LESSON TEN:

What Is an Ecological Site and What Causes Plant Community Change?

Ecological Sites

Ecological sites are a distinctive kind of land that is different from all other kinds of land based on soil and other physical characteristics and in its ability to produce a distinct kind and amount of vegetation.

An ecological site is a land unit classification based on a unique ecological potential.

An ecological site differs from other ecological sites in its ability to respond to management activity and natural disturbances.

An ecological site is based on distinct abiotic (physical) and biotic factors.

- Physical factors include soils, climate, hydrology, geology and physiographic (landscape and landform) features.
- Biotic factors include plant species, vegetation states and ecological dynamics. Ecological dynamics include grazing, fire, drought, invasive species, and management actions.

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1068392

Ecological Sites

An ecological site is the product of all environmental factors responsible for its development with its own set of key characteristics. Environmental factors include:

- Soils
- Hydrology
- Plant Communities
- Herbivory
- Fire Regime

Soils:

A soil is a complex mix of minerals, air, water and organic matter that occurs on the land surface, occupies space, is characterized by horizons (layers) and has the ability to support rooted plants in a natural environment.

Soil formation is affected by climate, living organisms, topography, landscape position, parent material and time.

Soil horizons indicate a change in the composition of abiotic and biotic components present.

Soils

Soil texture and structure strongly influence the vegetation present on an ecological site and are key in determining water availability.

Texture and structure directly influence the amount of spaces (pores) in the soil. These spaces allow movement of water, nutrients and air. They also allow space for the roots to grow.

Some soils can form barriers that slow or prevent water infiltration and root growth. These restrictive layers can be naturally occurring or caused by land management practices.

Hydrology:

The three primary functions of the hydrologic cycle are the capture, storage and release of water.

- Capture: Amount of water that moves from the atmosphere into the soil.
- Storage: Amount of water that remains in the soil and is not removed from the soil by evaporation or other processes.
- Release of Water: Amount of water that moves off the site as overland flow.

The amount of water captured and stored is related to the ground cover and soil type.

Hydrology:

Capture and infiltration rates are high in dense grasslands. Plant cover shelters the soil from raindrop impact.

Bare ground and exposed soils have low infiltration rates and increased overland flow.

Unhealthy sites have elevated erosion rates that reduce capture and infiltration.

Land managers can impact infiltration and erosion by managing the structure (vertical layers and height) and density (number of plants in an area) of vegetation.

Landscape Position:

There are 4 general landscape positions of rangelands in Nebraska. Each has distinct soils, hydrology, topography and plant community.

Uplands are nearly level to steeply sloping lands. These sites are wet or moist only for a short time after precipitation events.

Overflow/floodplain sites occur in drainageways and near stream channels. These sites receive additional water that runs off uplands. Floodplains may be subject to periodic flooding.

Riparian sites are adjacent to surface waters. These sites may have high water tables and/or may have short term ponding or flooding..

Wetland sites are lower in elevation than adjacent sites and their soils are permanently or seasonally saturated by water.

- Wetlands and riparian areas are natural water filters, removing sediment and other pollutants from the water or preventing pollutants from reaching the water.

Landscape Position:

Landscape position directly impacts the types of plants present on a site.

Upland sites are dominated by plants adapted to the amount of precipitation that occurs in the area. These plants have adaptations that conserve moisture and allow them to withstand periodic drought.

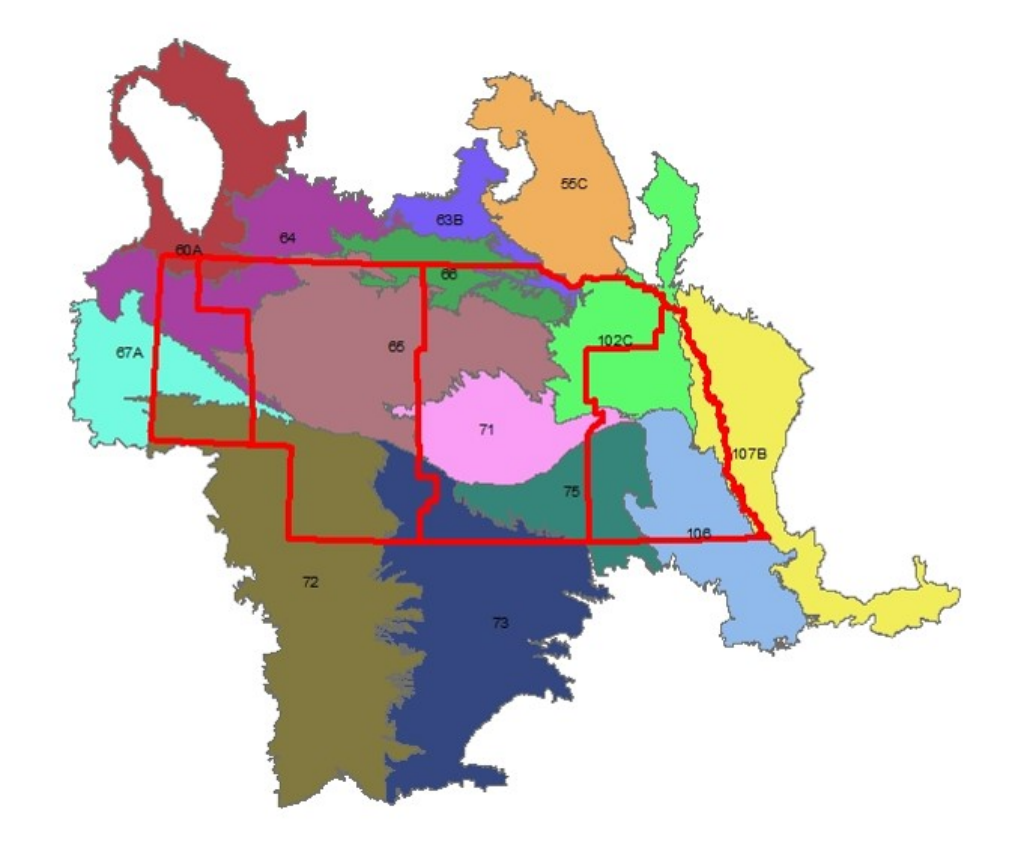
Overflow and floodplain sites can support plants that require more water than is received through precipitation. This additional moisture comes from groundwater or runoff.

Plants that are found on wetland and riparian sites require additional water and produce more biomass than drier sites. The additional water comes from the ground water or runoff. They are tolerant to flooding and soil saturation.

Plant Communities:

The kind, amount and development of vegetation is directly related to soils, hydrology and landscape position. Each of these influences the function and development of the others.

The plant community on an ecological site is characterized by an association of plants that differs from that of other ecological sites in the kind and/or proportion of species and/or total production.



The figure above shows the locations of MLRAs occurring in Nebraska.

Ecological Site Delineation

Ecological sites are described, identified and subdivided on a broad scale by Major Land Resource Areas (MLRA).

MLRAs are geographically based areas that share common land use, topography, elevation, climate, water, soils and vegetation.

There are 13 MLRAs in Nebraska.

Nebraska MLRA's

MLRA's in Nebraska identify distinctive landscapes, soil associations, climate, and productivity.

For example, the Nebraska Sandhills (MLRA 65) is a specific landscape characterized by vegetated, rolling sand dunes in uplands and groundwater fed streams and wetlands in lowlands.

Sands sites in MLRA 65 have a distinctly different plant community in terms of dominant species and productivity as compared to sands sites in other MLRAs.

Ecological Site Delineation

In Nebraska we have 12 general ecological sites which differ in plants and production from one MLRA to another.

In some MLRA's these general ecological sites are subdivided into more specific ecological sites.

For example, in MLRA 60A there are several different types of clayey sites – clayey, claypan, dense clay, and thin claypan.

The 12 general ecological sites will be discussed in detail in lesson 11.

Ecosystem Change

Ecosystems are constantly changing and the ecological sites reflect that change.

Soils, hydrology, and landscape positions are generally stable. The plant communities and associated animal and microbial communities found on ecological sites are dynamic and change with disturbances.

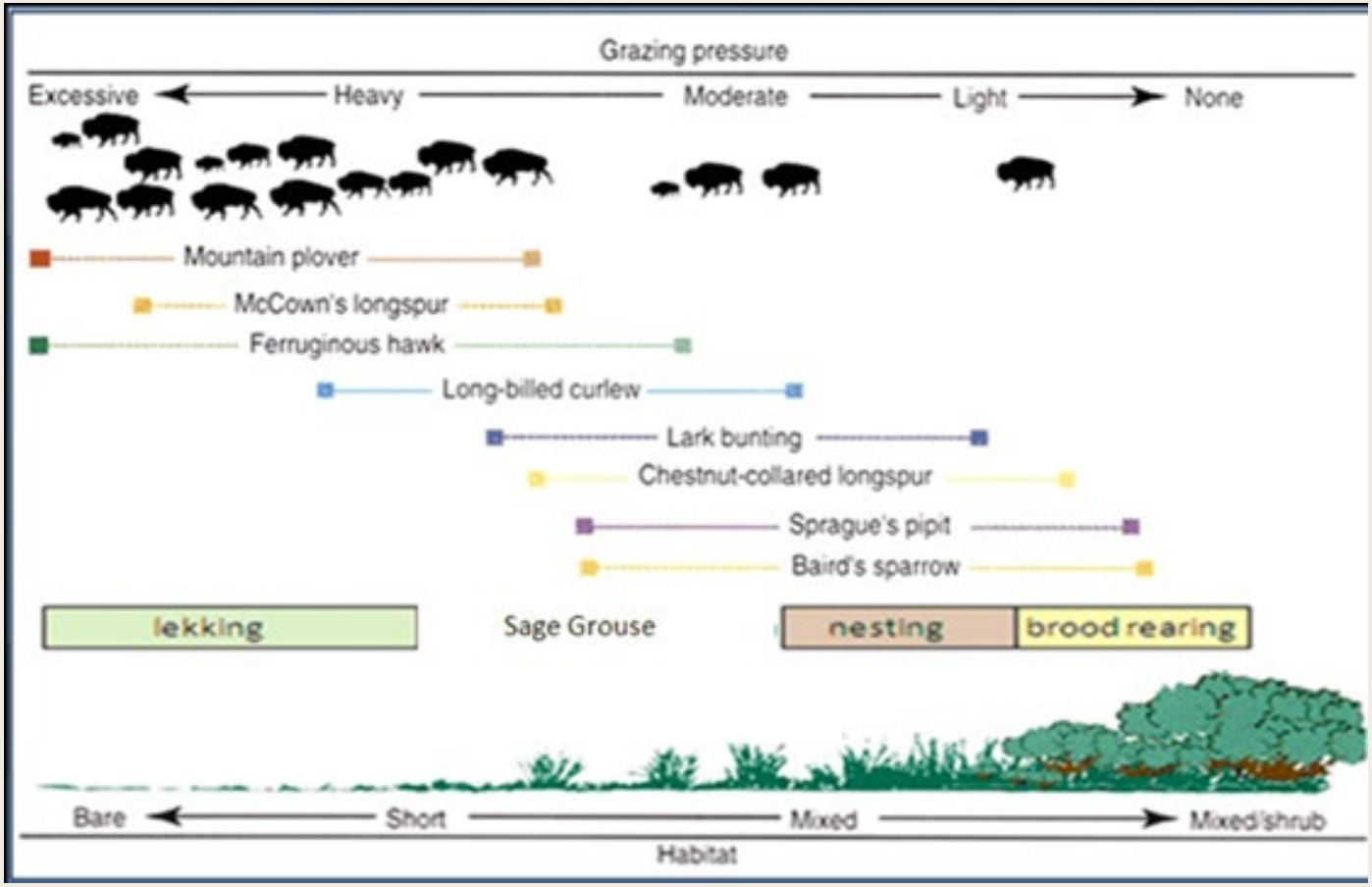
Common disturbances which impact plant communities include periodic drought, different grazing levels, wildfire, periodic above average rainfall and other weather events such as intense hail and early or late freezes.

The degree of ecosystem change depends upon the duration and intensity of disturbances.

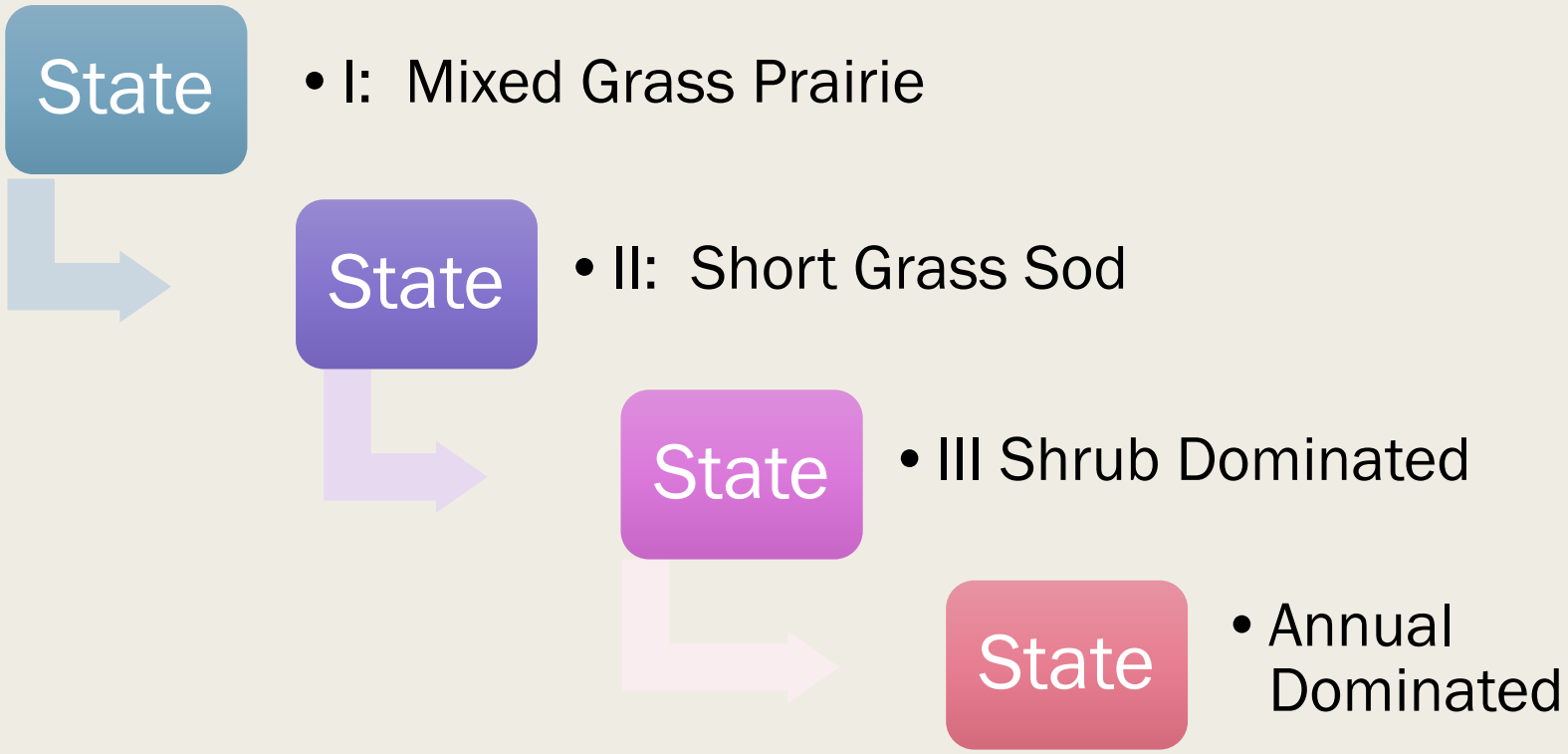
Disturbances

Disturbances can negatively or positively impact the biotic community. Disturbances that are negative to some biotic components may be positive to others.

For example, a disturbance that increases woody cover on rangelands has a negative impact on grassland plants and grassland birds but a positive impact for birds that utilize woody habitat. This change to woody cover will also have a negative impact on forage production and other ecosystem parameters.



Process of Ecosystem Change



Ecosystems are complex systems and so are ecological sites. Most ecological sites have several possible states and several possible plant communities within each state. Each state is a stable, steady state that is resistant to change.

What is a Stable, Steady State?

A stable, steady state is in equilibrium with its soil, hydrology and vegetative components. Each ecological site has several possible states. Each state is recognizable, resistant to change and resilient. Most states have several possible, identifiable plant community phases. The most productive, diverse state is called the reference state.

Within a state, plant communities shift from one to another following community pathways as they are subject to different management strategies and disturbances. The pathways are reversible though grazing management and/or reversal or removal of the disturbance.

If the disturbance is severe or extended, the plant community will eventually cross a threshold and move to a less productive state.

See the example State & Transition Diagram in slide 19.

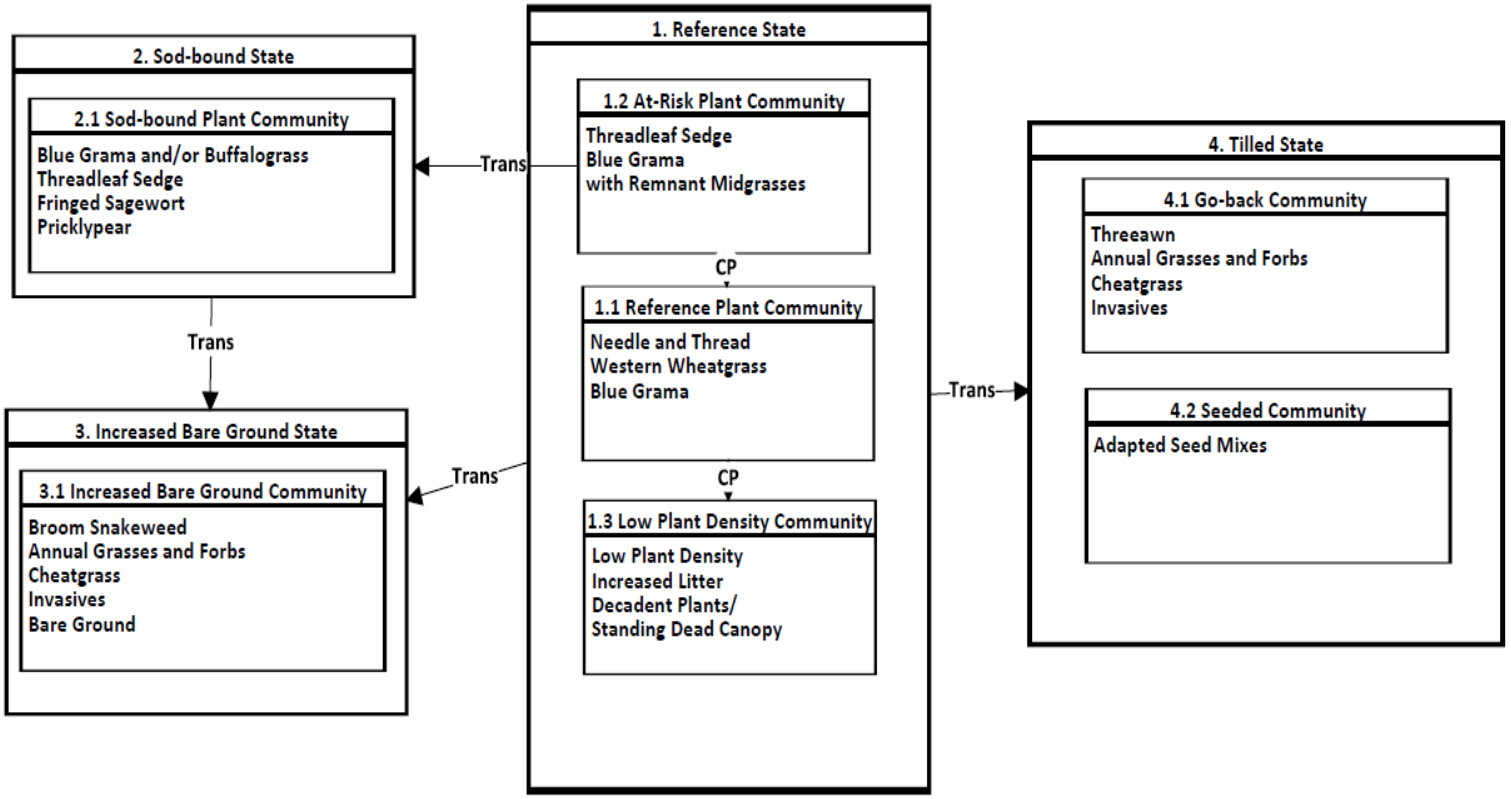
Transitions from State to State

Once the plant community crosses a threshold into a less productive state, it is difficult to return to the reference state. When a threshold is crossed there are often significant changes to soils, hydrologic function, and/or functional plant groups.

Transitions from the reference state to a less productive, less diverse state often include significant loss of topsoil, decrease in infiltration capacity of the soil, or plant communities dominated by invasive plants.

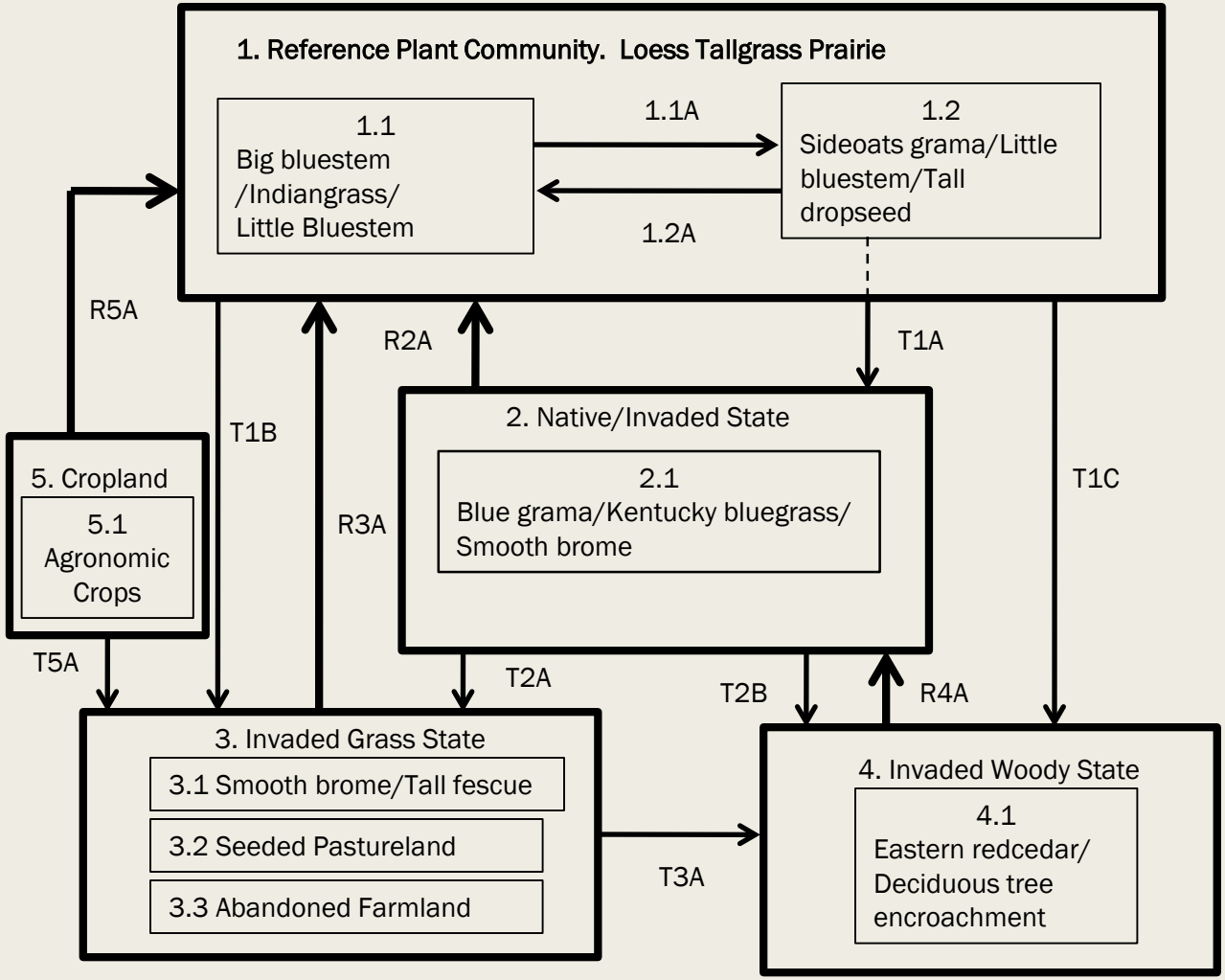
The alternate states are also stable, steady states and restoration to the reference state requires an extensive amount of time, energy and/or money. In many cases, the changes in the ecological processes are so severe that restoration is not possible.

State and Transition Diagrams



Plant community dynamics or change is represented in state and transition diagrams. These diagrams show the known possible states and different distinct plant communities within each state. The diagram legends describe the most common causes of change within the state and from state to state. This S&T diagram is for MLRA 67A Loamy Ecological Site.

S&T DIAGRAM EXAMPLE: CLAY UPLAND – MLRA 106



1.1A - Heavy continuous grazing, undergrazing/utilized, no fire. **1.2A** – Prescribed grazing management. **T1A** – Heavy continuous grazing. **R2A** – Prescribed grazing . **T1B**- Cool season management, reseeding. **T1C** - Heavy continuous grazing, undergrazing/utilized, no fire. **T2A** – Cool season management. **T2B** – No fire. **R3A** – Warm season management, reseeding. **R4A** – Fire, brush management, prescribed grazing management – Fire, brush management, cool season management.. **T5A –** Reseeding or abandonment. **R5A –** Reseeding.

Ecological Site Descriptions

- Ecological site descriptions (ESD) are documents that bring together information about a specific ecological site. The information found in an ESD includes:
  - Soils
  - Hydrology
  - Climate
  - Ecosystem Dynamics
  - Descriptions of State and Plant Communities
- ESD's can be found on-line in the Ecosystem Dynamics Interpretive Tool (EDIT).
- Ecological Site information can also be found in Web Soil Survey which allows the user to delineate a location to obtain a wide range of soils information, including ecological site information.

Activities & References

Activities

- Explore Web Soil Survey and EDIT (see links on right). Use one or both of these tools to learn about ecological sites in your area or the area of the state contest.
- Use this link to view and read the Ecological Site Description for MLRA 65 Nebraska Sandhills, Sands Site High Precipitation: https://edit.jornada.nmsu.edu/page?content=class-description&catalog=3&spatial=121&class=7468#top-bookmark

References

- http://extensionpublications.unl.edu/assets/pdf/ec150.pdf
- https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1068392
- https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/ecoscience/desc/
- Ecosystem Dynamics Interpretive Tool (EDIT)
- Web Soil Survey

END OF LESSON TEN