FORECASTING RANGELAND CONDITION WITH GIS IN SOUTHERN IDAHO
Overview and Preliminary Results

Jérôme Théau
theajero@isu.edu

GIS Training and Research Center
Idaho State University
Pocatello, ID USA

Keith T. Weber
webekeit@isu.edu

http://giscenter.isu.edu

Overview and Objectives

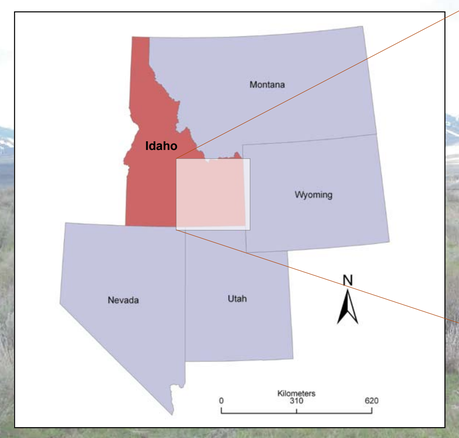
Past research at Idaho State University's GIS Training and Research Center has found that changes in the rangelands of southeastern Idaho can be attributed to three principal agents:
- Fire
- Invasive weeds
- Urbanization

However, Idaho has experienced severe to exceptional drought conditions since April 2001. The potential for drought to change rangelands is significant. Furthermore, without specific and purposeful monitoring of rangeland condition throughout this time period, observed changes could be misinterpreted. These changes to Idaho's rangeland landscape -regardless of the cause (drought, fire, invasive weeds, or urbanization) tend to degrade the health, productivity, and sustainability of rangelands and thereby pose problems for ranchers, range managers, and the economy of the state.

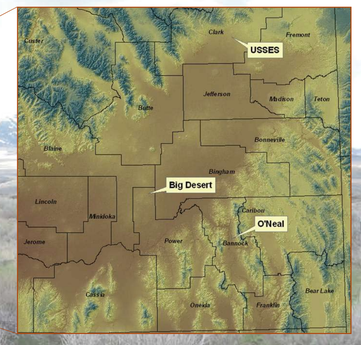
The purpose of this project is to use existing and new data (acquired both from the field and satellite remote sensing) to model rangeland sustainability relative to drought effects in southeastern Idaho at three study areas:
- Big Desert (managed by the USDI BLM),
- US Sheep Experiment Station USSES (managed by the USDA ARS),
- O'Neal Ecological Reserve (managed by Idaho State University).

This three-year project will:
1) examine specific drought effects relative to livestock grazing, rest treatments and bare earth exposure,
2) model and monitor rangeland condition as a function of hydrologic cycling,
3) forecast rangeland condition using cellular-automata/ Markov chain analysis and artificial neural network techniques,
4) continue and advance the GIS Training and Research Center's public outreach program.

Study Area



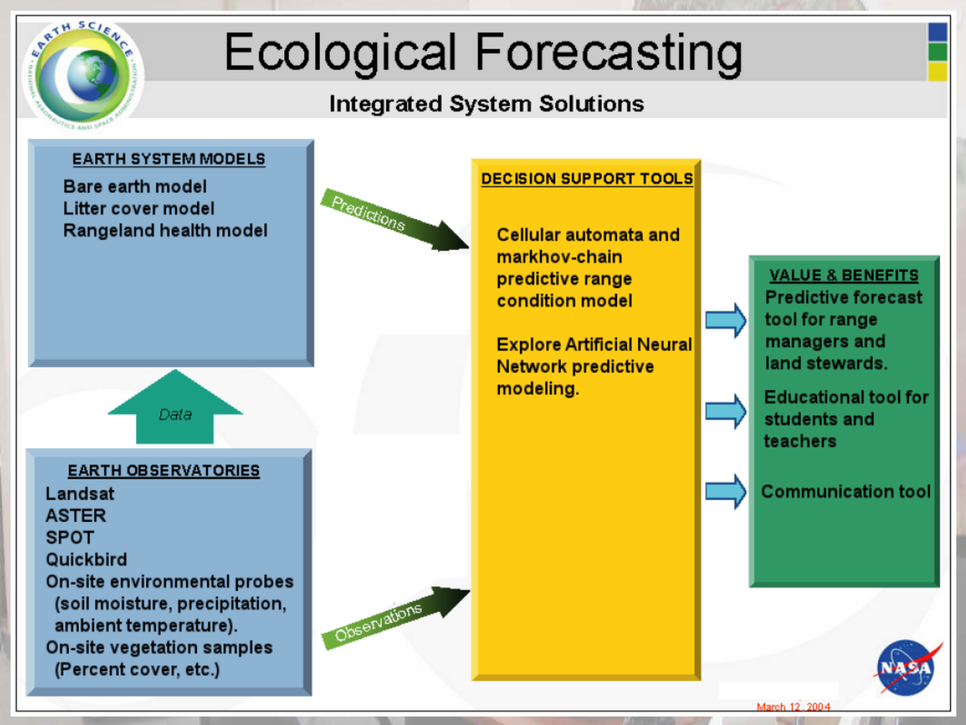
The study area is located in southeastern Idaho.



The O'Neal site will be the primary focus of the project.

The Big Desert and USSES sites will be used to validate models developed at the O'Neal site.

Ecological Forecasting Approach



Contribution of this study to NASA's Integrated System Solution

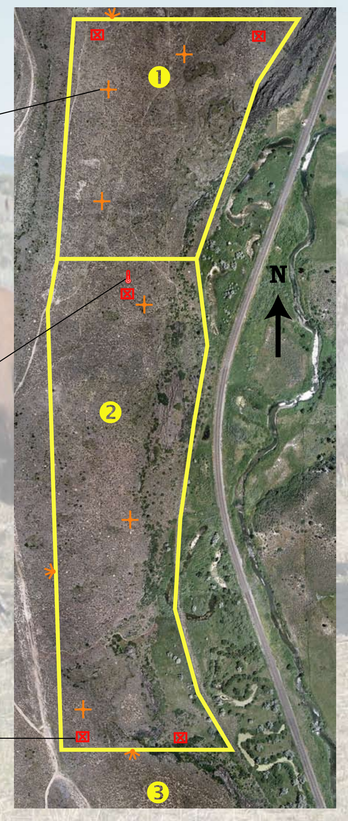
Experimental Design

O'Neal Study area

Soil moisture probes (EC-1O - 10 cm) permanently installed and linked to dataloggers (total of 36 probes linked to 9 dataloggers)

Full weather station recording:
-Wind parameters
- Temperature, UV, and total solar radiation
- Rainfall, humidity

Ground Control Platforms designed to improve geo-registration of images



Grazing treatments to be repeated each year

1. North Pasture 11 ha
   Treatment: High-intensity/Short-duration grazing
   Grazing intensity: 5.97 AU/ha (12 animal days/acre)
2. South Pasture 18 ha
   Treatment: Total rest
   Grazing intensity: 0 AU/ha (0 animal days/acre)
3. BLM (The Bureau of Land Management) Pasture
   Treatment: Rest-rotation grazing
   Grazing intensity: 0.32 AU/ha (6 animal days/acre)

Imagery to be acquired throughout the study

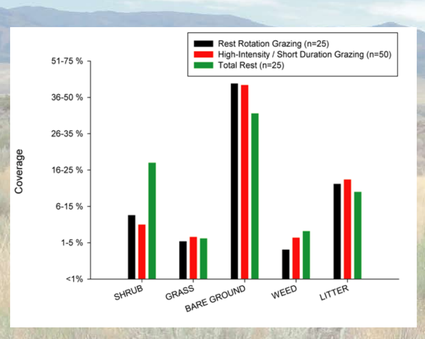
- Digital topo-maps
- NAIP aerial photography (1 m resolution)
- 3Di aerial photography (0.05 m resolution)
- QuickBird (2.44 m and 0.61 m (PAN) resolution)
- SPOT5 (10 meters resolution)

Hand-held soil moisture sensor
(measurement of the spatial distribution of soil moisture)

Bulk-density infiltrometer
(soil compaction analysis)

Preliminary Results

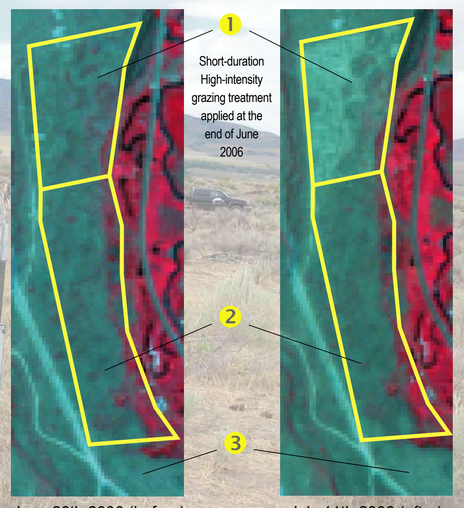
Pre-treatment vegetation inventory
at the O'Neal study area



Results from vegetation sampling in 2005 using randomly located plots within each treatment.

Preliminary analysis showed no statistical differences between vegetation coverage over the O'Neal study area before grazing treatments.

Grazing treatment in 2006
at the O'Neal study area (site 1)



June 20th 2006 (before) July 11th 2006 (after)
False color composites of SPOT5 images (not geo-rectified)

Expected Results and Timetable

- Bare earth exposure and vegetation cover models using remote sensing data
  - developed and tested at the O'Neal study site
  - repeated and validated at the USSES and Big Desert study areas
- Litter type model using remote sensing and GIS data
  - developed to categorize litter as either biodegrading or oxidizing
- Soil surface moisture model using GIS data
  - using artificial neural network
  - using NASA's HYDROS sensor when available
- Rangeland health models
  - using a combination of bare earth exposure, vegetation and litter models
- Predictive model of rangeland health/condition
  - using cellular automata and Markov chain analysis
  - using retroactive data (e.g. older imagery) available for all study sites
  - using artificial neural network predicitve models
- Organization of the annual Geo-spatial and Range Science Conference
- Workshops, field-day events and web site related to the project

Timetable

2006
- Begin imagery acquisition
- Field equipment installation
- Begin environmental monitoring
- Begin field work
- Process 1st year of data

2007
- Complete 1st version of vegetation, bare earth exposure, and litter models
- Complete 1st version of rangeland health model

2008
- Validate and revise modeling techniques
- Complete Forecasting model (Cellular automata/Markov chain)
- Complete manuscripts submission in peer-reviewed journals

Collaborators

Temuulen Sankey, GIS Training and Research Ceneter, Idaho State University
Jacob Tibbits, GIS Training and Research Center, Idaho State University
Corey Moffet, US Sheep Experimentation Station, USDA
Bhushan Gokhale, GIS Training and Research Center, Idaho State University

Partners

NASA
The GLOBE Program
USDA
USSES