IMPACT OF TEMPORAL LANDCOVER CHANGES IN SOUTHEASTERN IDAHO RANGELANDS

EXECUTIVE SUMMARY
SIGNIFICANT FINDINGS AND ACHIEVEMENTS

- Wildfires are commonplace in the West and managing post-fire recovery is important relative to the sustainability of rangeland natural resources and much of the economy of Idaho and the Intermountain West. A key to effective post-fire recovery is the understanding of where high-severity fires have occurred as these areas are most impacted ecologically and most susceptible to erosion and invasion by non-native plants such as Cheatgrass. As a result, high-severity fire areas experience a state of degraded rangeland health that can affect the site for several years.

  To aid land managers and decision-makers we developed accurate and reliable fire severity modeling techniques for semi-arid rangelands which perform better than other techniques commonly applied today (e.g., the normalized burn ratio which was developed for forested ecosystems and later applied to rangelands). This technique uses classification tree analysis and yields overall accuracies exceeding 85% (cf. chapter 9).

  Further research into fire severity modeling demonstrates that the models can be produced using field observations and post-fire imagery only with little loss in accuracy compared to using pre- and post-fire imagery. This greatly reduces the time and costs associated with the production of fire severity models (cf. chapter 10).

- Fire severity investigations using hyperspectral imagery indicate that fire severity can be accurately determined (>70%) for all fire severity classes in shrub-dominated areas. Distinguishing between moderate- and high-severity fires in shrub-dominated areas was challenging. However, moderate-severity fires could not be accurately distinguished in grass-dominated areas (cf. chapter 7).

- Field and hyperspectral remote sensing investigations confirmed that the majority of water repellent soils were found in areas of moderate and high severity fires but that a level of "background" soil repellency was also found within unburned areas as well. Hyperspectral image processing results indicate that water repellent soils could be detected only when using fire severity as a surrogate/proxy (cf. chapter 7).

- Much emphasis has been placed on the use of various vegetation indices derived from remote sensing imagery. Our research demonstrates that proper application and interpretation of vegetation indices relative to *in situ* field conditions is not as straightforward as commonly accepted. Indeed, the relationship between any pair of simple band ratios shows high correlation ($R^2 \geq 0.88$) regardless of the bands involved in the analysis. This suggests the need to further investigate the use, application, and practicality of vegetation indices in general (cf. chapter 13).

- A new technique was discovered using the quotient of two simple band ratios to effectively identify the most photosynthetically active vegetation in an area. This process uses the simple band ratios of the shortwave infrared-green / shortwave infrared-near infrared bands (cf. chapter 13).

- Comparisons of post-fire vegetation indices reveal fundamentally different responses of mountain big sagebrush compared to Wyoming big sagebrush. Changes in the greenness of rangelands are more pronounced and enduring following fire in Wyoming sagebrush compared to mountain sagebrush (cf. chapter 14).

- Understanding and reporting error and bias is critical to the proper and ethical use of geospatial technologies as a decision support tool. We investigated bootstrap resampling as a means to arrive at an accuracy statement with high confidence (i.e., 95%). Our research indicates that numerous iterations (>80) are frequently required to achieve confidence in classification validation (cf. chapter 15).

- Recent research in western rangelands suggests that greater soil loss can occur through wind rather than water erosion. In our previous NASA-funded research, we found little evidence of wind erosion in mountain big sagebrush communities and results presented here (cf. chapter 21) indicates that although substantial soil erosion occurs in the first few months following summer fires in Wyoming sagebrush communities, the re-colonization of burn areas following the first winter is likely adequate to stabilize soils. One of the most extensive and intensive land treatments in southern Idaho is post-fire reseeding for emergency stabilization of soils. In light of our research, the effectiveness of this management practice requires further consideration. We have obtained additional DOD funding to further examine wind erosion and addition funding from the USDI-BLM to investigate vegetation effects on wind erosion.

- Fire, post-fire rehabilitation methods, and some grazing regimes tend to promote grasses at the loss of sagebrush and other native perennial forbs. These changes likely confer benefits to exotic forbs such as leafy spurge. (cf. chapter 20) and these findings support the idea that maintaining an assemblage of functionally diverse native species can minimize weed invasions. Additional funding has been obtained from the USDA to continue this research.

- Several hundred people participated in formal public outreach events sponsored by this study (the annual Geospatial Range Sciences Conference and World GIS Day events) and broadened their knowledge of GIS and remote sensing applications to solve real-world problems. Countless others have benefited from this study, its research results and data sharing as users who have visited the study's website, http://giscenter.isu.edu/research/techpg/nasa_tlcc/template.htm

- As a direct result of knowledge gained at a Geospatial Range Sciences Conference, Massacre Rocks State Park (Idaho) has proposed a change in their land management practices to implement the use of livestock as a management tool instead of using prescribed fire, chemical herbicide/pesticides, and/or passive total rest. This progressive move by the park demonstrates the ability of geospatial technologies and the promulgation of geospatial research to benefit society.

- Three students (Finley, Goh, and Norton) completed their Master of Science degrees with support from this grant and mentoring by its investigators (cf. chapters 6-8 and chapters 17-19). In addition, numerous other graduate and undergraduate students were involved in this study and partially funded to pursue their degree programs while being mentored in geographic information science

- Four papers have been published in peer-reviewed journals, three MS theses have been completed, and six manuscripts are currently in preparation and/or review.