New Tools for Land Management:

A Quick Introduction to Ecological Site Descriptions

Land management agencies have the job of managing natural resources for multiple uses in a sustainable manner. A sound understanding of ecological processes is necessary to successfully manage agricultural and wild lands, and develop policy for programs that support management. Spatially variable and complex landscapes can be subdivided and classified into land units that behave similarly, called **ecological sites**. **Ecological site descriptions** synthesize the overwhelming amount of scientific information concerning soils, hydrology, ecology, and management into a concise document that provides land managers, landowners, conservationists and policy makers the information needed to make well-informed decisions.

Ecological sites

An ecological site is a kind of land with specific physical characteristics (climate, soil, topography) that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation. A landscape is made up of a patchwork of ecological sites. For instance, a single pasture may contain several different ecological sites (see Figure 1). Different ecological sites respond differently to management (see Box 1). Ecological site descriptions (ESDs) tell you about the characteristics of a given site, such as its distinct topography, soil depth and texture, the plants you might find there, and the value of the site for management objectives such as livestock grazing and wildlife habitat. ESDs also provide a resource to understand how specific types of land may change over time and what causes these changes. This product, or roadmap, is called a state and transition model.

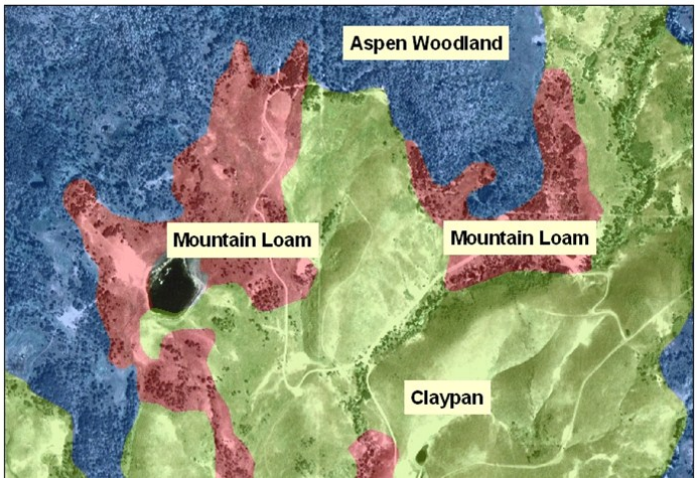

Figure 1. Aerial Photo With an Overlay Depicting Ecological Sites in a Portion of the Elkhead Watershed, Colorado

What is a state and transition model?

A state and transition model (STM) is a diagram that depicts our current understanding of ecological dynamics on an ecological site. An STM identifies the different plant associations or "states" that may exist on a given ecological site and how other site characteristics, such as hydrology and soil stability, might change with them. STMs describe the environmental conditions, disturbances and management actions that cause vegetation to change from one group of plant species to a different set of species, and the management actions needed to restore plant communities to a desired composition. STMs help you identify where the land is currently (its present state) and what potential alternative states it could inhabit, and provide ideas about how to move to a more desirable state and avoid unwanted transitions.

Figure 2. Claypan Ecological Site

Box 1. Ecological Sites and Response to Management

Different ecological sites have different vegetation composition, potentials and responses to management actions. Let's say we are interested in a property that is made up primarily of two ecological sites: Claypan and Mountain Loam. The following table compares these two ecological sites.

	Claypan	Mountain Loam
Soil Surface Color	Medium to Light	Dark
Organic Matter	Low	High
Type of Soil	Heavy Clay	Mix of Sand, Silt and Clay
Production	500 lbs/acre	1500 lbs/acre

Figure 3. Mountain Loam Ecological Site

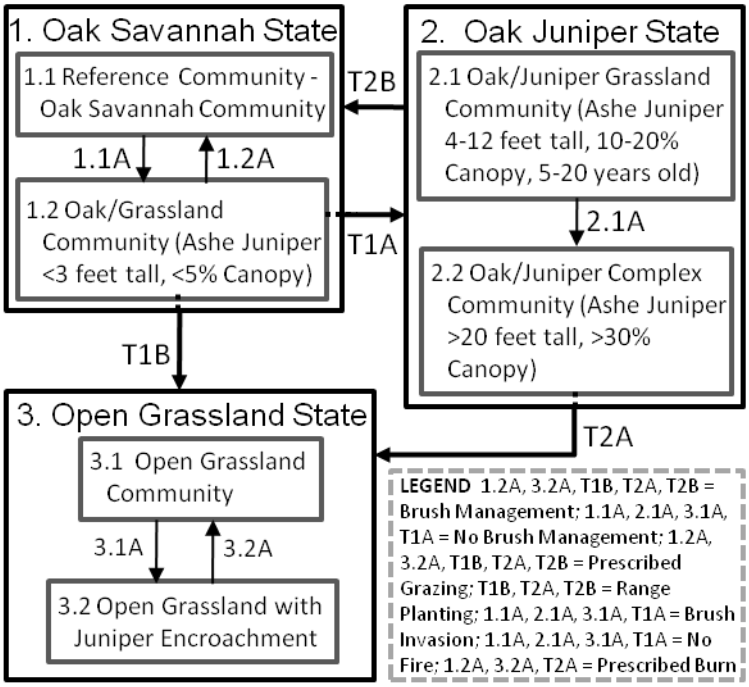

Figure 4. State-and-Transition Model (STM) for the Deep Redlands ecological site

What do STMs look like?

STMs include recognizable and relatively stable groupings of plant species or "states" (boxes) and the pathways of change between states (arrows). A state may contain several communities which are called plant community phases (or plant associations). Plant community phases (smaller boxes) can easily transition from one to another in short time frames.

If we were interested in understanding the Deep Redlands ecological site (Figure 4), the model would show us that there are three vegetation states (larger boxes) that might occur on this site, and two community phases in each state (smaller internal boxes). The narrative section of the STM model gives a written description of each of these states that explains what plants we would find in each state, how useful each state is for achieving specific management objectives, and other site characteristics. We would also notice that these states are connected through transitions (arrows). The arrows between the large boxes, or states, signify that a threshold has been crossed. This means that new ecological processes characterize the site, and it will take active management to shift back to the previous state. We could look at the descriptions of each transition in order to understand what we might have to do to move from one state (box) to a more desirable state.

How they are developed

Ecological site descriptions (ESDs) and their associated state and transition models are developed using expert knowledge, available inventory and monitoring data, previous range site descriptions, soil survey information and published research. One of the primary challenges in developing ESDs is a general lack of long-term data for individual sites. Typically, the Natural Resources Conservation Service (NRCS) will 1) develop a working model of how an ecological site works based on the range site description and existing data, 2) convene a group of knowledgeable local experts to ground-truth and inform the model, and 3) collect additional field data to confirm model assumptions as funding is available. Researchers are currently partnering with the NRCS to use long-term monitoring and scientific studies to provide a stronger empirical basis for STMs.

A May 2005 Interagency Memorandum of Understanding (MOU) was signed by the Chief of the US Forest Service (FS), Director of the NRCS, and the Director of The Bureau of Land Management (BLM), to develop a common ecological site description process. In compliance with the MOU, these agencies are cooperatively developing an Interagency Ecological Site Handbook for Rangelands. This Handbook will standardize how BLM, FS, and NRCS define, delineate, and describe terrestrial ecological sites.

Relationship to range sites

Ecological site descriptions are replacing range site descriptions. They provide a similar description of site potential and plant species you might expect in an area. The primary difference is that they reflect new understandings about the way that vegetation changes over time. Instead of describing vegetation change as a gradual linear process, the STMs included in ESDs reflect the sudden and unpredictable changes that sometimes occur in rangelands. Although the NRCS is working to revise all range site descriptions to ecological site descriptions, there are still some areas where range site descriptions are the best and only information available.

What can STMs do for you?

STMs are a valuable resource for a wide range of land management agency employees (such as BLM and FS) and technical assistance agencies (NRCS) (see Table 1). More broadly, STMs are an important tool for adaptive management. STMs are dynamic, representing our evolving understanding of changes in vegetation and ecological processes on a site. As more field data and new information become available, STMs will be revised. If you have information to add to or modify a given ESD, you should contact your local NRCS office.

STMs can also be used in the adaptive management process. STMs can help you set realistic management objectives by identifying the range of potential states for a given ecological site. They also can serve as the basis for rangeland inventory, assessment and monitoring by providing a framework to understand vegetation dynamics and identify appropriate monitoring indicators. STMs also suggest potential management strategies and can be used to develop and test management hypotheses about the effectiveness of different practices on specific ecological sites and states. Finally, STMs make assumptions about ecosystem dynamics explicit and help communicate them to landowners, permittees, other agency employees and across agencies.

Table 1. STM Applications

Application to:	
Fire Management	Different states in the same ecological site may react differently to fire. Prescribed burns may have different outcomes (e.g. in terms of erosion, plant re-growth) depending on the current state. The STM describes the role of fire in vegetation dynamics, suggests which ecological sites and states are more vulnerable to wildfire, describes which can be managed with prescribed fire, and provides information about how you can manage to reduce wildfire risk.
Woodland Management	Although traditionally a tool used in grassland and shrubland systems, ESDs are being developed for woodland and savannah systems as well. These descriptions can help to plan for sustainable woodland management, manage pest outbreaks and understand vegetation change.
Hydrology	Upland vegetation and site characteristics can impact infiltration and runoff rates, and resulting water quality and sediment loads. STMs provide valuable information about site characteristics such as erosion potential that could have a cumulative impact on watershed dynamics.
Grazing Management	STMs describe the potential of different types of land to support livestock grazing, and illustrate how grazing affects plant composition and ecological processes on a given ecological site. STMs can help make grazing management decisions that take advantage of opportunities to use grazing to make desired changes and avoid negative outcomes.
Recreation	Different states provide different recreational opportunities and may be preferred by some user groups. Knowing the potential of a site may influence recreation planning by changing management to provide different types of recreational opportunities. STMs can also help predict the impacts of recreation on plant communities and site stability.
Restoration	Some states are easier to change than others. When planning for restoration it is helpful to know if your actions are likely to have a positive impact. STMs help you prioritize restoration in the areas where you are most likely to succeed. ESDs also provide information about the plant communities that a given site can support, providing useful information for selecting appropriate plant materials for revegetation.
Invasive Species	The combination of management and natural disturbances can lead to areas that are more vulnerable to the establishment and spread of invasive species. STMs highlight vulnerable ecological sites and states so that you can manage to prevent the spread of invasive species.
Wildlife	Different ecological sites and states may provide habitat for different wildlife species, or be associated with different habitat quality for a given species. Ecological site maps can help wildlife managers prioritize areas for conservation based on their ability to provide suitable habitat for target species, and STMs can be useful in planning habitat improvement projects by identifying possible states for a given site.

Where to find ESDs

Ecological site descriptions are being developed for every ecological site in the United States. Central and Western states are further along, while many Midwestern and Eastern states are just beginning to classify potential ecological sites. To access draft and approved ESDs for your area, visit: esis.sc.egov.usda.gov. Web Soil Survey is also an excellent tool for land managers to use to see how soils, landscape and vegetation come together. It provides soil maps and data for almost all of the nation's counties. To find maps of soils, visit the Web Soil Survey at: websoilsurvey.nrcs.usda.gov. If you aren't finding what you are looking for, you may want to contact your local NRCS office directly.

Place Postage Here

This fact sheet was developed by researchers at Colorado State University and peer-reviewed by rangeland scientists and managers from a variety of agencies and organizations. To obtain a pdf of this or other fact sheets developed for agency or conservationist audiences please contact Dr. Maria Fernandez-Gimenez at maria.fernandez-gimenez@colostate.edu. This outreach effort is supported by a grant from the USDA AFRI Managed Ecosystems Program (Project Number COL0-2008-00725) and the Colorado Agricultural Experiment Station (Project Number COL00698). This fact sheet may be copied or reprinted for distribution.

Colorado State University

Identifying ecological sites

In the field it is often possible to identify different types of land just by looking at variations in vegetation and site characteristics (Figure 5). This gives you a general sense of the types of land, but in order to identify the ecological site of interest, it is necessary to gather a few additional resources. You will need to consider the topography, soils and plants on a site (see Box 3). Since different ecological sites have different characteristics and potentials, it is important to follow these steps in order to make sure that you correctly identify the ecological site of interest.

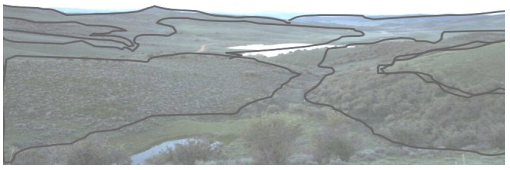

Figure 5. Rangeland Depicting Different Types of Land Based on Visual Clues in Aspect, Topography and Vegetation.

Box 3. Steps for Identifying Ecological Sites

1. Obtain your state's ecological site key, if one is available.
2. Obtain topographical and soil maps of the area of interest, along with the associated soil survey descriptions. Soil maps are available on the Web Soil Survey: websoilsurvey.nrcs.usda.gov. Soil map units represent one or more soil types and each soil type has its own ecological site description.
3. Obtain copies of the most common ecological site descriptions for the area of interest from the Web: esis.sc.egov.usda.gov or your local NRCS office.
4. Take the maps with you on the land and see what soil and ecological site they predict for the spot you are standing on.
5. Look at the ESD for the predicted site and see if the physical description matches the place where you are standing. Are the elevation, slope and topography similar or the same? What about the soil texture? If not, what ecological sites do match the physical description for that spot? It is important to remember that the ESD is the central concept for the site. While it describes the majority of locations in this site, variants may occur.
6. When you find the ESD that matches the physical characteristics of your site, look at the list of plant species in the reference state and alternative vegetation states. Does one of the described states or community phases fit what you see around you? If so, you have matched your location with an ecological site, state and/or community phase.
7. Use the supporting narrative within the ecological site description to understand how your land came to be in its current state, whether a change in states is desirable or possible and how a transition to another state might be achieved or prevented.