Spatial Analysis Lab
of the
Montana National Heritage Program

Montana Land Information Advisory Council Meeting
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MONTANA Natural Heritage Program

UNIVERSITY OF MONTANA

Spatial Analysis Lab
Background

- Founded in 1991 as Wildlife Spatial Analysis by research professor Roland Redmond.
  - USGS National GAP Analysis Program - Land Cover Data

- 2007: Montana Cooperative Wildlife Research Unit, University of Montana = > Montana Natural Heritage Program (a program of the Montana State Library's Natural Resources Information System operated by the University of Montana)
  - Natural Sciences Building, University of Montana, Missoula

Spatial Analysis Lab
Staff Skillsets

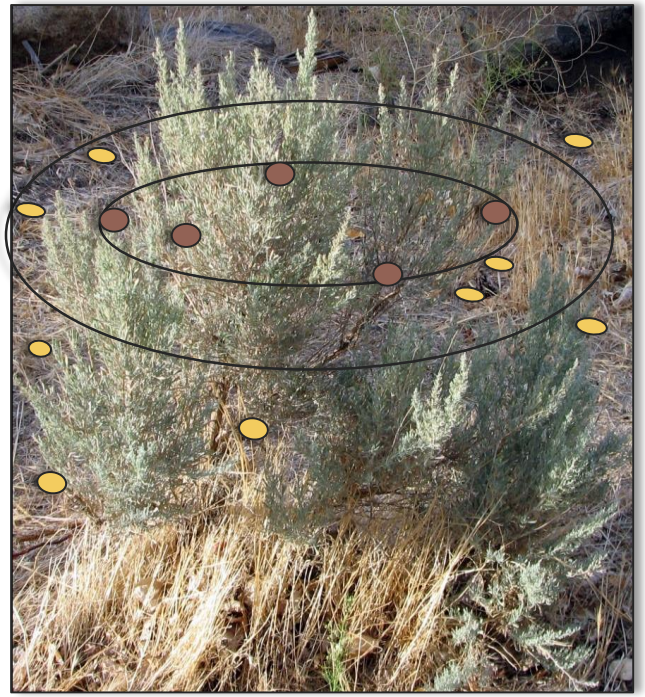
- Habitat and predictive distribution modeling
- Image interpretation (NWI) and processing
- Lidar elevation and vegetation modeling
- Object-based image analysis
- Spatial database management
- Field sampling and surveys
- Imaging spectroscopy for plant chemistry

*Large dataset handling, cloud-based computing

Spatial Analysis Lab

Develop landscape-scale ecological information through partnerships with agency personnel and academia to support effective management of terrestrial, wetland and aquatic communities

- Lead stewardship of MT **land cover** layer
- Assist with stewardship of the wetland and riparian layer
- Elevation Working Group Advisor
  - **Lidar** vegetation returns



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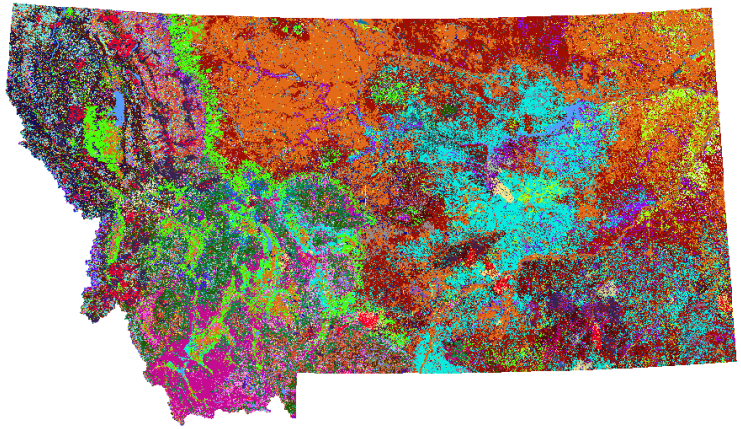
Land Cover

FY 2020 Priority: Develop and adopt a partnership-driven plan for creating and routinely updating a new Land Cover layer that integrates with other MSDI layers



Maintenance and updates
Detailed rangeland characteristics
Temporally dynamic (vs. shapefile download)
Fine scale [+ coarser scale disturbance history]
Interactive tools to visualize change / trends
Multi-date commercial imagery ?

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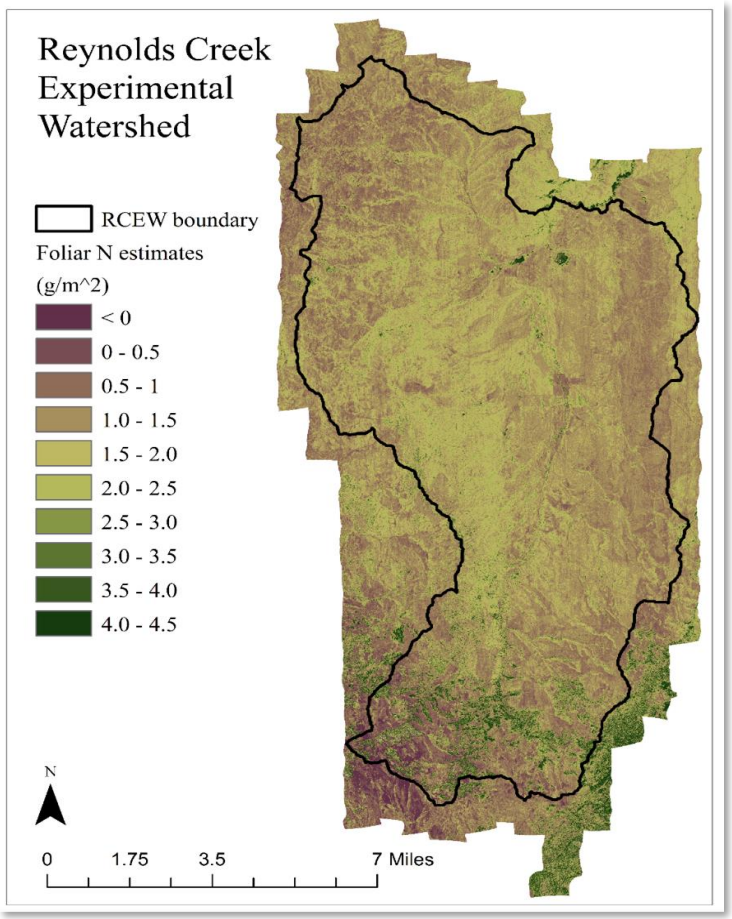
Research: scaling Earth observation data using remote sensing and modeling

- rangeland dietary and habitat quality
- biological invasions
- biodiversity indicators and conservation planning
- forestry monitoring
- decision support tools
- fine scale land use land cover



Spatial Analysis Lab
Funding Pursuits

We are involved with or looking for funding for:

- biodiversity detection & hotspot mapping
- invasive species mapping / modeling
- forage production estimates
- supplemental data collection & instrumentation
- evaluating new evapotranspiration products from ECOSTRESS

Spatial Analysis Lab

Bridge gaps between agency need and academic research

Promote use of geo-technologies in Montana

- provide internship and research opportunities
- generate remote sensing workshop & training material
- grow large dataset handling capabilities

Spatial Analysis Lab

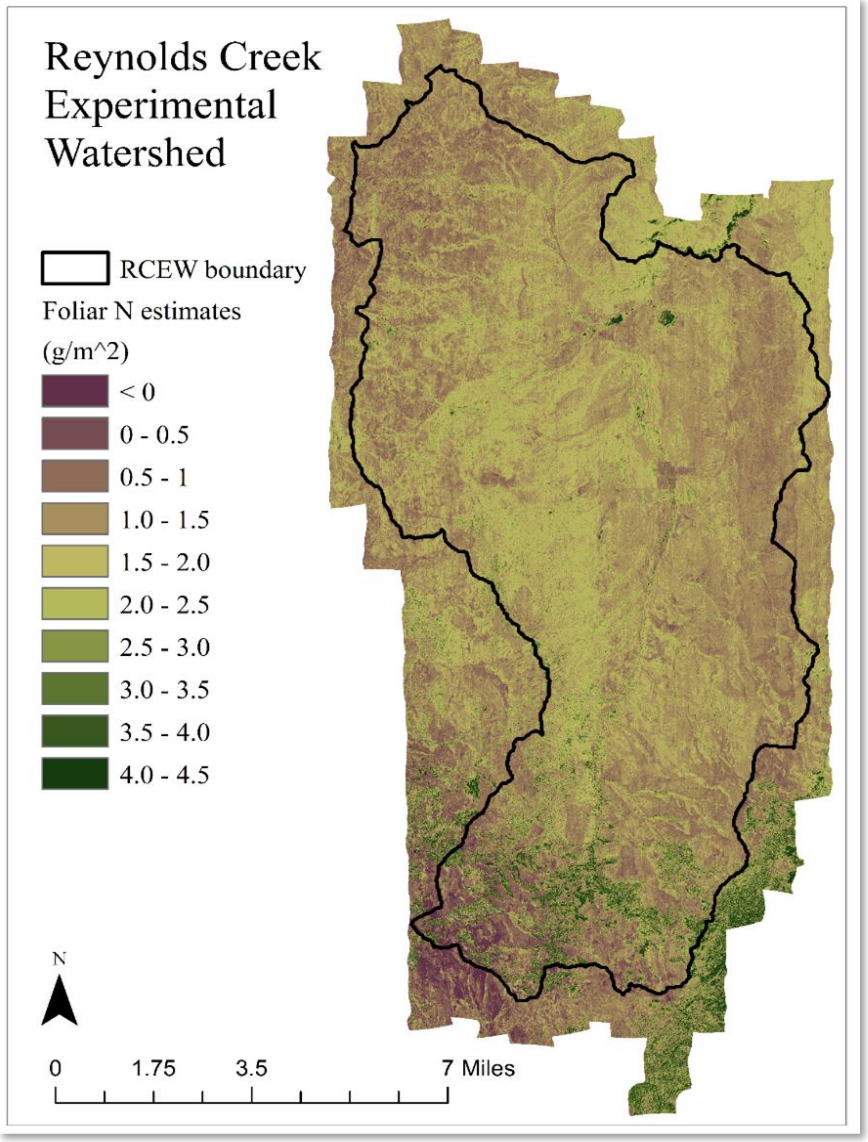
Current & Past Projects

Rangeland dietary and habitat quality

Shrub protein levels are mapped across a sagebrush dominated watershed => forage quality for grasses

Green biomass and live shrub density field data improve watershed mapping of foliar Nitrogen

Scaling method	RMSE	nRMSE	Adj. R^2
Biomass/Density	22.69	25%	0.63
Cover/LMA	0.257	40%	0.58
Height/Cover	10.48	53%	.21
Avg. %N	0.22	12%	.47

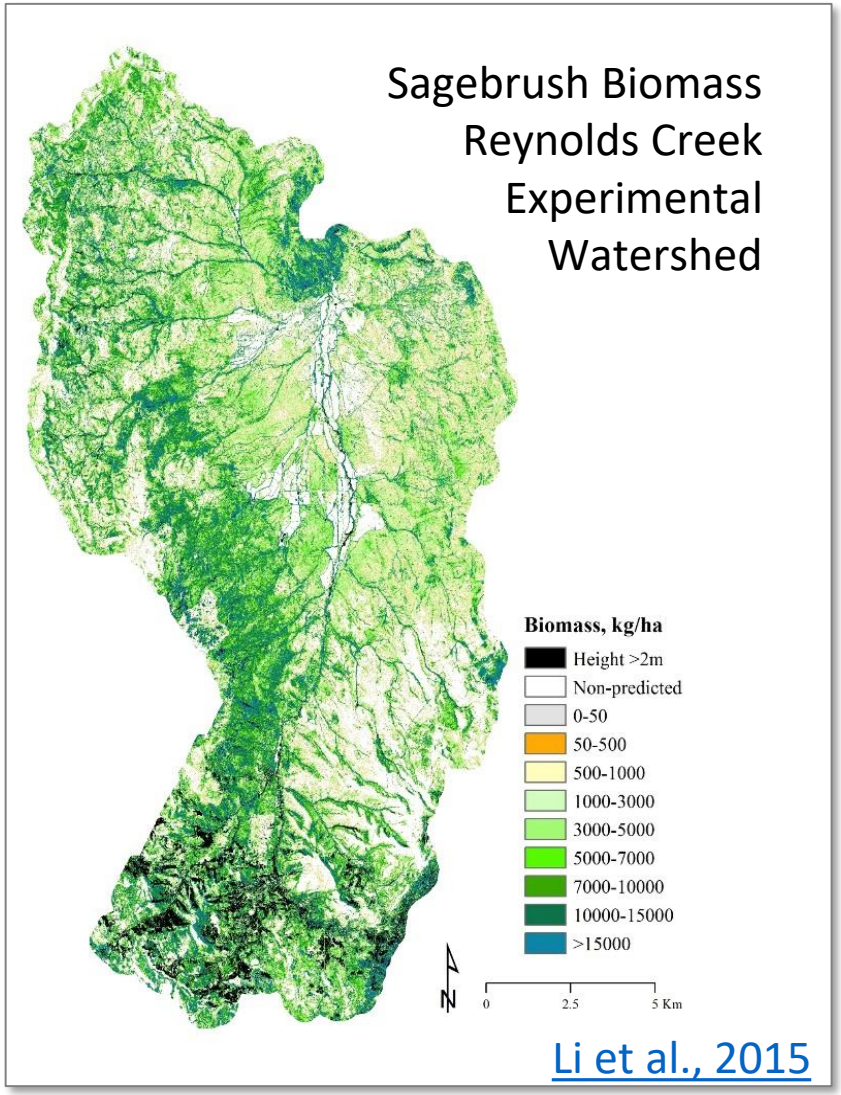


Maloney et al., in preparation

Rangeland dietary and habitat quality

A map of sagebrush biomass was created by scaling ground and airborne lidar measurements

- Major influence on processes such as evapotranspiration and fire disturbance
- Error was 35% of field estimates (45 kg/ha)



Li et al., 2015

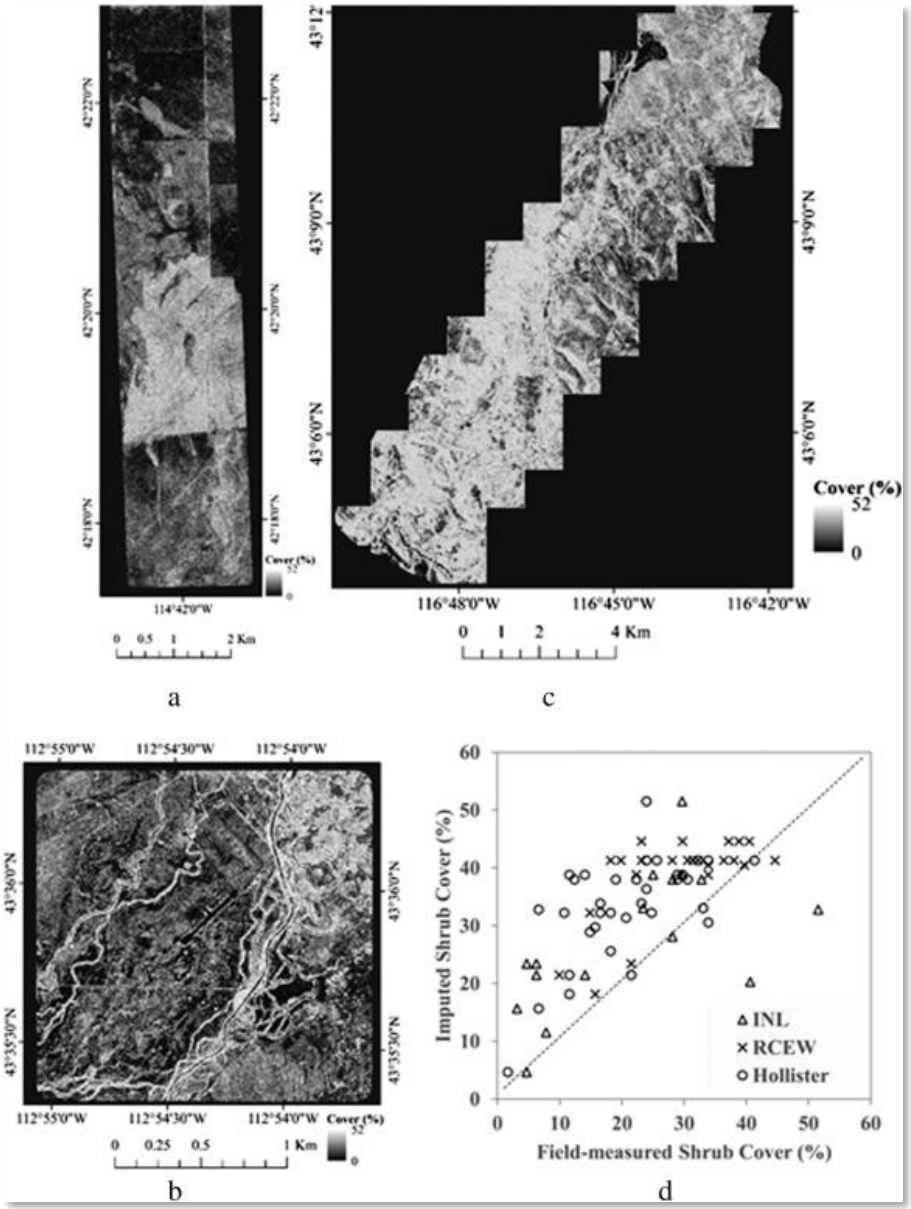
Rangeland dietary and habitat quality

Shrub biomass was mapped by combining field measurements with airborne optical and lidar variables

Lidar variables dominated shrub cover estimation

- Lidar + Optical r^2 = 0.58 (RMSE 7.35)
- Lidar-alone r^2 = 0.49 (RMSE = 8.19)

Spectral variables dominated grass cover estimation



Mitchell et al., 2015

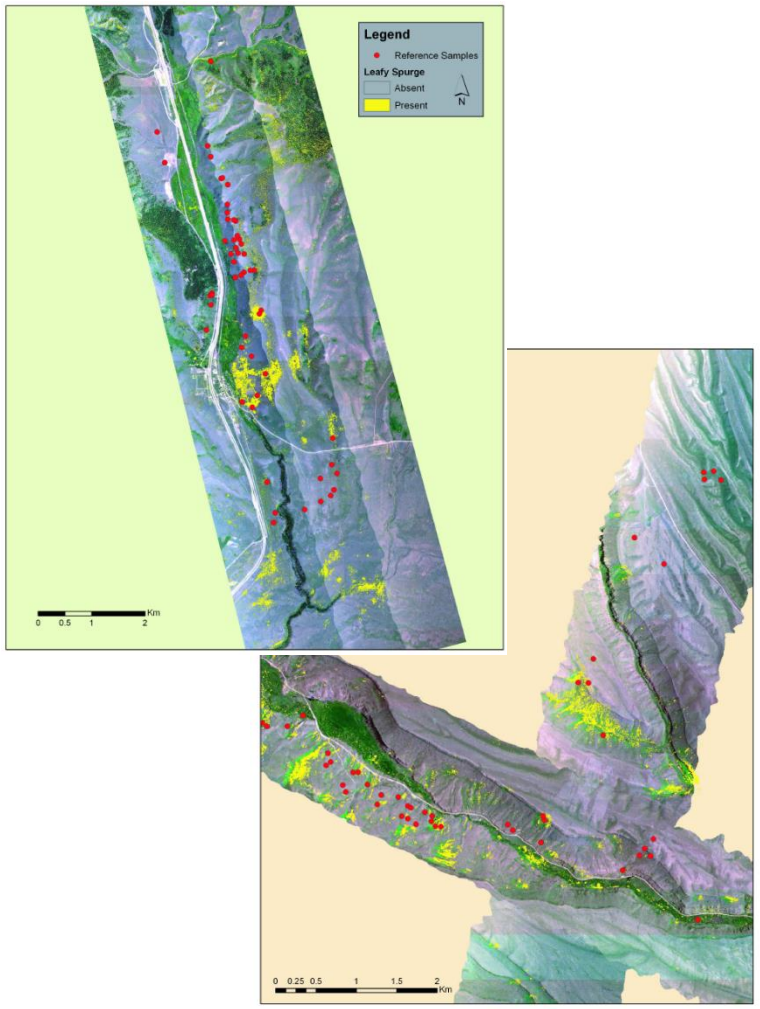
Biological Invasions

Noxious Weed (Leafy spurge) Presence / Absence Mapping

Detecting noxious weed species depends on unique spectral, textural and phenological features

A spectral classification of airborne hyperspectral imagery mapped invasion in difficult to access locations (67-84% accuracy)

Efforts could be extended to larger areas using new point and satellite observations



Mitchell et al., 2009a

Biological Invasions

Cheatgrass Habitat Suitability Modeling

Environmental, climate and remote sensing variables can be combined with occurrence points to prioritize treatment for species that are difficult to remotely detect

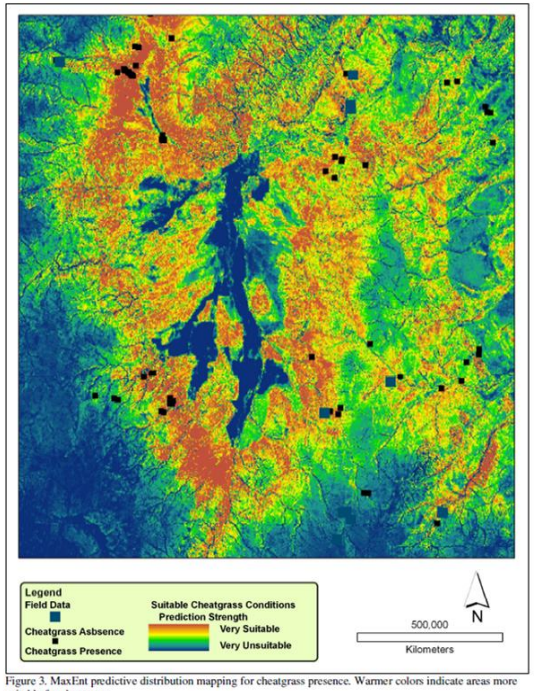


Figure 3. MaxEnt predictive distribution mapping for cheatgrass presence. Warmer colors indicate areas more suitable for cheatgrass.

Suitable Presence

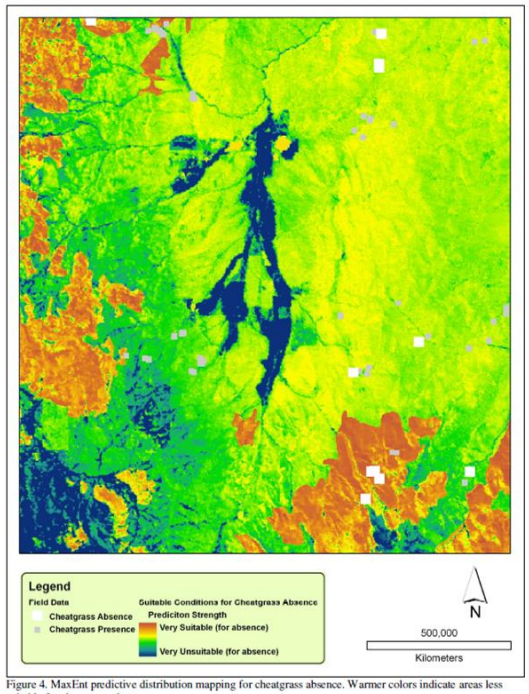


Figure 4. MaxEnt predictive distribution mapping for cheatgrass absence. Warmer colors indicate areas less suitable for cheatgrass absence.

Suitable Absence

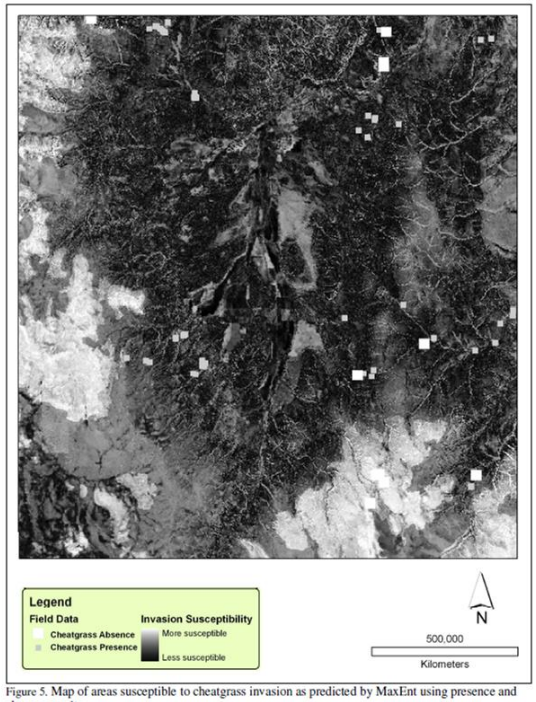


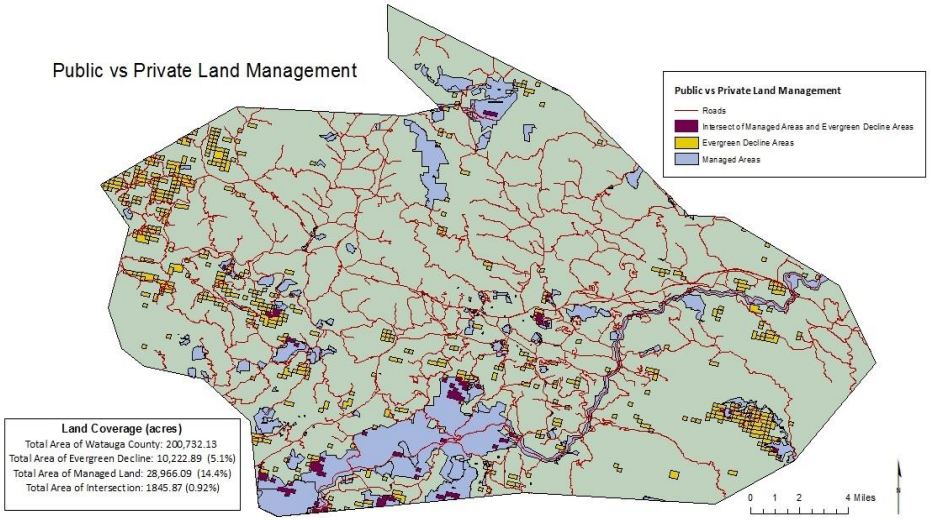
Figure 5. Map of areas susceptible to cheatgrass invasion as predicted by MaxEnt using presence and absence results.

Invasion Susceptibility

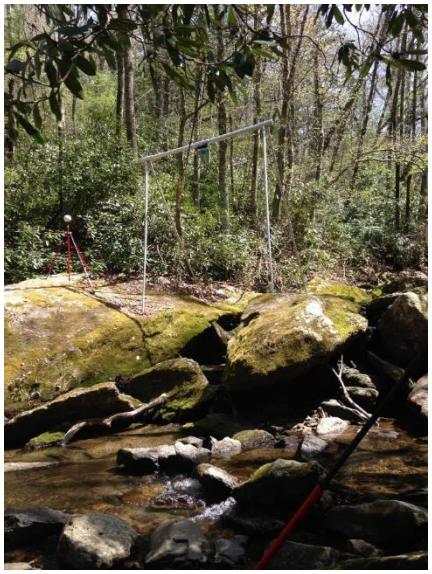
Biological Invasions

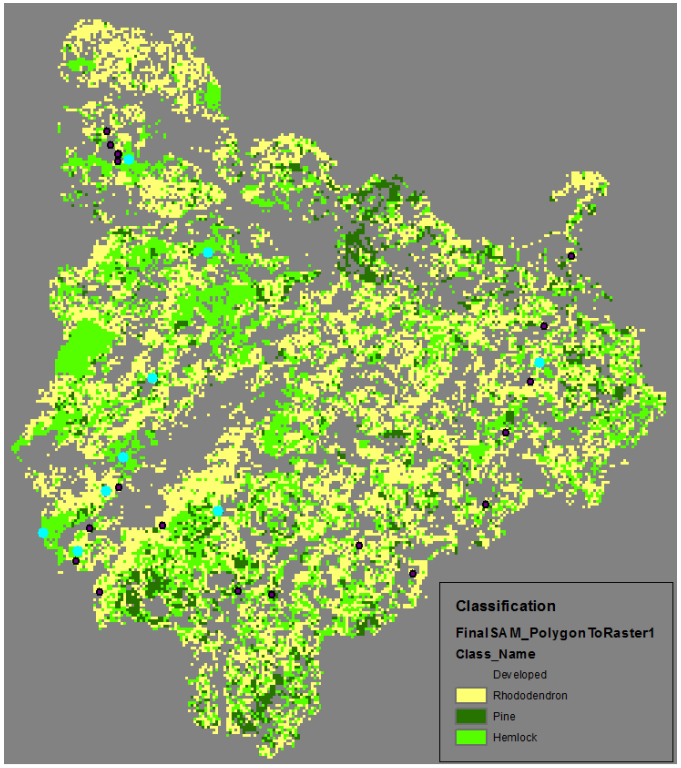
Hemlock Decline

Decline caused by the insect hemlock wooly adelgid can be detected with annual leaf-off NDVI time series



Public and private lands that intersect invasion are locations for studying impacts to the local economy (recreational, property values) and aquatic resources





Biological Invasions

Russian Olive

Naturalization of Russian olive is a serious concern along many local rivers, especially in eastern Montana; we tested the use of high resolution NAIP imagery for mapping its distribution.

- Current Russian olive infestation mapped along eastern MT rivers;
- Predictive model generated to identify areas threatened by colonization;
- Areas of Russian olive increase (new invasions and expansion of existing sites) and decrease (naturally or via active management) identified at the single tree scale.

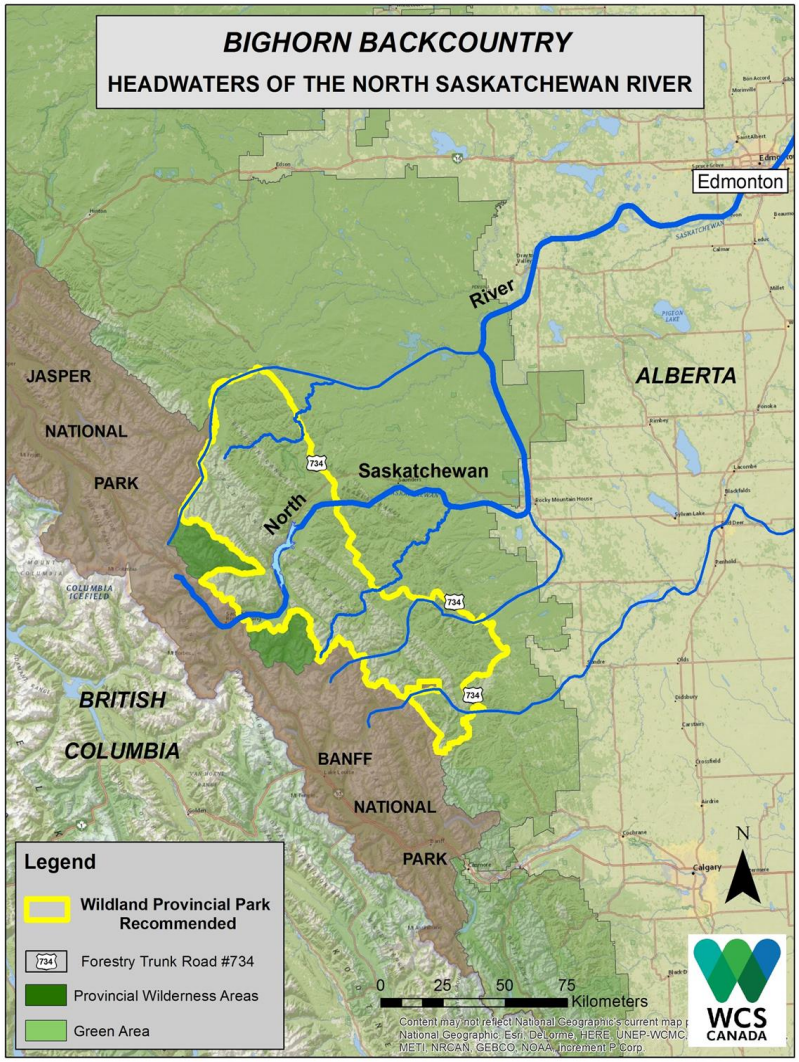
http://mtnhp.org/reports/ECO_EPA_Mapping_Russian_Olive_Stands_2017.pdf

Biodiversity Conservation Planning

Bighorn Backcountry of Alberta

We worked with Wildlife Conservation Society to develop habitat models for vulnerable species and assess conservation value for Provincial lands in North Saskatchewan River, Canada

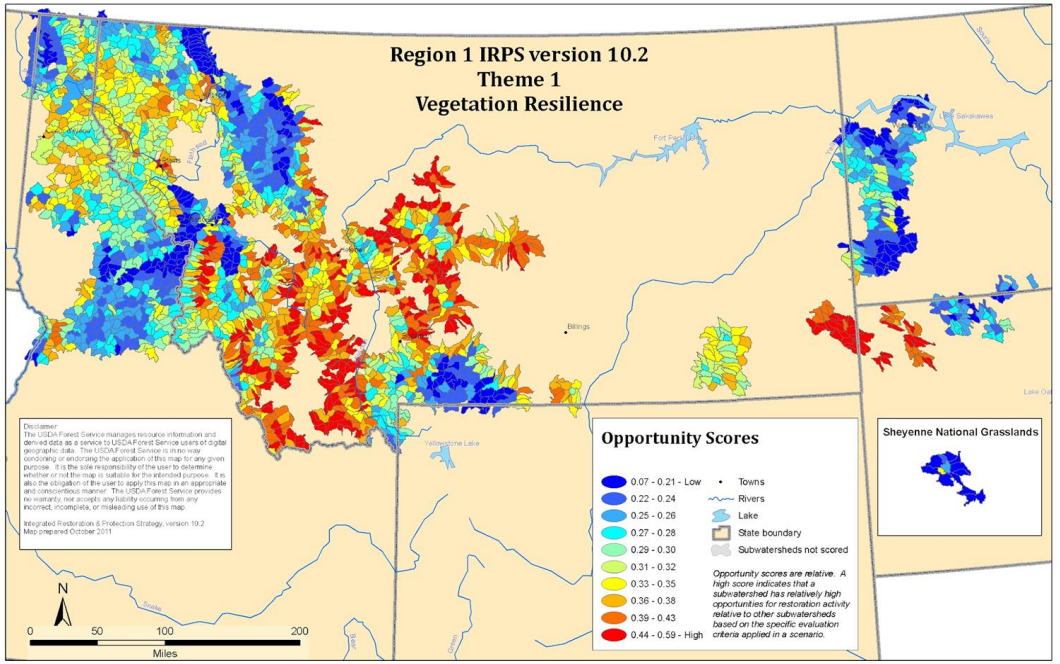
By comparing model outputs with existing conservation areas in the Bighorn Backcountry, we made recommendations for the protection of a significant acreage of currently unprotected land as a new “Wildland Provincial Park”.



Decision Support Tools

USFS Northern Region's Integrated Restoration & Protection Strategy

We assisted with the development of **IRPS**, a region-wide decision support system for prioritizing Forest Service units to address National Forest Plan goals and objectives.



Reynolds, K., B. Bollenbacher, C. Fisher, M. Hart, M. Manning, E. Henderson, and B. Sims. 2016. Decision support for the integrated restoration and protection strategy of the Forest Service, Northern Region. FS-1031. Washington, DC: U.S. Department of Agriculture, Forest Service. 182 p.

Bollenbacher, B.L., R.T. Graham, and K.M. Reynolds. 2014. Regional forest landscape restoration priorities: integrating historical conditions and an uncertain future in the Northern Rocky Mountains. J. For. 112(5):474-483.

Fine Scale Land Use Land Cover

Butte-Silver Bow Urban Area

Objective: map five landcover classes within the Butte-Silver Bow Urban Area Boundary with high accuracy.

Results: Using 1m NAIP imagery and multi-resolution segmentation and classification in eCognition, Barren, Impervious, Grass, Tree and Shrubland, and Water landcover classes were mapped with an accuracy greater than 92%.