Connecting Arizona's Wildlife Species to Ecological Site Descriptions – A New Model

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Author Note

This professional paper is intended to partially fulfill the requirements for a Master of Forestry degree in NAU School of Forestry. If this is converted to a formal agency report or scientific publication, additional authors will include Marcus Miller and Stuart Tuttle (NRCS) and Paul Beier (NAU), and the pronoun "I" will be changed to "we." This project was started to provide the Natural Resource Conservation Service with an additional resource when developing conservation and land management plans. While the internship that started this project has ended, I hope the project will aid in the future.

Abstract

Ecological Site Descriptions (ESDs) are a method of characterizing areas of land via soil properties, vegetation, precipitation, and other elements unique to the area. ESDs are used by the Natural Resource Conservation Service and other Federal agencies. Land managers can use these descriptions to better plan management activities and anticipate future conditions and challenges to the area. Most ESDs contain limited habitat information on the wildlife species expected to occur within the site, with an emphasis on game species. To expand the utility of ESDs, I created a database on the preferred habitats of Arizona's terrestrial wild vertebrates. This database lists terrestrial vertebrate wildlife that might occur in an ESD and describes their habitat requirements. A companion state and transition model suggest how each species might respond to management actions. This new model greatly expands the wildlife interpretation section of ESDs, providing land managers better information for basing management decisions as well as resources to further develop conservation and land management plans.

Keywords: Ecological Site Description, State-and-Transition model, wildlife, Arizona.

Connecting Arizona's Wildlife Species to Ecological Site Descriptions – A New Model

Introduction

Resource managers and private landowners need information to help accomplish objectives and goals. Many federal agencies use Ecological Site Descriptions (ESDs) to provide baseline knowledge of a chosen site (Busskohl et al 2011); however, the information provided in these descriptions tends to be limited to soil characteristics, topographical features, and precipitation amounts relegating wildlife and habitat information to footnotes. Some universities and state agencies have taken this lack of detailed wildlife habitat information and developed databases, maps, and programs to remedy this situation (BDB 2014, BISON-M 2018, TXNDD 2018, WDFW Habitat Program 2018, WYNDD 2018, ODFW 2018).

By analyzing a variety of the already developed databases, maps, and programs that are found in the western United States, I developed a similar resource for the state of Arizona and its terrestrial wildlife species. Rather than develop a brand-new tool, the goal of the project was to use ESDs as a baseline and develop a new model that complements the ESD by providing detailed information on the wildlife species and habitat that can be found at the ecological site.

Land managers may use this model alongside the ESD to provide an additional resource that complements the existing ESDs widely used by federal agencies. Knowing the starting conditions of a project site can provide a solid foundation on which land managers can build and help predict the outcomes and consequences of the changes made on the landscape.

Background

Ecological Site Descriptions

An ecological site is "a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation" (Sanchez 2011). Like the US Forest Service's Terrestrial Ecological Unit Inventory, ESDs use geology, climate, soils, hydrology, and vegetation to differ between sites making the two systems similar with comparable land classifications like major land resource areas and parallel information about the sites (US Department of

Agriculture 2005, Busskohl et al 2011). Other classification systems, like the Gap Analysis Program of the USGS use mainly land cover at different scales such as forested or non-forested, or agricultural and cropland to differ between sites (Gergely & McKerrow 2016). These systems have different scales, and techniques used to classify land and therefore the ecoregions of the Gap Analysis Program and others like it do not match with the ESD major land resource areas (US Department of Agriculture 2005, Busskohl et al 2011, Gergely & McKerrow 2016). ESDs are used by federal agencies including the Natural Resource Conservation Service (NRCS), and cover most of the rangeland and forestland of the United States, apart from riparian areas in the western part of the nation. The first section of an ESD is the site "stage", which has 3 possible states, (1) provisional, the lowest class of documentation that is releasable to the public; (2) approved, a higher status that "fully describes all distinguishing features of the site"; or (3) correlated, the highest status that includes everything from the approved status as well as all vegetative community phases documented and narrative interpretations (Busskohl et al 2011).

The site status is followed by the site name, which contains the soil type, precipitation zone, dominant vegetation, site type and identification,

Major Land Resource Area, and the Common Resource Area map (e.g. Figure 1).

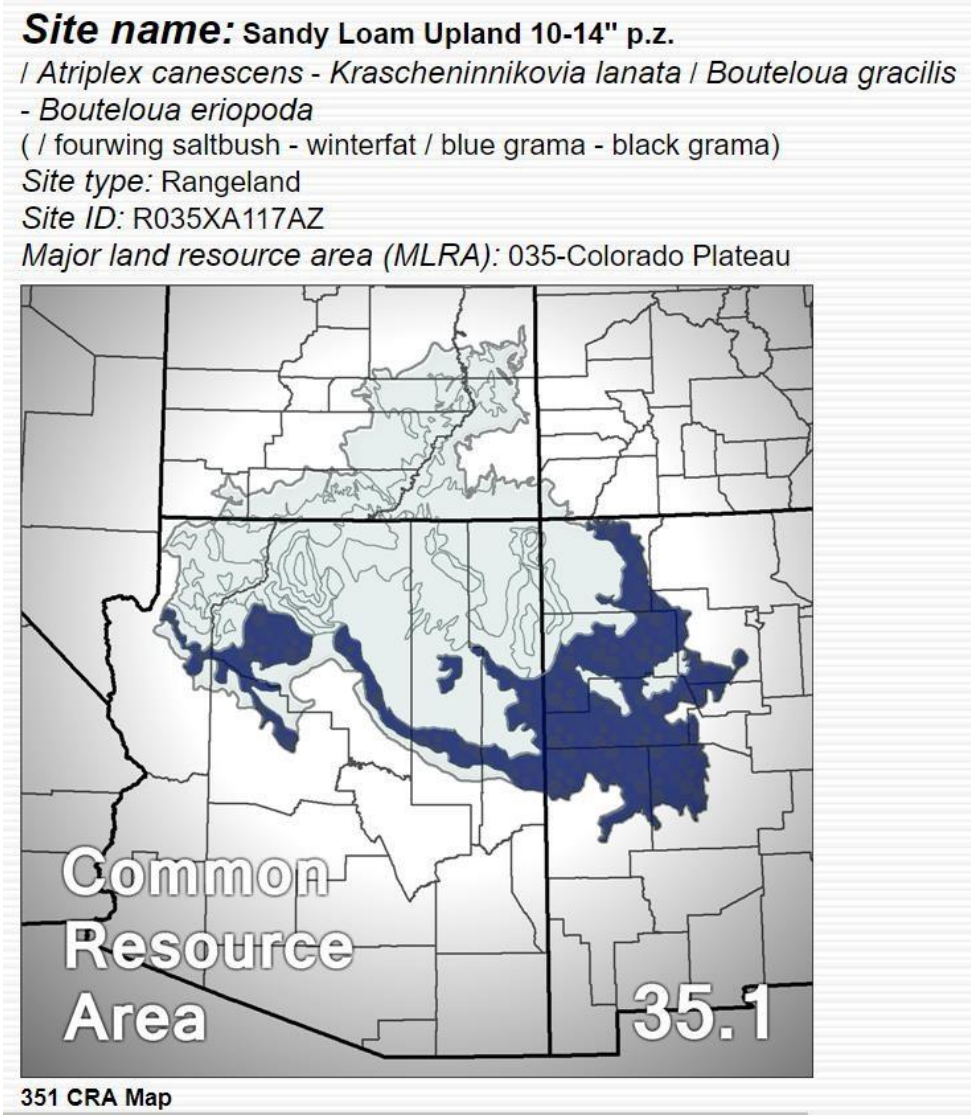


Figure 1. Example of an Ecological Site Description Site Name with a Common Resource Area (CSA) map, a subsection of an MLRA as denoted by the decimal – 35.1 (MLRA 35, CRA 1). (Busskohl et al 2011).

The map is followed by a narrative summary that describes the site's elevation, precipitation, vegetation, soil temperature regime, topography and land features, and type of soil parent material. Within the vegetation section, a state-and-transition model describes vegetation community "states" and the "transitions" between them. A state is an alternative, persistent community of vegetation that is not easily reversible in the linear successional framework (Bestelmeyer et al 2009, Briske et al 2008, Stringham et al 2003). Transitions are the paths that the plant community can take between each state and are often initiated by multiple disturbances

such as natural disturbances such as droughts, catastrophic events like fire or flood, or management actions like grazing or farming (Bestelmeyer et al 2009, Briske et al 2008, Stringham et al 2003). These models can help demonstrate the vegetation communities that may be present at a site and the drivers that influence those communities, such as grazing or fire (Bestelmeyer et al 2009, Briske et al 2008).

The other sections of the report further describe physiographic features, climate features, water features, soil features, plant communities, site interpretations, supporting information, and a rangeland health reference sheet (Sanchez 2011). Climate information is obtained from nearby climate stations as referenced in the ESD itself, while the soil information is obtained on site by the authors of that ESD. Partial information on the animal community can be found in the site interpretations section but is limited to forage production and grazing suitability with one or two species listed as using the plants present. An example of a complete ESD report can be found in Appendix II.

ESDs are used by land managers within the NRCS, the Arizona Game and Fish Department, the Bureau of Land Management, and other Federal agencies when evaluating project sites. ESDs provide a concise summary of abiotic features, biotic features, and management practices. The abiotic elements include expected precipitation, soil texture, structure and base material of the soils, topography, and features of the land. Biotic features include dominant vegetation, changing vegetation communities as stateand-transition models, and limited information about forage plants for livestock or game species like pronghorn (*Antilocapra americana*). Land management practices include grazing or agriculture.

When developing land management projects or conservation plans, ESDs provide a starting point for organizers and offer predictions of what changes can occur on the landscape. For example, the NRCS will work with private land owners, nonprofit organizations, university research groups, and state and federal agencies like Arizona Game and Fish Department and Bureau of Land Management on land areas one acre or larger to improve the land condition. These land improvements can range from increasing forage or livestock production, increasing water quality and quantity, improving soil health for croplands and agriculture, or introducing wildlife conservation easements and riparian buffers through various programs like Regional Conservation Partnership Program, Agricultural Conservation Easement Program, Conservation Stewardship Program or Environmental Quality Incentives Program all offered through the NRCS (USDA 2018). The NRCS can provide private landowners with funding to implement these improvements, offer economic incentives, and act as an intermediary between the different groups to facilitate communication, cooperation, development, and implementation of conservation plans. With the addition of

a more detailed wildlife component, ESDs can provide a better resource to land managers to identify wildlife species in the area, their status under the Endangered Species Act (e.g., threatened, or endangered and therefore requiring protection or special consideration), and to highlight species that may benefit from conservation to help persuade landowners to take an interest in conservation.

Similar Projects

Many state agencies and universities have developed information systems on wildlife-habitat relationships to support conservation actions. This section contains six examples from the western United States.

California Wildlife Habitat Relationships (BDB 2014)

The California Department of Fish and Wildlife developed Wildlife Habitat Relationships database. Last updated in 2014, this database provides information about life history, geographic range, habitat relationships and management information on >700 wildlife species found in California. The California Wildlife Habitat Relationships database can generate a list of all species for a single "situation" defined as a proposed course of action for a land management project or conservation plan, and a list of species comparing species or habitat value for two situations. Using this comparison option, land managers or other users can see the effects on the wildlife present in an area depending on the practices suggested, or how the habitat value will change with plan alternatives. This database also offers Geospatial Information System (GIS) data downloads like species ranges and habitat data.

Biota Information System of New Mexico (BISON-M 2018)

New Mexico's wildlife habitat database was developed for biologists by an assembly of agencies including the New Mexico Department of Game and Fish, and the Fish & Wildlife Information Exchange. This database includes all vertebrate and many invertebrate wildlife species found in New Mexico and Arizona. The New Mexican part of the database is continuously updated but is far from complete. It includes information on species, county lists, and a tool to share wildlife contracts and documents.

Texas Natural Diversity Database (TXNDD 2018)

The Texas Natural Diversity Database contains data on rare species, native plant communities and animal aggregations. This database was first established in 1983 and is a part of the NatureServe network which is

dedicated to colleting, managing, and disseminating species information (NatureServe 2018). Information is provided about the predicted home range of a species, native plant community, or an animal aggregation and the data that goes along with the observation.

Priority Habitats and Species (WDFW Habitat Program 2018)

Priority Habitats and Species is an interactive web-based map for public use developed by the Washington Department of Fish and Wildlife. This database contains information on which of 20 major vegetation types are associated with 193 vertebrate and invertebrate species and 10 species groups. The focal vertebrate species comprise about 17% of vertebrate species in Washington that are priorities for conservation and management, including Threatened and Endangered Species and animal aggregations like bat colonies and other groups of animals that live together (WDFW Habitat Program 2018).

Wyoming Natural Diversity Database (WYNDD 2018)

The Wyoming Natural Diversity Database contains data about wildlife species and vegetation communities of conservation concern. This database identifies and ranks species for conservation, gathers existing data and develops new data for conservation species, and distributes this data upon request. This database is also a part of the NatureServe network (NatureServe 2018) and is continuously updated.

Natural Resources Information Management Program (ODFW 2018)

The wildlife habitat database for Oregon is a cooperative undertaking of federal, state, and tribal agencies. This program provides GIS data, maps, photos and other data on wildlife areas, management units, streams and rivers, and vegetation types. This program was developed to promote the use of modern technology to gather data, encourage multidisciplinary management approaches, and identify and prioritize natural resource information needs.

Summary of the Example Projects

These six examples represent a small portion of the information available to the public on wildlife habitat relationships. Users of these databases can include Federal and State agencies, university research groups, private landowners and others interested in the relationships between wildlife species, their habitat requirements, and how they relate to the landscape or vegetation in an area. This information can be used for diverse applications such as academic research papers, conservation, and land management projects, or simply by providing information to those who

are interested. While these projects include maps, spatial data, population estimates, geographic ranges, and predicted locations, they differ from ESDs in that they do not contain state-and-transition models or landscape details such as soil characteristics and topography. Most of these projects are being continuously updated by scientists, researchers, and land managers to keep information current. These projects helped to provide a starting point for my project, and demonstrate what information is needed to update the ESDs. In the future, I would recommend adding further resources such as interactive maps, GIS data, and comparison tools to add more features to the existing ESDs.

A New Model

The focus of this project was to successfully develop a practical model for use in conjunction with ESDs by resource managers and others wishing to maintain or improve the condition of their land. This project resulted in a four-part model containing real-world information on the wildlife species and their habitat requirements that reside specifically in Arizona.

This model is still in the prototype phase of development. Specifically, I developed the model only for 20 of the hundreds of ESDs present in each of Arizona's six major resource land areas (MLRAs) as shown in Table 3 in Appendix I, and for only 10% of the vertebrate species. I selected three to four ESDs from each MLRA located within Arizona and tried to select for different dominant vegetation which would result in different habitat available. The species chosen for each ESD depended on the wildlife habitat and the species present, such as Threatened and Endangered species, species of conservation concern or generalist species that could be used to protect a multitude of species. However, my procedures could readily be extended to all ESDs and all species for which sufficient data exist.

Methods

I obtained a list of terrestrial wildlife species in Arizona from Steve Cassady of the Arizona Game and Fish Department. Next, for each species I assembled information on preferred vegetation types, geographic range location and approximate size, breeding and nesting season, preferred breeding and nesting habitat, diet, migratory patterns, other details such as status under the Endangered Species Act, when last seen in the wild, and what resources were used to gather this information as seen in Table 1 in Appendix I. I entered this information into a spreadsheet using Excel for ease of use, although in the future I would recommend converting the

database to a more suitable system like Accel to prevent corruption or accidental deletions.

I used published field guides, credible websites like the National Audubon Society, and technical guides and books (AGFD 2012, Brennan and Holycross 2009, Stebbins 1966, Ransom 1981, The Cornell Lab of Ornithology 2017, Whatbird.com 2017, Arizona Wildlife Views 2015, US Geological Survey 2011, Tekiela 2008, Floyd 2008, The Northern Arizona Environmental Education Resource 1999). Because my time was limited, I did not systematically search the scientific literature and unpublished agency reports but would advising doing this in the future.

I then selected species for which the spreadsheet entries could be linked to the data in the ESDs. I included Threatened or Endangered species, like Black-footed ferrets (*Mustela nigripes*), Gila monsters (*Heloderma suspectum*), and California condors (*Gymnogyps californianus*); game species, such as pronghorn; specialist species, or those that require certain features in their habitat like grassland species; generalist species, those that can inhabit a wide range of habitats like Red-tailed Hawks; and species that may have social or cultural value, like Bald Eagles. Then I evaluated each ESD's habitat value for each species based on the ESD's dominant vegetation and location (within or outside the species range) to generate a list of wildlife that might be present in that ESD location. Because the model uses only the dominant vegetation type and overlooks other vegetation present at the ESD site, some of the listed species are probably absent or other species not listed may be present in previously undocumented habitat. For the modified state-and-transition models, I adapted the existing models contained in the ESD. To do so, the model indicates potential wildlife habitat created or lost when one state transitions to another state. I included the species chosen to relate habitat requirements to ESDs in the adapted state-and-transition models to provide additional detail. The narrative interpretation was then written from the habitat descriptions gained earlier and summarizes the state-and-transition models into a concise report to provide a user-friendly summary of wildlife species that may be present and the potential habitat within an ESD.

Components

This new model consists of four parts: a wildlife habitat database, a state-and-transition model focused on wildlife, a narrative interpretation, and a field wildlife habitat assessment. These four components help provide both more detail to existing resources and new tools to use when conducting land analyses.

Wildlife Database

The first part of the model is a comprehensive database of Arizona's terrestrial vertebrate species – 150 mammals, 285 birds (including migratory species), 155 reptiles and amphibians – in an Excel spreadsheet. Details include preferred habitat, dominant vegetation in habitat, feeding ecology, migration habits, Threatened and Endangered Species status, and the resources used to find this information (Tables 1 & 2 in Appendix I). This database provides a foundation for the Narrative Interpretation that would be provided based on the site being surveyed, the state-and-transition model, and the wildlife assessment that can be used in the field to define the habitat and species that are found in the area.

Wildlife State-and-Transition Model

The second part of the project is a state-and-transition model that incorporates wildlife in the area. This modified model would provide land managers and others with additional information on the potential changes a landscape may experience and the effect on wildlife. Whether the changes to the landscape are a natural process such as fire or if they are implemented during conservation or restoration practices, these enhanced state-andtransition models can offer many insights to the consequences of these changes to both the vegetation and the wildlife that inhabit the site.

This project adds a wildlife element to these state-and-transition models, showing the possible changes to the wildlife species present along with the changing vegetation (Figure 2).

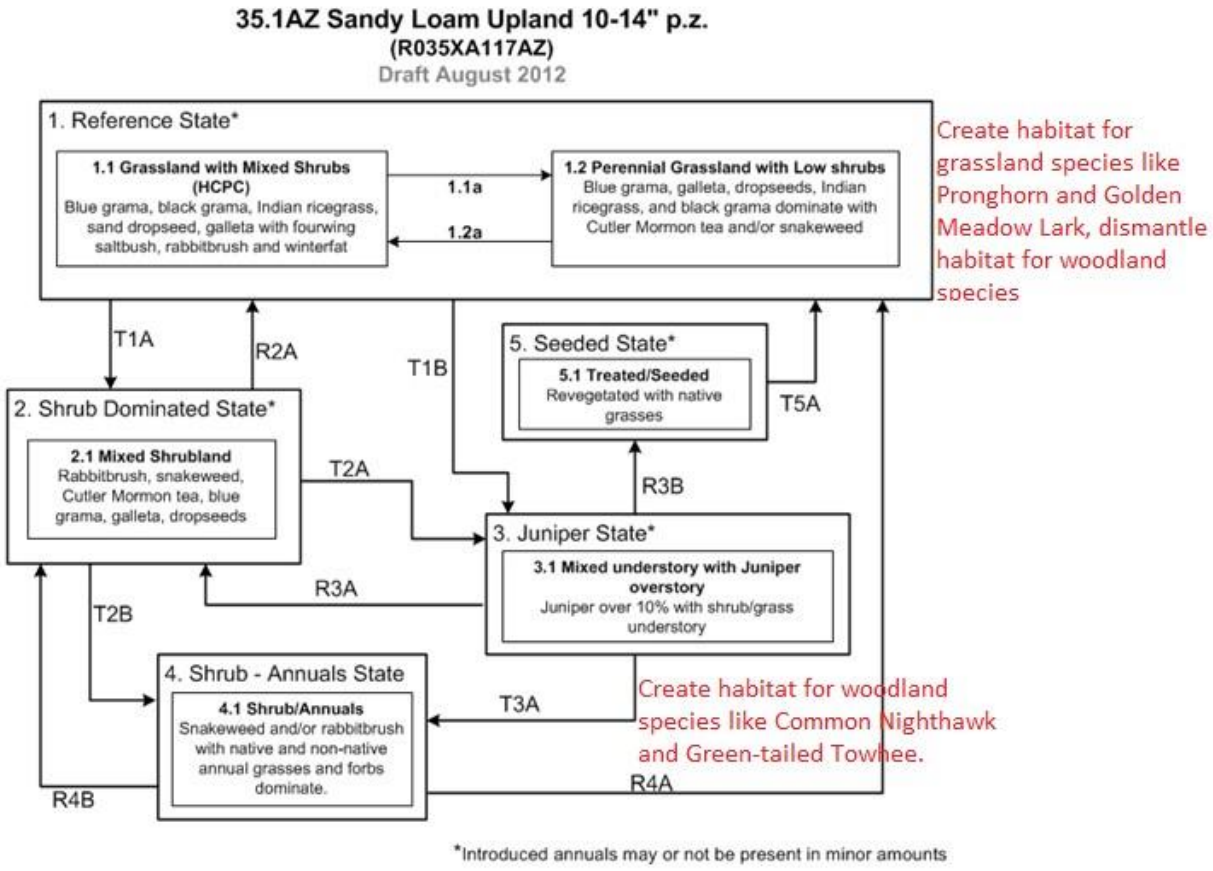


Figure 2. Example of a state-and-transition model with Wildlife Component added. The T (transition) and R (return), are paths that are detailed in the ESD. Modified from Ecological Site Description. Source: https://esis.sc.egov.usda.gov/ESDReport/fsReport.aspx?approved=yes&rptLevel=all&id=R035XA117AZ.

Since state-and-transition models show changes between plant communities and dominant plants, they can be used to assess wildlife that may use that habitat, and therefore may be present on the site. In the above example, I chose to represent grassland generalists with Pronghorn (*Antilocapra americana*) and the Golden Meadowlark (*Sturnella neglecta)*, and woodland generalists with the Common Nighthawk and Green-tailed Towhee. This is a simple example and could be expanded based on the needs of the users.

Narrative Interpretation

A narrative interpretation of the information in the database is the third part of the model. My innovation adds information from the new wildlife database to the conventional ESD Narrative Interpretations, which lacked detail about the wildlife species and habitats potentially present. A written interpretation of the wildlife habitat value will support development of conservation plans and land management projects, as well as communication with landowners and cooperating agencies. A summary of the habitats and wildlife species potentially present, whether the site might have Threatened and Endangered Species, game species, specialist species, or any other species of concern to the project will help identify conservation goals. Land managers or landowners can use this narrative to provide a baseline of habitat that is present and wildlife that may use available habitat. Because some of the species listed as using this habitat might be absent, a landowner should identify species present, and landowners and land managers should work together to identify conservation goals and what wildlife species they want to maintain or create habitat for. By using the narrative as a starting point, users can then develop plan and implement the conservation project.

Wildlife Assessment

Lastly, a wildlife assessment that can be used in the field is the final piece of the model. Although there are existing habitat assessments, they tend to be limited to one species at a time and focus on game or Threatened and Endangered species, like pronghorn (*Antilocapra* americana) and Southwestern Willow Flycatcher (*Empidonax trailii extimus*). This model provides a more inclusive wildlife assessment based on the habitat present in the area and the wildlife species that could potentially use that habitat. This assessment considers the existing habitat as well as the habitat that would be present with any changes to the landscape implemented by the project. This assessment is in the form of a questionnaire, like many of the existing field assessments the NRCS uses, giving values for features on the site that may augment wildlife habitat. By knowing the potential consequences of the actions taken on the landscape, land managers, owners, or conservationists can plan for which species they maintain, create, or destroy habitat.

Using the model

This model is meant to be used in conjunction with existing ESDs and provides information regarding wildlife species and their preferred habitat to land managers. Along with ESDs this model can provide estimates of wildlife

species present in an area, and a prediction of which wildlife species may be lost or gained with the implementation of a conservation or land management project. As the vegetation on a site changes, so do the wildlife species that may inhabit that site as illustrated by the state-and-transition model and the wildlife assessment, which may affect land management decisions. This model will provide a resource to illustrate the consequences of maintaining or changing a landscape, along with a narrative interpretation to better communicate with landowners.

Constraints and Future Improvements

While this model is meant to be as comprehensive as possible, it is only as good as the information I obtained. Home range information on wildlife species may not be very detailed, thus the locations of those ranges may vary within an ESD. This model is also meant to be used with ESDs, and therefore require that an ESD exists for the site, which is not true for riparian sites. The NRCS has yet to develop ESDs for riparian areas in the western United States and therefore this model cannot be used in those areas. As with other wildlife databases (BDB 2014, BISON-M 2018, TXNDD 2018, WDFW Habitat Program 2018, WYNDD 2018, ODFW 2018), this model will be continuously updated as data is gained, and I would recommend future updates include a systematic review of primary sources of data.

This project provides a starting point for improving the ESDs and the resources available to land managers, conservationists, and private landowners. Other future additions can include interactive maps, spatial data and GIS layers, comparison tools and other resources as they become available. Prioritization of future additions would be to first conduct a literature review of all available data and verify the information in the spreadsheet database and to add more species of concern and umbrella species to the ESDs, identified by the agencies and landowners that use the ESDs. Second would be to create home range maps that overlay the ESD MLRAs to create a visual representation of where wildlife species can be found. Third would be to create the GIS layers and interactive maps for public use. This would provide a beneficial upgrade to the models starting point.

Ethics in Conservation

I have learned a great deal during my academic career about the value and importance of ethics in both my professional life as well as my personal life. Doing what is “right” is different for everyone, but the ideas of

preservation and conservation of the landscape was a major learning objective at the Northern Arizona University's School of Forestry. I feel that ethics in conservation is the foundation of every proposed land management project or program, and that the "rule" should be to heal not harm. Humans have a responsibility to maintain or improve the landscape around them, not just for the betterment of humanity but for the sake of every organism we share this planet with. Since humans have the most significant impact on the landscape, it is humans that should be held accountable as land stewards.

Ethics are the basis of every project people undertake, and that is doubly so for wildlife conservation projects. This model assists in evaluating what impacts the decisions of land managers will have on the wildlife species on a landscape. By knowing these impacts, land managers can judge whether the project will have devastating effects on the wildlife, and if those effects violate their personal or professional ethics.

Conclusion

In conclusion, this project was conducted to provide additional information on the wildlife species and their habitat needs in relation to existing ESDs. The need for this project is illustrated in the development of similar projects and databases in other states, and the lack of detailed information in the animal community section of the ESDs. By using this model, land managers can better plan projects and predict the outcomes of changing the landscape.

Acknowledgements

I thank Steve Cassady of the Arizona Game and Fish Department for providing me with the initial list of wildlife species. Stu Tuttle and Marcus Miller of the Natural Resource Conservation Service encouraged me to develop this project during my internship with them and provided valuable input and feedback. I also thank my master's degree advisor Paul Beier for his help during this project.

Appendix I:

Table 1. List of the variable used in the wildlife spreadsheet and a description of those variables. Also indicates which group of animals (birds, reptiles and amphibians (herps) or mammals) include those variables.

Variable	Description	Birds	Herps	Mammals
Species	Common name	X	X	X
Ecological Site Description	List of possible ESDs species is found in	X	X	X
Major Land Resource Area	The MLRAs that encompass the species geographic range	X	X	X
Biotic Community	Description of the biotic community that the species inhabits	X	X	X
Selected Habitat	One-word habitat identifier (Riparian, Woodland, Wetland, etc.)	X	X	X
Special Habitat Features	Detailed description of selected habitat with any unique features	X	X	X
Preferred Cover Type	Dominant vegetation of the preferred habitat	X	X	X
Guild	Type of guild the species belongs to (Sparrow, Shorebird, etc.)	X		
Nesting Ecology	One-word description of nesting site	X		
Special Nesting Features	Description of nest features, the number of eggs laid, description of the eggs and the number of broods	X		
Selected Hibernating/Brooding Habitat	Where the species prefers to hibernate/brood		X	
Hibernating/Brooding Features	Describes the den created, the number of eggs/young, The number of clutches, the season/month, and any other reproductive details (parthenogenetic)		X	
Selected Fawning/Calving Habitat	Where the species prefers to fawn/calve			X

Special Fawning/Calving Habitat	Describes the number of young, the season/month of fawning, and any other reproductive details			X
Feeding Ecology	One-word identifier of feeding behavior (Carnivore, Insectivore, etc.)	X	X	X
Feeding Behavior	Description on how the species feeds (ground forager)	X		
Feeding Ecology Details	Description of what the species eats	X	X	X
Migrates	Yes or No	X		X
Migration Description	Where the species migrates to and when			X
Arizona Range Description	Where the geographic range is located and what time of year the species inhabits it	X	X	X
Comments	T&E status, last seen, any other interesting details	X	X	X
Resources	List of resources used to obtain the information (Table 2)	X	X	X

Table 2. Resource list used to compile spreadsheet database. Numbers correspond to numbers listed in database for resources used for each species.

Number	***Reference/Source***
1	Arizona Game and Fish Department (AGFD). (2012). Arizona's State Wildlife Action Plan 2012 - 2022
2	Brennan, T.C., Holycross, Andrew T. (2009). Amphibians and Reptiles in Arizona
3	Stebbins, Robert C. (1966). A Field Guide to Western Reptiles and Amphibians
4	Ransom, Jay Ellis (1981). Harper & Rows Complete Guide to North American Wildlife
5	The Cornell Lab of Ornithology. (2017). All About Birds. https://www.allaboutbirds.org
6	What Bird.Com. (2017). http://identify.whatbird.com
7	Arizona Wildlife Views, January – February 2015, Arizona Game and Fish Department

8	US Geological Survey, Gap Analysis Program (GAP). May 2011. National Land Cover, Version 2
9	Tekiela, Stan. (2008). Mammals of Arizona Field Guide.
10	Floyd, Ted. (2008). Smithsonian Field Guide to the Birds of North America.
11	The Northern Arizona Environmental Education Resource Center. (1999). Arizona Roadside Environments. Biotic Communities of Arizona. http://dana.ucc.nau.edu/~are-p/road_map/eco/biotic.html
12	Busskohl, C., Padley, E., Stanley, C., Talbot, C. (2011). Ecological Site Description. ESIS User Guide. Source: https://esis.sc.egov.usda.gov/Welcome/pgESDWelcome.aspx

Table 3. List of 20 ESD selected for model. Species selected within ESDs result of T&E species, species of concern, and generalist species present.

MLRA	ESD Identification
Mojave	R030XC379AZ
Desert	R030XC381AZ
(30)	R030XA121AZ
Colorado	R035XC377AZ
Plateau	R035XG717AZ
(35)	R035XH821AZ
	R035XC308AZ
Mogollon	R038XA103AZ
Transition	R038XB215AZ
(38)	R038XB226AZ
AZ & NM	R039XA104AZ
Basin & Range	R039XA108AZ
(39)	R039XA121AZ
Sonoran	R040XA104AZ
Basin &	R040XA120AZ
Range	R040XC303AZ
(40)	R040XC315AZ
SE AZ Basin	F041XB218AZ

& Range	F041XA112AZ
(41)	F041XA113AZ

Appendix II:

United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

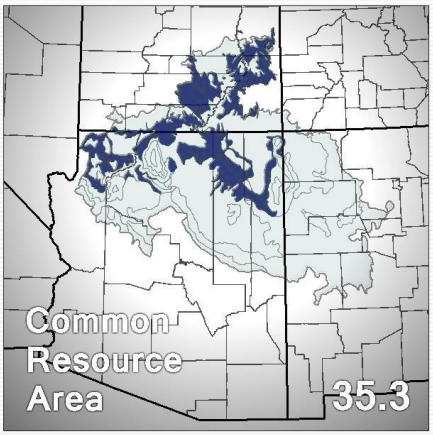
Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site stage: **Provisional**

Provisional: an ESD at the provisional status represents the lowest tier of documentation that is releasable to the public. It contains a grouping of soil units that respond similarly to ecological processes. The ESD contains 1) enough information to distinguish it from similar and associated ecological sites and 2) a draft state and transition model capturing the ecological processes and vegetative states and community phases as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. It is expected that the provisional ESD will continue refinement towards an approved status.

Site name: **Sandy Slopes 10-14" p.z.**
Juniperus - Pinus edulis / Artemisia tridentata ssp. wyomingensis - Atriplex canescens / Bouteloua gracilis - Achnatherum hymenoides
(Juniperus - Colorado pinyon / Wyoming big sagebrush - fourwing saltbush / blue grama - Indian ricegrass)
Site type: Rangeland
Site ID: R035XC377AZ
Major land resource area (MLRA): 035-Colorado Plateau



CRA 35.3AZ

This ecological site is found in Common Resource Area 35.3 – the Colorado Plateau Sagebrush – Grasslands.

The Common Resource Area occurs within the Colorado Plateau Physiographic Province. It is characterized by a sequence of flat to gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Elevations range from 4800 to 6700 feet and precipitation averages 10 to 14 inches. The elevation range is lower (about 4500 to 6000) on the western side of the Colorado Plateau along the Grand Canyon, and moves up about 500 to 800 feet higher on the eastern side in the areas of the Navajo and Hopi Indian Reservations due to rain shadow effects from the Kaibab Plateau and Mogollon Rim. Common vegetation in this region includes Wyoming big sagebrush, Utah juniper, Colorado pinyon - cliffrose, Mormon tea, fourwing saltbush, blackbrush Indian ricegrass, needle and thread, western wheatgrass Galleta, black grama, blue grama, and sand dropseed. Sedimentary rock classes dominate the plateau with volcanic fields occurring for the most part near its margin. The soil temperature regime is mesic and the soil moisture regime is ustic aridic.

Physiographic Features

This ecological site occurs on stabilized dunes with steep slopes. The overall slope of the site is 15 to 45 percent, but may include flatter or steeper spots. This ecological site is found on hillslopes, edges of plateaus and valley sides with soils that are deep to very deep to any plant root restricting layer. The surface texture of the soil is generally loamy sand, loamy fine sand or fine sand. Subsurface horizons are generally fine sand or sand.

Landform: (1) Hill
(2) Escarpment
(3) Valley side

	Minimum	Maximum
Elevation (feet):	4800	6700
Slope (percent):	15	45
Flooding		
Frequency:	None	None
Ponding		
Frequency:	None	None
Runoff class:	Very low	Low
Aspect:	North South West	

Climatic Features

Winter summer moisture ratios range from 70:30 to 60:40. Late spring is usually the driest period, and early fall moisture can be sporadic. Summer rains fall from June through September; moisture originates in the Gulf of Mexico and creates convective, usually brief, intense thunderstorms. Cool season moisture from October through May tends to be frontal; it originates in the Pacific and the Gulf of California and falls in widespread storms with longer duration and lower intensity. Precipitation generally comes as snow from December through February. Accumulations above 12 inches are not common but can occur. Snow usually lasts for 3-4 days, but can persist much longer. Summer daytime temperatures are commonly 95 - 100 F and on occasion exceed 105 F. Winter air temperatures can regularly go below 10 F and have been recorded below - 20 F.

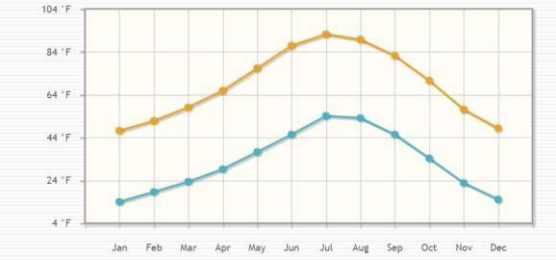
	Averaged
Frost-free period (days):	152
Freeze-free period (days):	178
Mean annual precipitation (inches):	14.00

Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	1.44	1.62	1.58	0.97	0.63	0.41	1.38	1.66	1.27	1.16	1.20	0.98
Low	0.68	0.69	0.84	0.66	0.47	0.32	1.21	1.60	1.06	1.02	0.80	0.00

Monthly Temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	47.7	52.3	58.6	66.4	76.8	87.4	92.7	90.2	82.7	71.1	57.6	48.8
Low	14.5	19.1	23.9	29.7	37.7	45.9	54.6	53.6	45.9	34.8	23.3	15.6



Climate stations: (1) 21920, Colorado City, AZ. Period of record 1963-2005
(2) 23303 Ganado, AZ Period of Record 1948-2005

Influencing Water Features

The soil moisture on this ecological site comes from precipitation. The site does not benefit significantly from run-on moisture. The sandy surface texture of the soil allows the site to capture the majority of both gentle winter storms and intense summer thunderstorms with little runoff.

Representative Soil Features

The soils associated with this ecological site are deep to very deep to any plant root restricting layer. The surface texture of the soil is generally fine sand, loamy sand to loamy fine sand. Subsurface horizons are generally sand, fine sand, loamy sand and loamy fine sand. Parent material is eolian material and alluvium derived mainly from sandstone. The soil ranges from slightly to moderately alkaline (pH 7.4 to 8.4). The permeability is moderately rapid to rapid and the soil profile can absorb all the moisture the climate can supply. The available water capacity is very low to low. Wind erosion is a severe problem if the vegetative cover is lost. Soil moisture regime is ustic aridic. Soil temperature regime is mesic.

Typical taxonomic units on this site include:
SSA 711 Navajo Mountain Area MU's 35 Pinavetes and 39 Mido;
SSA 713 Chinle Area MU 39 Mido;
SSA 715 Fort Defiance Area AZ/NM MU's 82 & 84 Pinavettes family.

Parent materials
Kind: Eolian deposits, Alluvium
Origin: Sandstone

Surface texture: (1) Loamy sand
(2) Loamy fine sand
(3) Fine sand

Subsurface texture group: Sandy

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	20
Surface fragments >3" (% cover):	0	5

Drainage class: Excessively drained
Permeability class: Moderately rapid to rapid

	Minimum	Maximum
Depth (inches):	60	80
Available water capacity (inches):	2.50	4.00
Electrical conductivity (mmhos/cm):	0	2
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent (percent):	0	2
Soil reaction (1:1 water):	7.4	8.4

Plant Communities

Ecological Dynamics of the Site

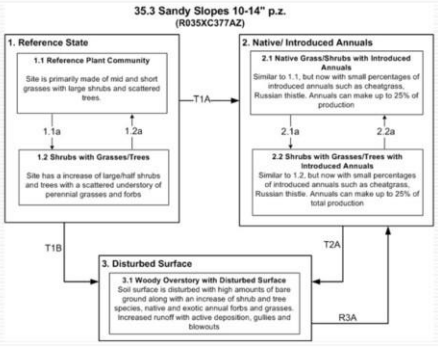
The plant communities found on an ecological site are naturally variable. Composition and production will vary with yearly conditions, location, aspect, and the natural variability of the soils. The historical climax plant community (HCPC) represents the natural potential of plant communities found on relict or relatively undisturbed sites. Other plant communities described here represent plant communities that are known to occur when the site is disturbed by factors such as grazing, fire, or drought.

Production data provided in this site description is standardized to air-dry weight at the end of the summer growing season. The plant communities described in this site description are based on near normal rainfall years.

NRCS uses a Similarity Index to compare existing plant communities to the plant communities described here. Similarity Index is determined by comparing the production and composition of a plant community to the production and composition of a plant community described in this site description. To determine Similarity Index, compare the production (air-dry weight) of each species to that shown in the plant community description. For each species, count no more than the maximum amount shown for the species, and for each group, count no more than the maximum shown for the group. Divide the resulting total by the total normal year production shown in the plant community description. If rainfall has been significantly above or below normal, use the total production shown for above or below normal years. If field data is not collected at the end of the summer growing season, then the field data must be corrected to the end of the year production before comparing it to the site description. The growth curve can be used as a guide for estimating production at the end of the summer growing season.

The State and Transition model shows the most common occurring plant communities likely to be encountered on this ecological site. This model may not show every possible plant community, but only those that are most prevalent and observed through field inventory. As more data is collected these plant communities may be revised, removed, and some added to reflect the ecological dynamics of this site.

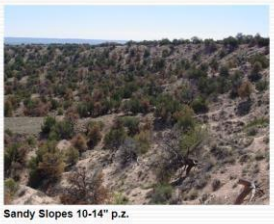
State-and-Transition Diagram



State 1: Reference Plant Community

Community Phase 1.1: Historic Climax Plant Community

Sandy Slopes 10-14" p.z.



Sandy Slopes 10-14" p.z.

This site has a plant community made up of primarily short and midgrasses with a mixture of shrubs and minor amounts of forbs and scattered trees. Major grasses include blue grama, Indian ricegrass, sand dropseed, needle and thread and black grama. Major shrubs include Wyoming big sagebrush, Greene's rabbitbrush, fourwing saltbush and broom snakeweed and mormon tea. A light overstory (5-15% canopy) of juniper and pinyon pine is present on this site.

Plants most likely to increase or invade when the site deteriorates are sandhill muhly, Fendler's threeawn, false-buffalo grass, galleta, rabbitbrush, broom snakeweed, dunebroom and juniper; annual forbs and grasses will invade.

Community Phase Pathway 1.1a
Unmanaged grazing, natural tree regeneration/lack of fire

Historic Climax Plant Community Plant Species Composition

Grass/Grasslike				Annual Production (pounds per acre)		Foliar cover (percent)	
Group name	Common name	Symbol	Scientific name	Low	High	Low	High
0 -Cool Season Grasses				100	200		
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	75	125		
	bottlebrush squirreltail	ELEL5	*Elymus elymoides*	25	50		
	needle and thread	HECO26	*Hesperostipa comata*	50	100		
	muttongrass	POFE	*Poa fendleriana*	0	25		
1 -Warm Season Grasses				80	160		
	black grama	BOER4	*Bouteloua eriopoda*	5	30		
	blue grama	BOGR2	*Bouteloua gracilis*	50	100		
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	5	30		
	galleta	PLJA	*Pleuraphis jamesii*	5	30		
	spike dropseed	SPCO4	*Sporobolus contractus*	0	20		
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0	20		
	floating bur-reed	SPFL	*Sparganium fluctuans*	0	20		
	mesa dropseed	SPFL2	*Sporobolus flexuosus*	0	20		

Forb				Annual Production (pounds per acre)		Foliar cover (percent)	
Group name	Common name	Symbol	Scientific name	Low	High	Low	High
2 -All Forbs				25	65		
	Forb, annual	2FA		0	15		
	Forb, perennial	2FP		0	20		
	Abronia	ABRON	*Abronia*	0	6		
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	0	10		
	rose heath	CHER2	*Chaetopappa ericoides*	0	10		
	Cryptantha	CRYPT	*Cryptantha*	0	10		
	winged buckwheat	ERAL4	*Eriogonum alatum*	0	10		
	Oxytropis	OXYTR	*Oxytropis*	0	5		
	Penstemon	PENST	*Penstemon*	0	10		
	Sphaeralcea	SPHAE	*Sphaeralcea*	0	10		

Shrub/Vine				Annual Production (pounds per acre)		Foliar cover (percent)	
Group name	Common name	Symbol	Scientific name	Low	High	Low	High
7 -Common Shrubs				70	180		
	sand sagebrush	ARFI2	*Artemisia filifolia*	5	30		
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata subsp. wyomingensis*	10	50		
	fourwing saltbush	ATCA2	*Atriplex canescens*	10	50		
	Ephedra	EPHED	*Ephedra*	5	30		
	winterfat	KRLA2	*Krascheninnikovia lanata*	5	30		
	antelope bitterbrush	PUTR2	*Purshia tridentata*	5	30		

8 -Other Shrubs				40	70
	Subshrub (<.5m)	2SUBS		0	5
	prairie sagewort	ARFR4	*Artemisia frigida*	0	10
	Greene rabbitbrush	CHGR6	*Chrysothamnus greenei*	0	15
	Douglas rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0	15
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	0	5
	sand buckwheat	ERLE9	*Eriogonum leptocladon*	0	5
	rubber rabbitbrush	ERNAB2	*Ericameria nauseosa var. bigelovii*	0	15
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0	15
	plains pricklypear	OPPO	*Opuntia polyacantha*	0	5
	dune broom	PAFI4	*Parryella filifolia*	0	10
	rosemary mint	POIN3	*Poliomintha incana*	0	10
	narrowleaf yucca	YUAN2	*Yucca angustissima*	0	5

Tree				Annual Production (pounds per acre)		Foliar cover (percent)	
Group	Group name	Common name	Symbol	Scientific name	Low	High	Low	High
14 -Trees					25	85		
		Juniperus	JUNIP	*Juniperus*	15	50		
		Colorado pinyon	PIED	*Pinus edulis*	10	35		

Annual Production by Plant Type

	Annual Production (lbs/ac)		
Plant type	Low	Representative value	High
Grass/Grasslike	180	275	360
Forb	25	40	65
Shrub/Vine	100	175	250
Tree	25	50	85
Total	330	540	760

Structure and Cover

Soil Surface Cover

Cover type	Minimum	Maximum
Basal cover, grasses/grasslikes	5%	10%
Basal cover, forbs	0%	2%
Basal cover, shrubs/vines	1%	5%
Basal cover, trees	0%	10%
Nonvascular plants	0%	1%
Biological crust	0%	15%
Litter	20%	30%
Surface fragments >0.25" and <=3"	0%	10%
Surface Fragments >3"	0%	10%
Bare ground	45%	60%

* Decomposition classes: N=No or little integration with the soil surface. I=Partial to nearly full integration with the soil surface.

** >4" diameter at 4.5' above ground and >6' height. If diameter or height is smaller, use applicable downed wood type. For pinyon and juniper, use 1.0' above ground.

*** Hard=Tree is dead with most or all of bark intact. Soft=Most of bark has sloughed off.

Structure of Canopy Cover

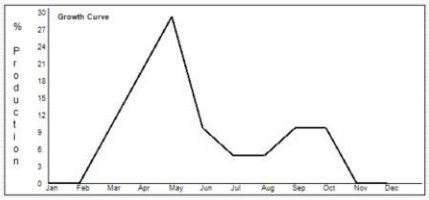
Height above ground	Grasses/grasslikes		Forbs		Shrubs/vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 foot	5%	10%	0%	2%	1%	10%	--	--
>0.5 to <1 foot	0%	5%	--	--	1%	5%	--	--
>1 to <=2 feet	--	--	--	--	0%	1%	--	--
>2 to <4.5 feet	--	--	--	--	--	--	--	--
>4.5 to <=13 feet	--	--	--	--	--	--	5%	10%
>13 to <40 feet	--	--	--	--	--	--	0%	5%
<40 to >=80 feet	--	--	--	--	--	--	--	--
>80 to <120 feet	--	--	--	--	--	--	--	--
>=120 feet	--	--	--	--	--	--	--	--

Plant Growth Curve

Growth curve number:	AZ3501
Growth curve name:	35.3 10-14" p.z. needle and thread
Growth curve description:	Growth starts in spring and extends into summer, plants may be green in the fall.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	10	20	30	10	5	5	10	10	0	0

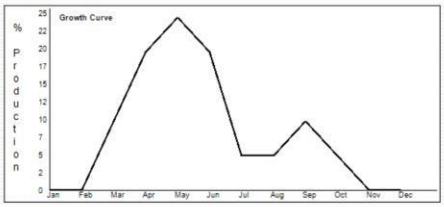


Plant Growth Curve

Growth curve number:	AZ3505
Growth curve name:	35.3 10-14" p.z. Indian ricegrass
Growth curve description:	Growth begins in spring, with semi-dormancy occurring during July through August. Plants will green up again in the fall.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	10	20	25	20	5	5	10	5	0	0

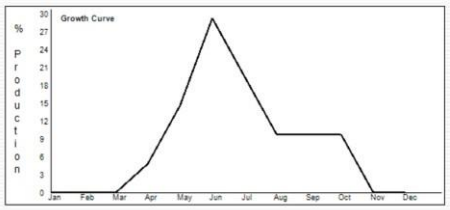


Plant Growth Curve

Growth curve number:	AZ3508
Growth curve name:	35.3 10-14" p.z. Wyoming big sagebrush
Growth curve description:	Most growth occurs in spring and early summer. Stem elongation and seed set occur in the fall.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	15	30	20	10	10	10	0	0

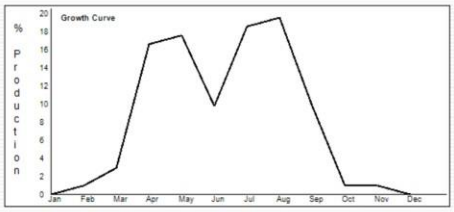


Plant Growth Curve

Growth curve number:	AZ3531
Growth curve name:	35.3 10-14" p.z. all sites
Growth curve description:	Growth begins in the spring and continues through the summer.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	1	3	17	18	10	19	20	10	1	1	0

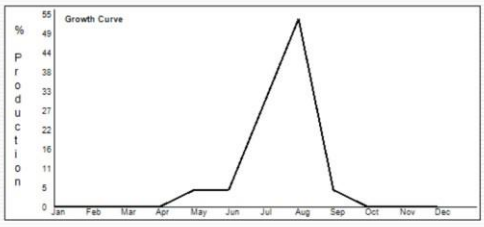


Plant Growth Curve

Growth curve number:	AZ3567
Growth curve name:	35.3 10-14" p.z. blue grama
Growth curve description:	Growth occurs mostly during the summer rainy season.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	5	5	30	55	5	0	0	0



Community Phase 1.2: Shrubland with Trees

Shrubs and Trees

Shrub and Trees

This plant community is characterized by a decline of perennial cool season grasses and a increase of shrubs, especially half shrubs and succulents. Trees cover (up to 25% canopy) may also increase, especially on cooler aspects. Grasses expected to increase are blue grama, galleta, sand dropseed, sandhill muhly and threeawns. Common shrubs include snakeweed, rabbitbrush, mormon tea, cacti, antelope bitterbrush and dune broom.

Community Phase Pathway 1.2a
Prescribed grazing, insect infestation (beetle kill) and/or extensive woodcutting, followed by periods of favorable or return normal precipitation events.

Transition T1A

Introduction of non-native annuals species creates an irreversible change in the plant community

Transition T1B

Continuous heavy grazing and/or continous soil surface distance, natural tree regeneration/lack of fire, Introduction of non-native annuals, reduced perennial cover.

State 2: Native/ Introduced Annuals

This state has native shrubs and grasses, but now has introduced non-native annuals in the plant community. This is a loss of biotic integrity and degradation of soil site stability. Severe droughts, unmanaged grazing and frequent soils surface disturbance has allow for the introduction and establishment of non-natives. During periods of above average precipitation annuals can produce moderate amounts of cover.

Community Phase 2.1: Native Grass/Shrub with Introduced Annuals

Introduced exotic annual grasses and forbs are present in minor amounts in the plant community, but the amount and proportions of native plants is similar to that found in plant community 1.1, Reference Plant Community.

Community Phase Pathway 2.1a
Unmanaged grazing, natural tree regeneration/lack of fire

Community Phase 2.2: Shrubs with Grasses/Trees with Introduced Annuals

This plant community has a mix of large and half-shrubs with scattered overstory of trees. Grasses cover is reduced and most grasses are found within the shrub or tree canopies. Introduced exotic annual grasses and forbs are present in moderate amounts (5-25%) in the plant community.

Community Phase Pathway 2.2a
Prescribed grazing, insect infestation (beetle kill) and/or extensive woodcutting, followed by periods of favorable or return normal precipitation events.

Transition T2A
Continuous heavy grazing and/or continous soil surface distance, natural tree regeneration/lack of fire, loss of perennial cover.

State 3: Disturbed Surface

This state is dominated by trees and shrubs with native and non-native annuals. Grasses are mostly absent or severly reduced. Bare ground patches are large and connected within the woody canopy. There are active signs of erosion and deposition.

Community Phase 3.1: Woody Overstory with Disturbed Surface

This site is characterized by a overstory canopy dominated by Junipers and Pinyon Pine with a understory of annuals and scattered shrubs and succulents. Prolonged drought conditions along with improper grazing have reduced the perennial herbaceous ground cover and increased soil erosion. There is significant disturbances to the soil surface through rills and gullies. Gullies show signs of active headcutting and rills/water flow patterns are evident and connected. A return pathway for this plant community may existm but is not displayed in the state and transition model. The possibe return pathways to state 2 may take several years or decades to occur thru management and practices, but may not be feasible due to the need for significant inputs.

Restoration Pathway R2A
Brush treatment to control woody species, reseeding or seed source for grass recovery, Prescribed grazing or No grazing. This pathway may not be feasible on a large scale due to significant inputs required.

Section II: Ecological Site Interpretations

Animal Community

This site has limited suitability for grazing by stocker cattle, horses, and sheep during spring, summer and fall with a good variety of plants. In areas of steep slopes, livestock grazing is severely restricted and proper grazing distribution is often impossible to attain. Heavy use may occur in areas where access areas are frequented by livestock.

This site provides a great deal of habitat diversity because of the variety of food, topography, exposures and cover for wildlife species. Water can be scarce in natural springs or pockets.

Wildlife found on this site include golden eagles, red-tail hawks, badgers, porcupines, ground squirrels, snakes, blacktail jackrabbits, lizards and mule deer.

Recreational Uses
Site is typically on edges of escarpments, terraces, valley sides and hills with sandstone parent material. It produces a mix of grasses, shrubs, forbs and a light overstory of trees which can be very picturesque.

Winters are cold, however, relatively mild spring, fall and summer months are attractive to recreationists.

Activities include hunting, cross-country riding, photography, hiking, and wildlife observation

Supporting Information

Similar Sites

Site name	Site ID	Site narrative
Sandy Upland	*R035XC315AZ*	
Sandy Upland	*F035XC323AZ*	

Other References
Updates and revisions for this ESD were conducted as part of a 2007-2012 Interagency Technical Assistance Agreement between the Bureau of Indian Affairs–Navajo Region and the NRCS-Arizona.

Site Authors
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Quality Assurance
Provisional Status Verified in Legacy System

Reference Sheet

Author(s)/participant(s): Ken Gishi

Contact for lead author: State Rangeland Management Specialist, NRCS-Arizona State Office, Phoenix, AZ

Date: 10/9/2008 **MLRA:** 035X **Ecological Site:** Sandy Slopes 10-14" p.z. R035XC377AZ This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: X Annual Production, Foliar Cover, Biomass

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural distrurbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. **Number and extent of rills:** A few rills may form on steepest slopes.

2. **Presence of water flow patterns:** Somewhat common, probably cover no more than 15% of the area; mostly discontinuous, usually less than 8 feet in length. On steepest slopes water flow patterns may be continuous and as long as 12 feet in length.

3. **Number and height of erosional pedestals or terracettes:** Pedestals and terracettes may be common, especially during a drought, due to high wind erosion hazard of the soils and steepness of soils.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** Bare ground averages about 50%. Drought may cause an increase in bare ground.

5. **Number of gullies and erosion associated with gullies:** Uncommon, but occasional gullies will form in natural drainages on steeper slopes due to reduced plant cover and lack of rock fragments.

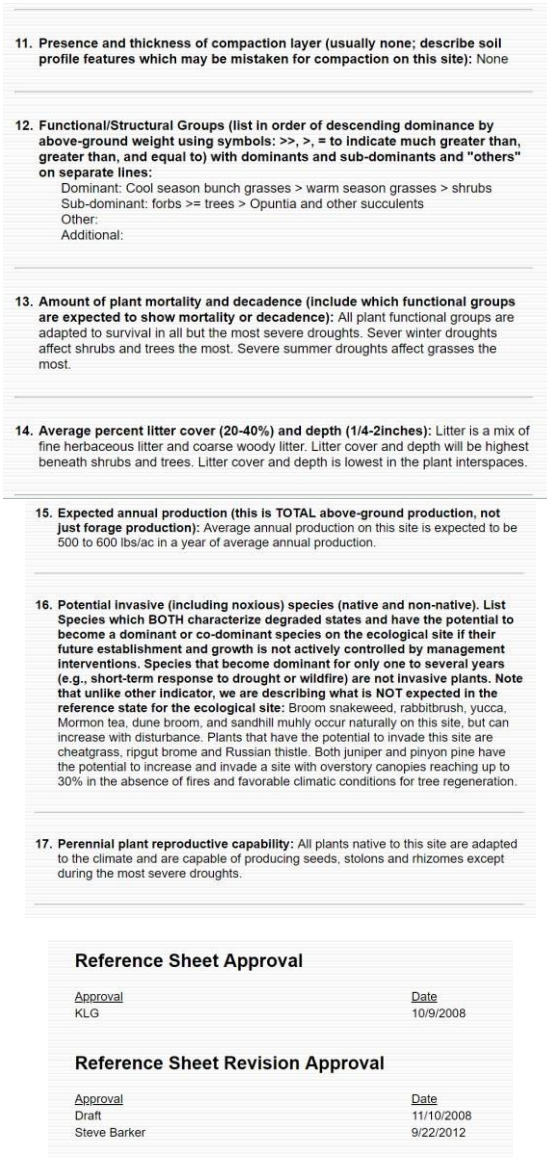
6. **Extent of wind scoured, blowouts and/or depositional areas:** Some wind scoured areas and depositional areas may occur, especially on edges of escarpments and during droughts, due to high wind erosion hazard of the soil. High wind erosion hazard occurs on soils with surface textures of loamy sand, fine sand and sand.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous and fine woody litter will be transported primarily by wind and in water flow pathways. Coarse woody litter will remain under tree and shrub canopies.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface texture range from loamy sand to sand. Coarse rock fragments range from 0 to 15 percent and help protect the site. Soil on this site will often have a thin crust (biological or physical) providing some protection against erosion. Soil aggregate stability ratings should average 3 under plant canopies and 2 in the interspaces.

9. **Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** Soil surface structure is single grain; loose, but some soil surfaces are weakly granular. Surface textures are loamy sand, loamy fine sand and fine sand with thickness ranging from 2-3 inches. Surface color is light brown (7.5YR 6/4) and subsurface is pink (7.5YR 7/4), however color can be variable with hues of 5YR to 7.5YR.

10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This site is characterized by scattered plants with a light overstory of trees, generally with less than 15% canopy cover by trees. The plant community consists of about 50% grasses, 35% shrubs, 10% trees and succulents with about 5% forbs. Basal cover range from 5-15% (Grasses>Shrubs>forbs>trees).



11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None

12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Cool season bunch grasses > warm season grasses > shrubs
    Sub-dominant: forbs >= trees > Opuntia and other succulents
    Other:
    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** All plant functional groups are adapted to survival in all but the most severe droughts. Sever winter droughts affect shrubs and trees the most. Severe summer droughts affect grasses the most.

14. **Average percent litter cover (20-40%) and depth (1/4-2inches):** Litter is a mix of fine herbaceous litter and coarse woody litter. Litter cover and depth will be highest beneath shrubs and trees. Litter cover and depth is lowest in the plant interspaces.

15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** Average annual production on this site is expected to be 500 to 600 lbs/ac in a year of average annual production.

16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what is NOT expected in the reference state for the ecological site:** Broom snakeweed, rabbitbrush, yucca, Mormon tea, dune broom, and sandhill muhly occur naturally on this site, but can increase with disturbance. Plants that have the potential to invade this site are cheatgrass, ripgut brome and Russian thistle. Both juniper and pinyon pine have the potential to increase and invade a site with overstory canopies reaching up to 30% in the absence of fires and favorable climatic conditions for tree regeneration.

17. **Perennial plant reproductive capability:** All plants native to this site are adapted to the climate and are capable of producing seeds, stolons and rhizomes except during the most severe droughts.

Reference Sheet Approval

Approval	Date
KLG	10/9/2008

Reference Sheet Revision Approval

Approval	Date
Draft	11/10/2008
Steve Barker	9/22/2012

Example of a complete ESD report from the ESIS website. Source:

https://esis.sc.egov.usda.gov/ESDReport/fsReport.aspx?id=R035XC377AZ&rptLevel=all&approved=yes&repType=regular&scrns=&comm=

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