



# The Role of Data and Inference in the Development and Application of Ecological Site Concepts and State-and-Transition Models

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## On the Ground

- Information embodied in ecological site descriptions and their state-and-transition models is crucial to effective land management, and as such is needed now.
- There is not time (or money) to employ a traditional research-based approach (i.e., inductive/deductive, hypothesis driven inference) to address the unknowns in developing and documenting ecological site concepts.
- We propose that the development of ecological site products is a dynamic task of defining concepts and processes that best explain the available data (i.e., abductive reasoning), and as such a more iterative approach to their development is needed than is currently used.
- Under the proposed approach, ecological site concepts are never viewed as final but only the best representation that is supported by available knowledge and data.
- The natural result of this way of thinking is that products like ecological site descriptions and state-and-transition models should continually be tested and improved as new data become available.

**Keywords:** ecological site, state-and-transition model, inference, scientific method, rangeland management, monitoring.

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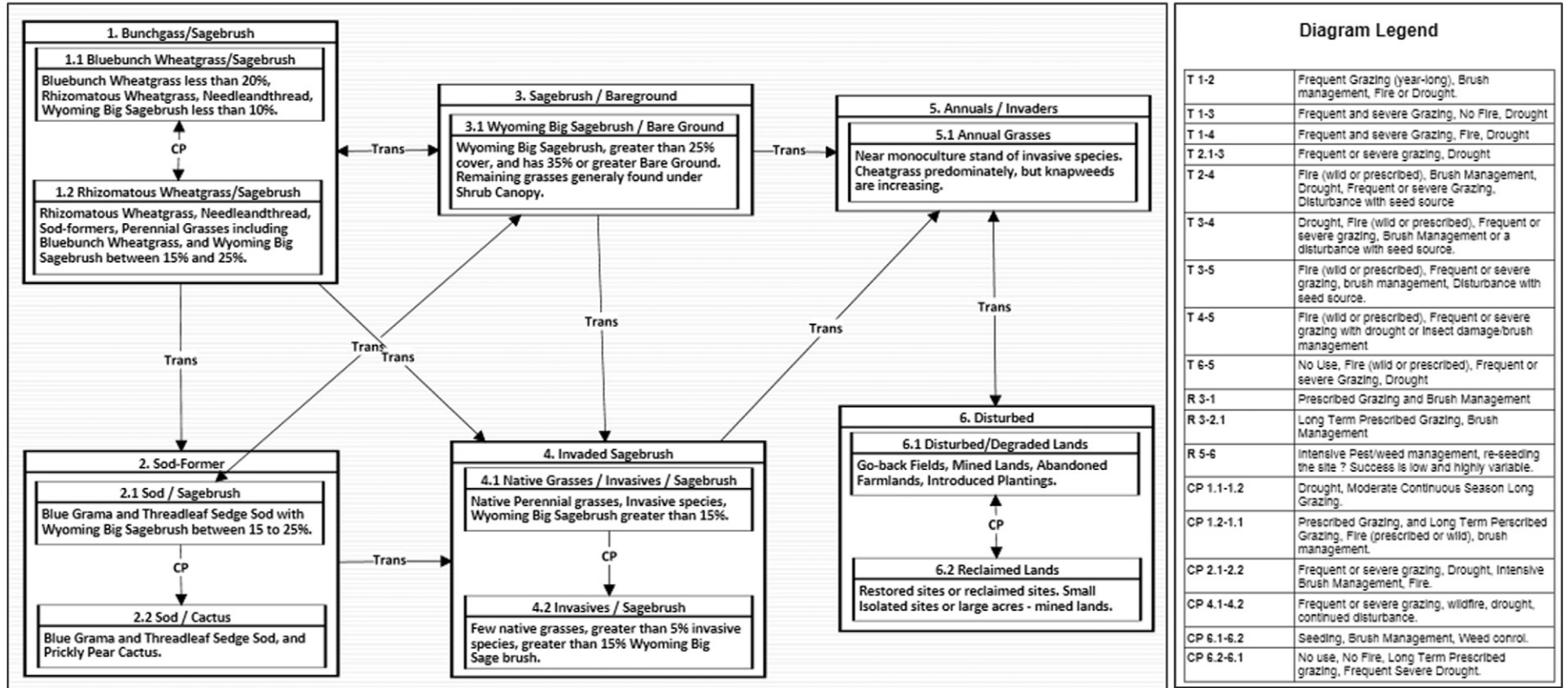
A long-running TV commercial for Tootsie Roll Pops that aired in the United States beginning in 1969 depicted the cartoon story of a boy, Tootsie Roll Pop in hand, asking the wise owl the following question: “Mr. Owl, how many licks does it take to get to the Tootsie Roll center of a Tootsie Pop?”<sup>1</sup> The owl takes the sucker from the boy and replies, “Let’s find out.” After three licks of the sucker, the owl crunches to the center, and responds, “Three!”

An often-asked question regarding development of ecological sites is, “How many data points or plot locations are needed to develop and validate an ecological site concept?” We contend that this question is akin to asking how many licks it takes to get to the center of a Tootsie Roll Pop, and that the answer could range from a very small or very large number depending on the approach and philosophy of the “Wise Old Owl” (ecologist/soil scientist) you ask. Furthermore, we suggest that this is the wrong question entirely because it is predicated on the erroneous ideas that an ecological site concept is static, that a final/conclusive ecological site description (ESD) can be achieved, and that an ecological site concept or its supporting documentation is not useful (or trustworthy) until that final ESD is finished. Rather, we propose that an iterative, dynamic approach to developing data-supported ecological sites and ESDs is needed.

To respond effectively and quickly to resource management concerns, rangeland professionals need information on land potential and expected responses to disturbances or treatment. For this reason, ecological sites are one of the most useful concepts for supporting land management activities.<sup>1</sup> An ESD and its state-and-transition model (STM) describes in concise terms the potential plant communities a site could support (e.g., states and phases) and the processes (e.g., succession, disturbances, management activities) that cause transitions between states.

“**H**ow many licks does it take to get to the center of a Tootsie Roll Pop? The world may never know.” – Tootsie Roll Pop commercial beginning in 1969.

<sup>1</sup> See the commercial at [https://en.wikipedia.org/wiki/Tootsie\\_Pop#Commercials](https://en.wikipedia.org/wiki/Tootsie_Pop#Commercials).



T 1-2	Frequent Grazing (year-long), Brush management, Fire or Drought.
T 1-3	Frequent and severe Grazing, No Fire, Drought
T 1-4	Frequent and severe Grazing, Fire, Drought
T 2.1-3	Frequent or severe grazing, Drought
T 2-4	Fire (wild or prescribed), Brush Management, Drought, Frequent or severe Grazing, Disturbance with seed source
T 3-4	Drought, Fire (wild or prescribed), Frequent or severe grazing, Brush Management or a disturbance with seed source.
T 3-5	Fire (wild or prescribed), Frequent or severe grazing, brush management, Disturbance with seed source.
T 4-5	Fire (wild or prescribed), Frequent or severe grazing with drought or insect damage/brush management
T 6-5	No Use, Fire (wild or prescribed), Frequent or severe Grazing, Drought
R 3-1	Prescribed Grazing and Brush Management
R 3-2.1	Long Term Prescribed Grazing, Brush Management
R 5-6	Intensive Pest/weed management, re-seeding the site ? Success is low and highly variable.
CP 1.1-1.2	Drought, Moderate Continuous Season Long Grazing.
CP 1.2-1.1	Prescribed Grazing, and Long Term Prescribed Grazing, Fire (prescribed or wild), brush management.
CP 2.1-2.2	Frequent or severe grazing, Drought, Intensive Brush Management, Fire.
CP 4.1-4.2	Frequent or severe grazing, wildfire, drought, continued disturbance.
CP 6.1-6.2	Seeding, Brush Management, Weed control.
CP 6.2-6.1	No use, No Fire, Long Term Prescribed grazing, Frequent Severe Drought.

Figure 1. Example STM from the Loamy 5-9 Big Horn Basin Precipitation Zone ecological site (R032XA12WY) in Wyoming.

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