Inyo County, California (Calflora, 2016) and, in Nevada, it is found in Clark County on higher elevations in the Sheep Range near Bootleg, Yellowjacket, and Basin Springs (Reveal, 2016). Its preferred habitat is a variety of woody shrubs in sagebrush, mountain mahogany, pinyon-juniper, and montane conifer woodlands (NatureServe, 2016). While slope is not a factor, the plant prefers any soils that are rocky to gravelly at elevations of 6,000 ft. to 9,000 ft. MSL (Calflora, 2016; Jepson Flora Project, 2016).

The parameters used to prepare the Habitat Suitability Model for Pinyon Mesa buckwheat were the following:

- Elevation: 6,000 – 9,000 ft. MSL (Not weighted; not inclusive)
- Slope: Not a limiting factor
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not weighted; not inclusive
  - Lower Montane Woodlands
  - Sagebrush
- Soil Associations: Prefers gravelly soils; Not weighted; not inclusive.
  - Bellehelen-Ravenswood-Mohocken
  - Bellehelen-Squawtip-Rock Outcrop
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 2; not inclusive
  - CEGL000825 *Pinus monophylla* Woodland
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
  - A3219 *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance
  - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
  - A3222 *Artemisia nova* Steppe & Shrubland Alliance

To date, no observations of Pinyon Mesa buckwheat have been made within the study area. The Habitat Suitability Model indicated potential habitat on the mountain ranges of the North Range Study Area (Figure 68). High potential for the occurrence of the species was especially noted on the upper elevations of Stonewall Mountain, Tolicha Peak, Timber Mountain, Belted Range, Cactus Range, and the Kawich Range. Less suitable habitat was mapped on the South Range Study Area with the better suitable habitat occurring along the western slopes of the Sheep Range. Maxent was not run for this species due to an insufficient number of observation points within the study area.

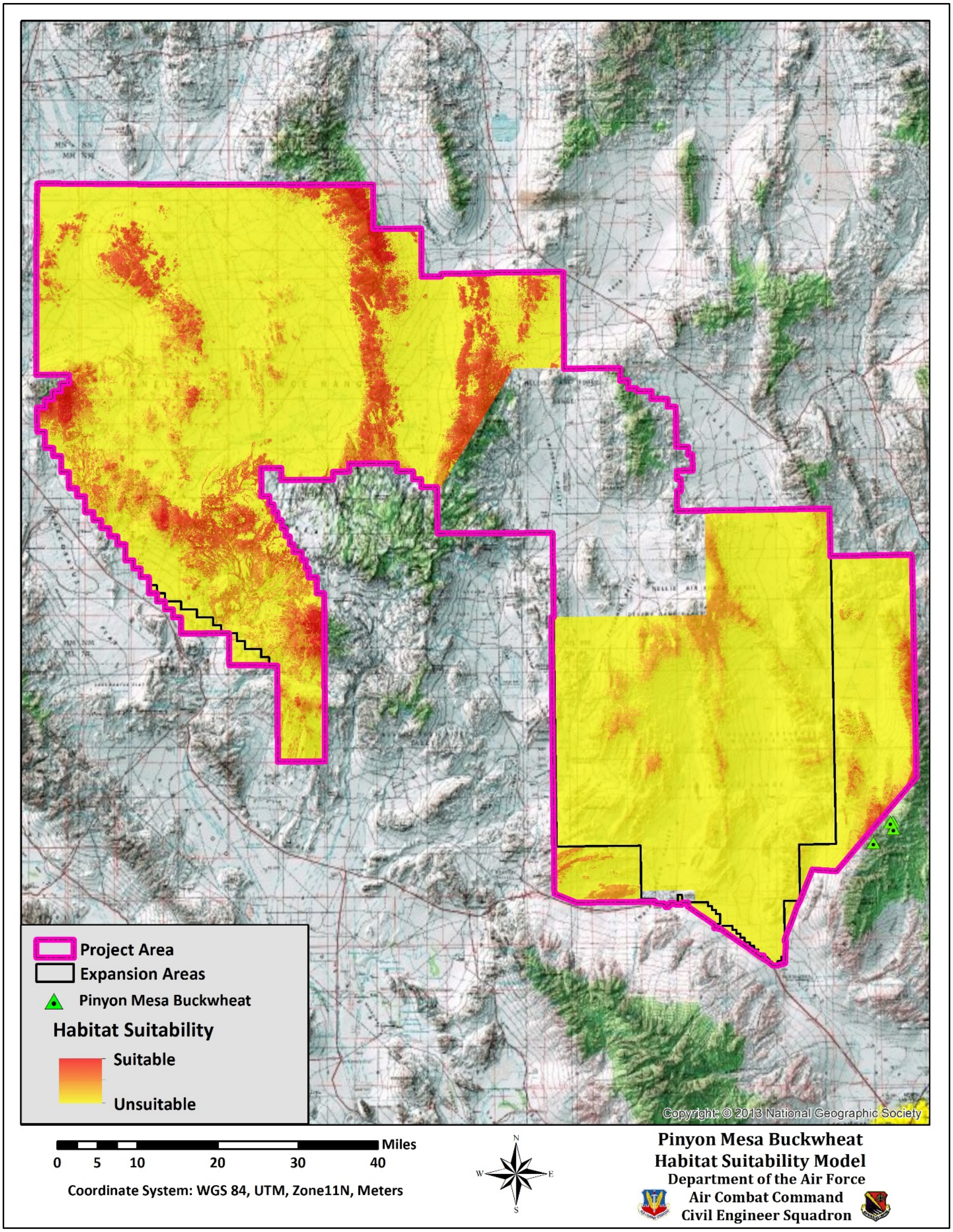


Figure 68. Habitat range of Pinyon Mesa buckwheat as determined by the Habitat Suitability Model.

Cliff Needlegrass (*Piptatherum shoshoneanum*)

Cliff needlegrass is only known from two small areas in south-central Nevada and east-central Idaho (NatureServe Explorer, 2016). This tufted grass has a distinctive growth habit in that it is found in nearly vertical cliff faces (NatureServe Explorer, 2016). It is found in higher elevations, mostly in pinyon-juniper, montane, and conifer habitats (Nevada Natural Heritage Program, 2016). This grass prefers to grow on west or southwestern-facing cliffs composed of felsic to siliceous rock, such as rhyolite tuff and/or quartzite (Nevada Department of Natural Resources and Conservation, 2016). The species has also been shown to become established in moist cracks and crevices of intrusive or extrusive igneous, metamorphic, or west facing sedimentary cliffs and rock walls in the montane conifer and pinyon-juniper vegetation communities (Nevada Natural Heritage Program, 2016).

Cliff Needlegrass

The parameters used to prepare the Habitat Suitability Model for cliff needlegrass were the following:

- Elevation: 6,000-10,000 ft. MSL (Weighting Factor of 2; inclusive)
- Slope: Cliffs and steep slopes; weighting factor of 2; not inclusive
- Aspect: South and west aspect; weighting factor of 2; not inclusive
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Not weighted; not inclusive
  - Lower Montane Woodlands
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 3; not inclusive
  - CEGL000825 *Pinus monophylla* Woodland
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance

The plant is best known from eastern Idaho, but has been observed in the Belted Range in southwestern Nevada (SEINet: Arizona-New Mexico Chapter, 2016). NNHP recorded an observation of the plant within the study area near Cliff Spring on the western slopes of the Belted Range in NTTR and, additionally, a similar observation in the same general area in 1995. No other observations have been made within the study area.

The Habitat Suitability Model indicated suitable habitat for this species across all mountain ranges of the study area (Figure 69). Potential occurrence of the species was highest in the upper elevations of those mountain ranges. Maxent was not run for this species due to an insufficient number of observation points within the study area.

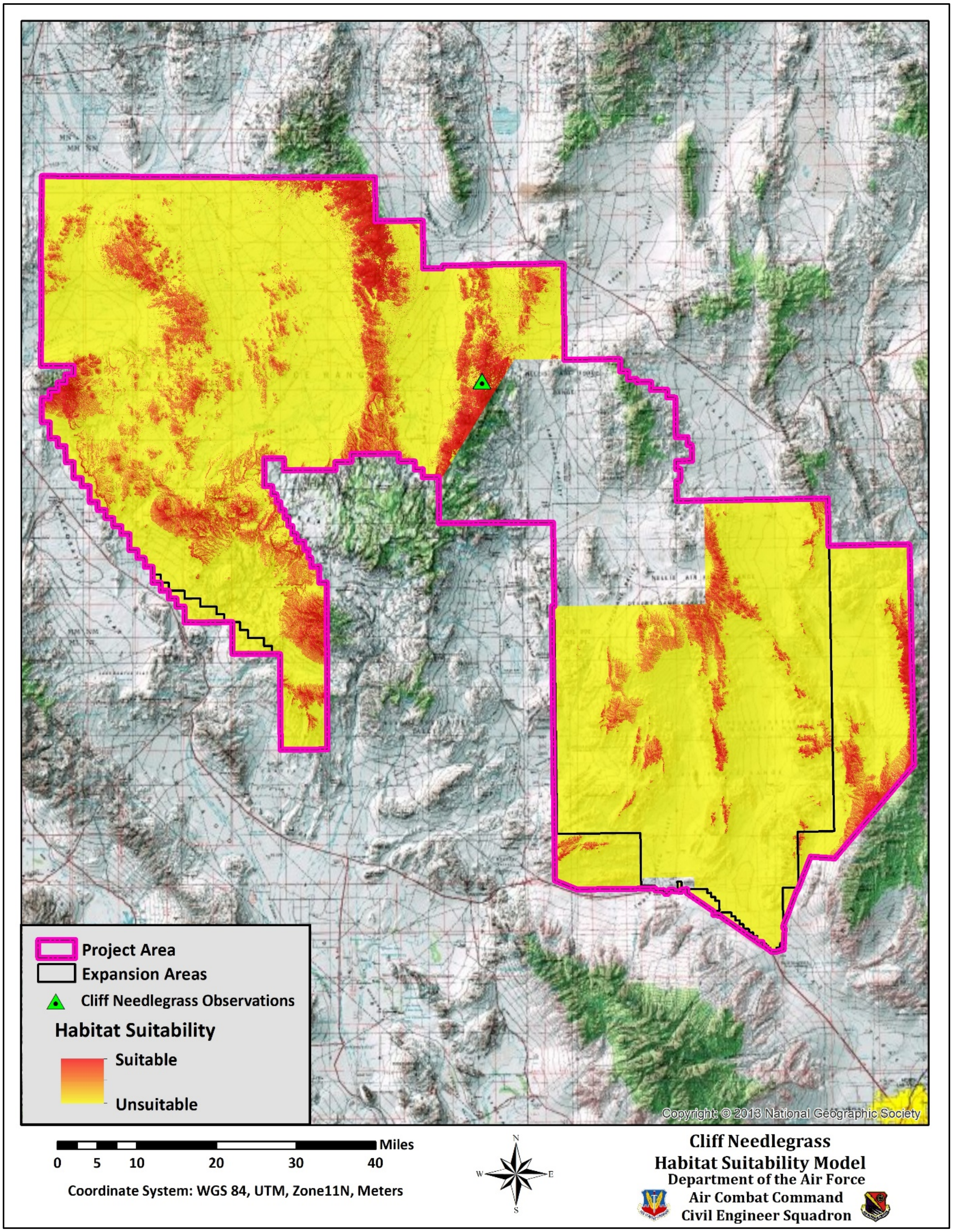


Figure 69. Habitat range of cliff needlegrass as determined by the Habitat Suitability Model.

Rock Purpusia (*Ivesia arizonica* var. *saxosa*)

Rock purpusia in bloom (Photo by Gregory Gust)

Rock purpusia is a BLM sensitive perennial plant identified in a few locations in south central Nevada (NatureServe Explorer, 2016). Four observations have been made on the NNSS (Nevada Natural Heritage Program, 2016). Populations of this species tend to establish within crevices of steep cliffs and boulders in higher elevations that are comprised of volcanic and carbonic rock (Nevada Department of Natural Resources and Conservation, 2016). Rock purpusia may be found in sagebrush and pinyon-juniper habitats that contain patches of bare rock, talus, or scree where the plant may grow. The species has been found at elevations of 4,900 ft. – 6,890 ft. MSL (NatureServe Explorer, 2016). The plant has been observed on the North and South Pahroc ranges in Lincoln County, and on Pahute Mesa in Nye County, Nevada. It has also been identified in the Sheep Range of Clark County (Ertter & Reveal, 2017).

The parameters used to prepare the Habitat Suitability Model for rock purpursia were the following:

- Elevation: 4,900 – 6,890 ft. MSL (Weighting factor of 3; not inclusive)
- Slope: Cliffs and steep slopes; weighting factor of 2; not inclusive
- Aspect: Not a limiting factor
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Not a limiting factor
- Key Habitat: Weighting factor of 2; inclusive
  - Lower Montane Woodlands
  - Sagebrush
- Soil Associations: Associations that included outcrops; not weighted; not inclusive.
  - St. Thomas-Rock Outcrop-Kyler
  - Mokiak-Rock Outcrop-Breko
  - Stewval-Gabbvally-Rock Outcrop
  - Akela-Rock Outcrop-Dedas
  - Blacktop-Downeyville-Rock Outcrop
  - Stewval-Rock Outcrop-Gabbvally
  - Kyler-Theriot-Rock Outcrop
  - Rock Outcrop-St. Thomas-Tecopa
  - Downeyville-Rock Outcrop-Tokoper
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 3; not inclusive
  - CEGL000825 *Pinus monophylla* Woodland
  - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
  - A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance

To date, no observations of rock purpusia have been made within the study area. The Habitat Suitability Model shows potential occurrence of the species on the mountain ranges of the North Range Study Area with the highest potential for species occurrence where the mountain ranges have steep slopes and cliffs. Additional habitat was mapped on the northern ends of the mountain ranges on the South Range Study

Area (Figure 70). Maxent was not run on this species due to an insufficient number of observation points within the study area.

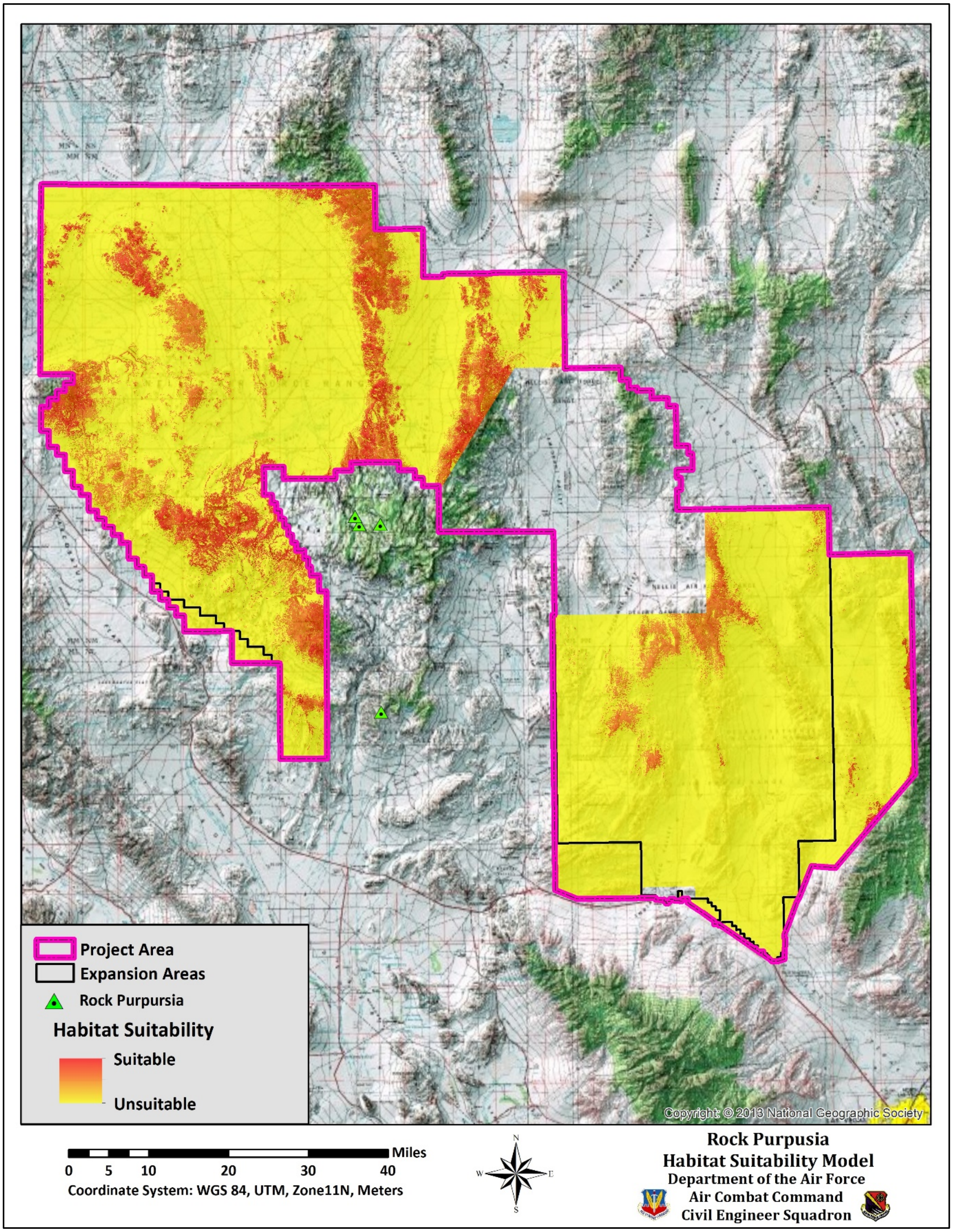


Figure 70. Habitat range of the rock purpursia as determined by the Habitat Suitability Model.

Kingston Mountains Bedstraw (*Galium hilendiae ssp. kingstonense*)

Kingston Mountains Bedstraw is a perennial forb known from only a few locations in south-central Nevada and eastern California (Nevada Department of Natural Resources and Conservation, 2016). It grows in in rocky to gravelly soils derived from rhyolitic tuff in pinyon-juniper habitat (Calflora, 2016; Nevada Natural Heritage Program, 2016). It is typically found in the shade of shrubs and trees on steep hills (Nevada Department of Natural Resources and Conservation, 2016). Based on data collected during field surveys on the Nevada Test Site, over 80% of the area occupied by this species occurs on slopes greater than 20%, and it was found predominantly on the mid to upper slopes (Blomquist, et al., 1995). Half of the areas supporting Kingston Mountains Bedstraw populations were on southeast facing slopes. In Nevada, it is only known to occur on the Belted and Eleana Ranges (Blomquist, et al., 1995). According to the NNHP, this species prefers dry, rocky to gravelly soils derived from rhyolitic tuff on steep northeast to south aspects, mostly under trees and shrubs in the pinyon-juniper-Gambel oak community from 3,940 – 6,980 feet MSL (Blomquist, et al., 1995; Nevada Natural Heritage Program, 2016).

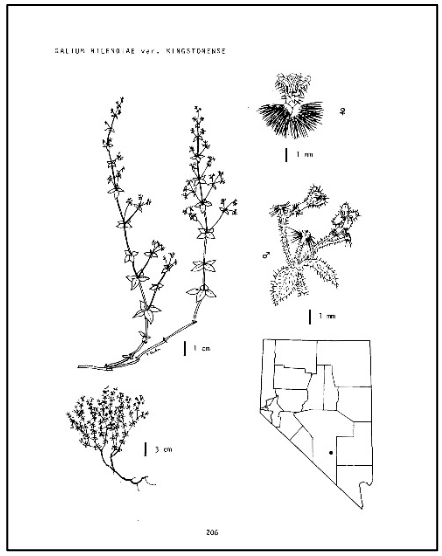


Illustration of Kingston Mountains Bedstraw (copyright Mozingo and Williams, 1980, via Nevada National Heritage Program)

The parameters used to prepare the Habitat Suitability Model for Kingston bedstraw were the following:

- Elevation: 3,940 – 6,980 ft. MSL (Not weighted; not inclusive)
- Slope: Cliffs and steep slopes (>20%); weighting factor of 2; not inclusive
- Aspect: South and East; Weighting factor of 2; not inclusive
- Permanent Water: Not a limiting factor
- Temporary Water: Not a limiting factor
- Geology: Rhyolitic flows; Not weighted; not inclusive
    - Tr2--Rhyolitic flows and shallow intrusive rocks
    - Tr3--Rhyolitic flows and shallow intrusive rocks
- Key Habitat: Not weighted; not inclusive
    - Lower Montane Woodlands
- Soil Associations: Not a limiting factor
- Mountains were not excluded.
- Valleys were excluded.
- Plant Communities: Weighting factor of 3; not inclusive
    - CEGL000825 *Pinus monophylla* Woodland
    - A2108 *Pinus monophylla - Juniperus osteosperma* / Shrub Understory Woodland Alliance
    - A3144 *Coleogyne ramosissima* Mojave Desert Scrub Alliance (Community at observation point)
    - A3148 *Yucca brevifolia* Wooded Scrub Alliance (Community at observation point)
    - CEGL005294 *Yucca brevifolia / Coleogyne ramosissima* Wooded Shrubland (Community at observation point)
    - A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance

Kingston Mountains Bedstraw has been observed at three locations in the South Range Study Area, with three additional locations along the study area border, both on and due north of the NNSS. Two additional historical observations within the NNSS were made near Oak Spring Butte, an area that borders the study area. The Habitat Suitability Model indicated potential habitat for this species across all of the mountain ranges in the South Range Study Areas (Figure 71). On the North Range Study Area, the more suitable habitat was found on the northern Kawich Range, Belted Range, and Stonewall Mountain. Maxent was not run for this species due to an insufficient number of observation points within the study area.

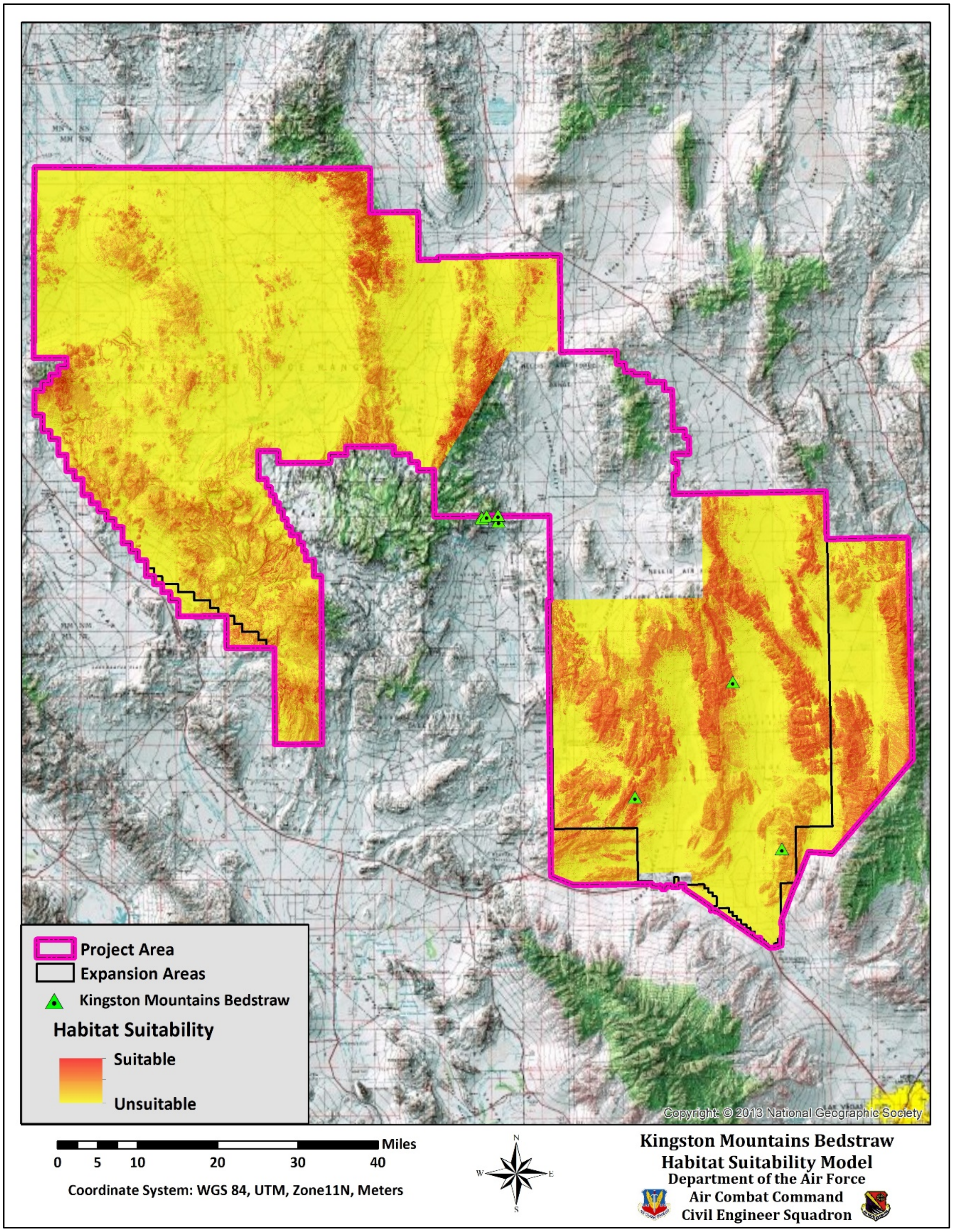


Figure 71. Habitat range of Kingston Mountain bedstraw as determined by the Habitat Suitability Model.

Conclusion

Maps prepared for this report are intended to be used for conservation and protection of special status species potentially inhabiting the study area. The habitat models illustrate potential habitat ranging from excellent, suitable habitat to unsuitable habitat. These maps should be used to determine where additional surveys or mitigative measures should be implemented when actions by the military mission occur within suitable habitat for a species. The final boundaries between suitable and unsuitable habitat for each of the species should be determined by the natural resources manager in cooperation with state and federal agencies, where required. It is important to note that these maps are “living documents” that will constantly require updates and changes as more surveys and more refined GIS layers are developed for the study area.

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