Proposal: NC CSC FY2012, USGS CENTER RFP

SECTION 1. PROJECT ADMINISTRATIVE INFORMATION

- *Project title:* **Integrating climate and biological data into land management decision models to assess species and habitat vulnerability: A collaboration for Greater Sage-Grouse and their habitats**
  Short description: A collaboration among USGS, university, and DOI scientists and land managers will be expanded with NOAA/NCPPP to build and assess climate, vegetation, and habitat data layers for sage-steppe communities that are necessary for Greater Sage-Grouse vulnerability assessments. The strength of our approach is to engage resource managers, USGS, NOAA, and university scientists to address the potential climate change vulnerabilities of species and habitat in a collaboration from the start. In addition, we will leverage several concurrently funded projects on scenario analysis (MSU's Computer Science Department), adaptive management for sagebrush vegetation (post-doc at MSU with Institute on Ecosystems), and integrating monitoring of upland vegetation with the three I&M NPS networks and USGS.
- *Lead Agency/Institution/Organization requesting funding:* USGS-Northern Rocky Mountain Science Center
- *Project Lead/Principal Investigator:* Richard S. Sojda, Erik A. Beever, Kathryn M. Irvine, Gregory T. Pederson Sojda (Wildlife Biologist), Beever (Landscape Ecologist), and Irvine (Statistician) lead the sage-steppe element. Pederson (Climate Scientist) is the point of contact with NCPPP scientists, and assists with the sage-steppe elements.
- *Mailing Address:* 2327 University Way, Suite 2, Bozeman, MT 59715
- *Telephone, Fax, and E-mail:* 406.994.1820, [F]406.994.6556; sojda@usgs.gov

SECTION 2. PARTNERSHIPS & COMMUNICATION

- *Description of any collaborative partnerships:* Cathy Whitlock, MSU IoE; Yvette Converse, Tom Olliff, Sean Finn, GNLCC; Rick Nelson, Mike Olson, PPPLCC; Jeff Warren of USFWS I&M; Rick Potts, CMR NWR; Sten Benes, Lewistown Field Office, BLM; Kate Kitchell, BLM State Office, Billings; Andrea Ray, NOAA, Boulder, CO;
  We will collaborate with the Great Northern to participate in their Sage-Steppe forum and will post products to their LCMAP web service.
- *List of additional investigators & affiliations involved in project:* At MSU: Dr. John Sheppard, Computer Science; Dr. Michael Reilly and Donald Greer, College of Business; Dr. Elizabeth Shanahan, Political Science. At UM: Dr. Linda Vance, Montana Natural Heritage Program
- *Potential links to LCC and other DOI Partner Strategic Science needs:* The Great Northern LCC Steering Committee has not yet formally agreed on priority concerns and outcomes, but one being considered is to have "Large intact, resilient landscapes of natural and/or desirable terrestrial and aquatic community assemblages, and to maintain ecological function in the face of stressors." In addition and in combination with neighboring LCCs, the Great Northern LCC is convening a Sage-Steppe Partner Forum to address such specific issues. The PPPLCC continues a similar priority setting process and has currently identified sage-steppe habitats are key to their LCC along with a focus on climate change.
- *Opportunities provided to young researchers and post-docs:* We are currently advertising for a USGS funded postdoc at MSU to work on adaptive management of sage-steppe habitats at John Day Fossil Beds National Monument, and this person will be integrated with our team working on the proposed project. All the PIs serve on graduate committees at Montana State University (Ecology, Land Resources and Environmental Sciences, Mathematical Sciences, Earth Sciences, and Computer Science); Colorado State University (Computer Science); and the University of Montana (Systems Ecology). NOROCK is also the liaison to the Great Northern LCC for the PACE (Postdocs Applying Climate Expertise) program of NOAA and USGS.

SECTION 3. ESTIMATED BUDGET

- *Project Fiscal Contact:* Judy L. O'Dwyer, TEL: 406.994.7544, EMAIL: jodwyer@usgs.gov
- *Total project cost:* If we prorate the existing matching funds 50% to this project, the total cost is 191K
- *Total CSC request:* 124,457: 40.6K salary, 10K travel, 50K university contracts, 10K equipment,13.9K IDC
- *Agency overhead (general indirect costs not directly associated with project):* NOROCK: 0.12567; MSU & UM: 0.175
- *Agency/Partnership matching amount(s)*: 133.5K: 45K USGS funds in university contracts to MSU IoE for Scenario Analysis; 88.5K USGS funds in contract to MSU IoE for Postdoc in Adaptive Management for Sage-Steppe

SECTION 4. PROJECT SUMMARY.

Introduction. We have initiated a collaboration with the USFWS and BLM about Greater Sage-Grouse (*Centrocercus urophasianus*) and their habitats in Montana and throughout the Great Northern and Plains and Prairie Potholes LCCs (Figure 1). Based on preliminary discussions and meetings, we decided to focus our pilot effort on Charles M. Russell National Wildlife Refuge (CMR) and adjacent BLM lands. After our pre-proposal was accepted, we organized a subsequent conference call to garner more specific input. The enthusiasm for the idea of developing a spatial data layer of sage-steppe vegetation and habitat was overwhelming, with one alteration: there was an appeal to expand the pilot area to all of Phillips and Valley Counties (MT) if at all possible based on two factors. First, recent telemetry has demonstrated 100 mile migrations of grouse from breeding areas in Southern Canada to wintering areas on South-facing slopes at CMR, thus demonstrating the need for transboundary and landscape considerations in management scenarios. Second, both the USFWS and BLM have increased their efforts in working with private landowners and grouse management in the matrix of public and private land that is Northern Montana. Furthermore, a recurring theme in LCC priorities has been habitat connectivity across landscapes.

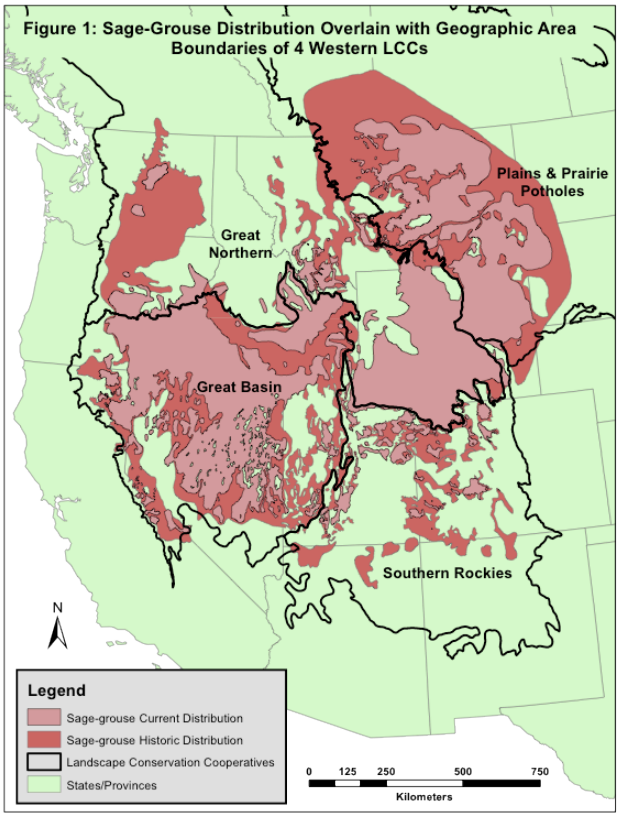

Figure 1. Sage grouse distribution overlain with geographic boundaries of 4 Western LCCs (from USFWS).

The Mountain Prairie Region of the USFWS has proposed a "Sage Grouse Conservation and Landscape Conservation Cooperative Integration Plan" in which three key research questions are posed:

1. *What are the essential habitat parameters in existing high value, occupied habitat with viable sage-grouse populations that will be necessary to sustain populations now and under future climate scenarios?*
2. *Where are those habitat parameters likely to persist in the next 50-100 years given the range of possible climate change scenarios? What conservation actions must we take now to ensure the persistence of those habitat parameters to enable sage-grouse to occupy these areas in the future, including quality, quantity, temporal and spatial juxtaposition, and connectivity?*

3. *How do we assess and maintain the highest level of genetic diversity in future sage- grouse populations to ensure that the maximum genetic diversity and genetic connectivity are retained to enhance adaptability of sage-grouse under the influence of future change factors?*

Our proposed work addresses all three, with the exception of looking at specific genetic aspects of habitat connectivity. We believe that developing an adaptive management framework from the beginning will allow managers to focus their efforts, evaluate them, and learn about the interactions with climate as we progress. Furthermore, this pilot will contribute to the LCCs' Sage-Steppe Partner Forum in a key part of the Greater Sage-Grouse's range (Figure 1) and will address management concerns for one of the currently more abundant segments of the population (Figure 2).

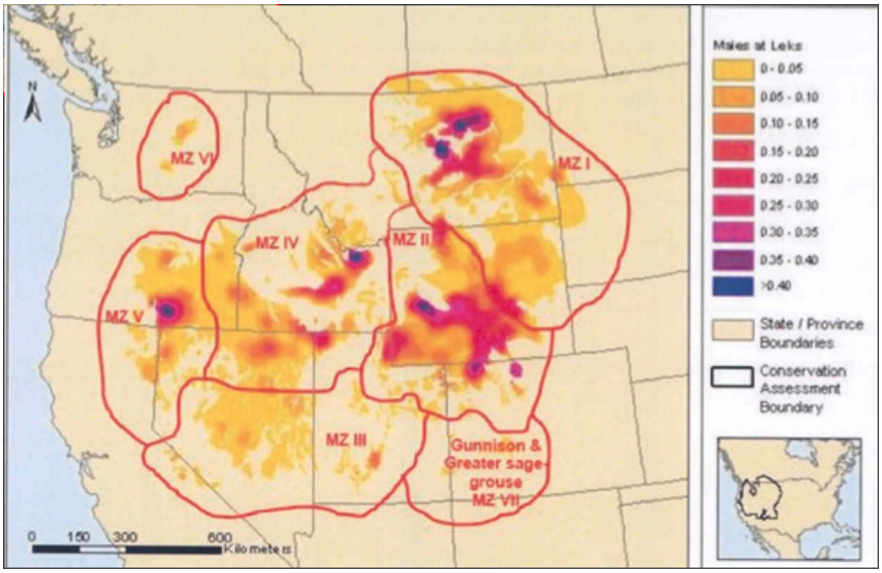

Figure 2. Northcentral Montana is one of the four centers of Greater Sage-Grouse distribution and the heart of the Great Plains Management Zone (from USFWS).

The principal point made by our partners is that all management, climate response modelling, and other Greater Sage-Grouse monitoring efforts are inhibited in Montana by the lack of an accurate and fine-resolution (~5m) sage-steppe habitat layer. So, our project has the following components:

- Understanding the decisions faced by the USFWS and BLM managers
- Framework development for the long-term application of adaptive management
- Production of an accurate, fine-scale sage-steppe vegetation and habitat layer for the pilot area
- Provide guidance on the development of monitoring methods and statistical approaches for evaluating progress on reaching objectives
- Provide a basic understanding of projected regional climate changes, the proper use and suite of available downscaled future climate scenarios available for the region (from CIG, UBC, and USGS), and linkage with NCPPP and PACE (Postdocs Applying Climate Expertise)

Methods.

Strategically, NOROCK is collaborating with CMR NWR and the BLM Lewistown Office to establish an adaptive management program focused on long-term refuge and landscape objectives. We will expand this to include climate scientists from the NCPP and the NC CSC. We are engaging resource managers, USGS, NOAA, and university scientists to address the potential climate change vulnerability of species and habitat as we begin the collaboration.

Workshop with managers

We are listening to our partners and will face head-on their observation that landscape level stressors interact with, and may even outweigh, climate effects on habitat and demography of Greater Sage-Grouse. Any causal relationships, however, must be examined by considering future scenarios that relate to the decision space of field managers, made feasible through the ongoing collaboration with the Montana Institute on Ecosystems (MIoE), specifically MSU's Computer Science Department and Business College. Our existing USGS funded project is entitled: "*Scenario Analysis Using Climate Knowledge for Fish and Wildlife Managers: Exploring and Integrating Artificial Intelligence and Related Probabilistic Graphical Method*s." We will contract with our MSU colleagues in the Business College to organize a workshop designed to identify land management decisions having a nexus with specific projected regional climate change impacts. Prior to that workshop, key managers from FWS and BLM will be interviewed one-on-one to gather additional information regarding decisions being made and how they are made. This will form the basis of the initial portion of the workshop that will delve into these questions further, identifying a suite of management actions that are available for use in species and habitat conservation measures. A conceptual model of their decision processes will be constructed as a key component to recommending an adaptive management framework that would link with climate data, both historic and projected. Another critical component will be to assist our partners in designating the ecological objectives on which their management actions will be evaluated. Our Business colleagues often use term "OODA loop" (for observe, orient, decide, and act) as their version of such a framework. A key analytical component of their approach is that one must progress through the loop faster than the conditions being faced change to foster effective resource management, and this will be assessed. We will begin to consider this in terms of climate data, climate change, and managers' capability for incorporating such new knowledge. And, of course, this relates closely to embracing and working with the non-stationarity in climate data as well as that of the ecological and management response(s). PIs Sojda, Beever, and Irvine will work with the MSU experts in guiding this effort.

We will progress from this portion of the workshop (1.5 days) to a one day training session on understanding climate data and climate change in Western North America with an emphasis on the pilot area. This will include climate scientists from NOROCK (Pederson as lead, and Hostetler), PACE (Towler), and NCPPP (Ray and colleagues).

The final day of the workshop will focus on identifying potential long-term ecological monitoring strategies for evaluating management actions. This will be co-lead by PIs Beever and Irvine (NOROCK) and include Vance (UM).This will include discussion of the sage-steppe vegetation and habitat map.

Climate Information

Assessing species and habitat vulnerability to hydroclimatic change, along with evaluating related management actions, relies on incorporating high-resolution, physically plausible climate data into species or ecosystem response models. This in turn, needs to be combined with knowledge transfer and technical assistance as managers consider how to respond and adapt. We propose to address these needs at the above proposed managers workshop by integrating the expertise of scientists from NOROCK, NC CSC university partners, and the NOAA NCPPP with land managers in the DOI. This portion of the project addresses priorities of the Great Northern and Plains and Prairie Potholes LCCs and seeks to provide statistically and dynamically downscaled future climate scenarios for use in sage-steppe habitats modeling efforts that will initially cover the northern portion of the Greater Sage-Grouse range. Future efforts will seek to expand both the habitat mapping and research on specis vulnerability induced by climate change research throughout Western North America. The proposed study area is a climatically complex region that presents unique climate modeling and downscaling challenges. For example, high-resolution (~4-15 km^2) downscaled climate data is needed that produces realistic warm season precipitation, convection, evapotranspiration, and a physically plausible representation of current and likely future behavior (i.e. position and strength) of the spring low-level jet stream. The high-resolution climate data are needed to match the spatial resolution of the species distribution data, and realistic warm-season hydroclimate scenarios are required because they have been shown to be important for sagebrush persistence (Aldridge et al. 2008, Schrag et al. 2010).

Towards these ends, we intend to work with NCPPP scientists and climatologists within the USGS, University of Oregon, and the University of Washington, to select a subset of the currently available downscaled climate data that best replicates the historic warm-season climatology. These data will then be used in the eventual species

and/or habitat vulnerability models, and also used to produce an ensemble of likely future climate scenarios of specific hydroclimatic metrics (see above) important to the long-term persistence of sagebrush and related components of grouse habitat. For historic climatology we will use the gridded (4 km^2) monthly temperature and precipitation data from the Precipitation-Elevation Regression on Independent Slopes Model (PRISM) dataset (Daly et al. 2008) (http:www.ocs.orst.edu/prism/). The future suite of downscaled climate scenarios we intend to investigate for potential use in species/habitat vulnerability models includes: 1) the 15 km^2 dynamically downscaled datasets from Hostetler et al. (2011, http://regclim.coas.oregonstate.edu/), 2) the 4km^2 bias corrected statistically downscaled suite of climate models with routing through the Variable Infiltration Capacity (VIC) Hydrological model recently produced by CIG for the USFS and GNLCC for modeling efforts in the Upper Missouri Basin (data not yet online; for exmple of methods & datasts see: http://cses.washington.edu/cig/fpt/ccscenarios.shtml), and 3) the Climate WNA 4km^2 bias corrected statistically downscaled suite of climate model data from UBC (Wang et al. 2012; http://www.genetics.forestry.ubc.ca/cfcg/ClimateWNA/ClimateWNA.html).

Sage steppe habitat map

At our Fall 2011 I&M workshop co-sponsored by the GNLCC on sagebrush steppe vegetation monitoring, our partners identified a lack of adequate spatial information for sage-steppe habitat as constituting a challenge attain their conservation priorities. They need a Northern Montana (and beyond) sage-steppe vegetation layer classified from remotely sensed imagery and augmented with current and accurate spatial representations of slope, aspect and human impacts. We will begin by building a prototype layer for Charles M. Russell NWR (CMR NWR) and its adjacent lands covered by the available SPOT imagery cells (Figure 3). The prototype layer will provide a minimum of the 5 vegetation classes needed for Greater Sage-Grouse habitat suitability analysis (e.g., Doherty et al. 2008): sage-steppe (>20% cover of *Artemesia tridentata*), grass, conifer, riparian, and barren. This layer will also support connectivity studies, and can be used as the sampling frame for future monitoring efforts. Specifically, the staff at CMR are currently engaged in analyzing their long-term Greater Sage-Grouse lek data and this layer can provide useful information to them for exploring the possible multi-scale relationships with habitat characteristics. Greater Sage-Grouse telemetry data are also available and this layer can be used by them to better understand habitat use across management boundaries.

Figure 3. Proposed mapping area CMR wildlife refuge and northern areas outside the refuge boundaries covered by 7 SPOT images to be classified into a minimum of 5 vegetation categories: sage steppe, grass, conifer, riparian, and barren.

Current land cover mapping (e.g., NLCD, ReGAP, Landfire) is inadequate for evaluation of Greater Sage-Grouse habitat. All these products are derived from Landsat imagery, which has a 30 meter spatial resolution. This resolution makes classification of interspersed or sparse vegetation –typical of sagebrush steppe communities in this region - especially challenging, because grass, sagebrush, and bare ground all have different spectral signatures (Okin et al. 2001). Furthermore, regional or national map products generally use ground data collected over a broad area as training data, resulting in incorrect classification of pixels where soils or dominant grasses differ from the data collection locations. In an accuracy assessment of the Pacific Northwest ReGAP sage steppe classification for West Central Montana, MNHP researchers found map-producer's accuracy was less than 52%, while user's accuracy was less than 37% (Vance and Tobalske).[1] Furthermore, the underlying imagery for these layers dates from the 1990s.

Classification inaccuracy is often compounded by the classification scheme itself. For example, the NLCD class "shrubland" is defined as being dominated by woody vegetation <5 m tall, with a canopy cover >20% of the total. By contrast, ReGAP and Landfire use ecological systems classifications, with Big Sagebrush Steppe –the only class mapped in the CMR— is defined as having >10% cover of sage and >25% cover of graminoids and forbs. More problematic is the difficulty of applying these classes to Greater Sage-Grouse management. "Shrubland" can include any upland species, e.g., sagebrush, serviceberry, snowberry, gooseberry or rose, and thus does not necessarily indicate which areas are sagebrush dominated. Big sagebrush steppe, having only a 10% sagebrush component, would be unsuitable for either nesting and wintering habitat. Because Greater Sage-Grouse are known to nest and winter in the CMR, we can presume that suitable habitat exists. However, without more precise and accurate mapping, habitat cannot be measured, evaluated or analyzed over a large scale. Even more importantly, the lack of baseline data makes it impossible to follow trends (e.g., conifer encroachment or expansion of non-native invasive species) over time, critical to any climate change projection.

Although current maps are inadequate from a Greater Sage-Grouse management perspective, it is possible to produce more accurate and precise maps of sage steppe habitat using different imagery, local field and telemetry data, and alternative image analysis approaches. Because of the need to distinguish between suitable and unsuitable habitat patches across the landscape, and to assess fragmentation and connectivity, researchers have moved away from the artificiality of pixel-by-pixel classification, and towards object-based image analysis (Stow et al. 2008, Hamada et al., 2011). In object-based image analysis (OBIA), discrete landscape elements are identified through image segmentation prior to classification. This approach is especially effective with higher-resolution imagery. SPOT-5 images classified by the University of Montana MTNHP Spatial Analysis Lab using this approach have been used successfully to evaluate Greater Sage-Grouse winter and nesting habitat in Wyoming (Doherty et al. 2008) and assess the potential impacts of energy development (Walker et al. 2007).

Despite its greater potential for accurate mapping, high-resolution imagery such as SPOT and Quickbird have not been used across large landscapes because of the high acquisition costs. However, in 2011, the USGS bought all the US SPOT-5 images collected across the US, and is making these available at no cost to federal agencies and partners. We have examined the image gallery, and have found that there are multiple dates with cloud-free scenes for the CMR. Moreover, the State of Montana purchased 2011 1-meter four-band aerial imagery covering the entire state. The UM-MTNHP will use this imagery, digital elevation models, soils data, derived slope and aspect models, and effective precipitation models to produce a baseline classification of the vegetation classes necessary for assessing habitat suitability across the CMR. Training data points will be collected from existing data sources (CMR, BLM, UM-MTNHP), and additional points will be collected by UM-MTNHP ecologists using an approach similar to that described by Homer et al. (2008). Once processed, images will be segmented with eCognition 8, and classified with a Random Forest algorithm. This output, augmented by additional spatial information, can be further analyzed for habitat suitability for Greater Sage-Grouse habitat suitability using the

[1] Producer's accuracy is a measure of the accuracy of a classification scheme, based on the percent of a validation set that is correctly classified. It measures omission error (underclassification). User's accuracy measures the reliability of an output map, and measures commission error (overclassification).

methodology outlined in Doherty et al. (2008), with telemetry data inputs specific to northern Montana Greater Sage-Grouse. The end product will be a sage steppe map for the area encompassing adjacent BLM lands and CMR (Figure 3), contained in a file geodatabase that will be made available to the USGS and the USFWS, as well as to interested stakeholders via the Montana GIS Portal. FGDC- and GIS Portal-compliant metadata will be included.

The base sage steppe map can be used to identify areas locally that need to be monitored over time in terms of relevant on-the-ground ecological indicators of suitable habitat for Greater Sage-Grouse and Sharp-tailed Grouse (*Tympanuchus phasianellus*). Although it is important to consider the local management objectives and questions for designing an effectiveness monitoring program into the future, we can leverage the statistical methodology being developed for a joint project with NPS I&M and USGS (P.I. K. Irvine) in this effort as well to achieve landscape-level inferences on trends over time. National Park units in Montana are currently developing or have in place upland vegetation monitoring programs. K. Irvine is developing an analytical framework for modeling the collective vegetation monitoring data as a function of climate/weather and disturbance variables at multiple scales. Specifically, in this project K. Irvine is exploring how to incorporate data gathered using different sampling designs into the same model for trends over time in visually estimated percent cover. K. Irvine is developing a Bayesian hierarchical ordinal model that accommodates sampling design weights. The currency for integrating data collected from different probabilistic sampling designs is using properly adjusted design weights. A design-weight can be thought of as the number of population units represented by the sample (Lohr 2007). We are exploring how to properly adjust the initial design weights to provide proper ecological inferences over a larger landscape. However, the main piece of information is the sampling frame derived locally and then aggregated to the landscape; in this case the habitat layer produced by UM-MTNHP could be used for CMR/BLM such that their data could be included in the future. An interesting emerging issue in long term monitoring is addressing frame errors (e.g., omission and commission errors[1]) and whether these could change as a function of climate change if based on current conditions versus a more static frame developed based on only soils. We can begin to tease apart these important issues collectively with the expertise of climate and ecologists that are a part of this collaborative team.

Anticipated Deliverables

- Managers' Workshop to be scheduled for Summer/Fall 2012
- Workshop report Oct 1, 2012 or one month after workshop conclusion. This will incorporate the information gathered from the interviews prior to the workshop.
- Workshop presentations and training materials made available on NOROCK's website by Oct 1, 2012 or month after workshop conclusion
- Report on adaptive management framework to address transboundary management decisions identified in workshop by Nov 30, 2012 or 2 months after workshop conclusion
- Data transfer and delivery to partners through LCMAP and/or UM-MTNHP and NRIS web services by Dec 31, 2014
- Sagebrush steppe habitat map by Dec 31, 2014.
- Any derived climate data provided to partners will be made available through LCMAP.

Data Management Plan

We will follow the guidelines developed for the "Great Northern Landscape Conservation Cooperative on Information management, delivery, and sharing standards". On the conclusion of the project we will submit instructions on how to access the raw data and derived products through the UM-MTNHP and/or LCMAP to our partners and the NC CSC. Specifically, how the generated data or derived product can be accessed by our partners as a geodatabase for additional analysis and incorporation into their occupancy response models which are currently under-development. Metadata will be FGDC compliant and will meet the metadata requirements for spatial data publication in the Montana GIS Portal, all of which are compliant with USGS standards.

Bibliography

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Data Management Plan

Project Title: Integrating climate and biological data into land management decision models to assess species and habitat vulnerability: A collaboration for Greater Sage-Grouse and their habitats

Data Inputs – Existing Data Collections

1	[Name of Collection]
Description:	▪ Gridded (4 km^2) monthly temperature and precipitation data from the Precipitation-Elevation Regression on Independent Slopes Model (PRISM) dataset (Daly et al. 2008) (http:www.ocs.orst.edu/prism/). ▪ the 15 km^2 dynamically downscaled datasets from Hostetler et al. (2011, http://regclim.coas.oregonstate.edu/) ▪ the 4km^2 bias corrected statistically downscaled suite of climate models with routing through the Variable Infiltration Capacity (VIC) Hydrological model recently produced by CIG for the USFS and GNLCC for modeling efforts in the Upper Missouri Basin (data not yet online ▪ the Climate WNA 4km^2 bias corrected statistically downscaled suite of climate model data from UBC (Wang et al. 2012; http://www.genetics.forestry.ubc.ca/cfcg/ClimateWNA/ClimateWNA.html). ▪ 2011 SPOT-5 images covering study area (multiple dates with cloud-free scenes are available for the CMR). ▪ 2011 1-meter four-band aerial imagery purchased by State of Montana. ▪ digital elevation models, soils data, derived slope and aspect models developed by MT NHP.
Restrictions:	All publicly available

Data Inputs – New Data Collection

1	[Provide a brief name to describe new data collection]
Description:	Training data points will be collected from existing data sources (CMR, BLM, UM-MTNHP), and additional points will be collected by UM-MTNHP ecologists using an approach similar to that described by Homer et al. (2008). For scale, please see Figure 1-3 in the proposal.
Data Management Budget:	Part of UM contract Also see data outputs section as these are linked in production
Protocols:	Montana Natural Heritage Program Standards for training data collection
Quality Checks:	Responsibility of Montana Natural Heritage Program
Exclusive Use:	Two years to accommodate funding years and contractual deliverable schedule
Restrictions:	none
Contact:	Kathryn Irvine, kirvine@usgs.gov 406.994.7492 Linda Vance, livance@mt.gov 406.444.3380

Data Outputs – Deliverables, Datasets and Products

1	Name of Output

Description:	The end product will be a sage steppe vegetation layer for the area encompassing adjacent BLM lands and CMR, contained in a geodatabase. This will be a minimum of five vegetation categories: sage steppe, grass, conifer, riparian, and barren. The training points collected in the field will be made available in a geodatabase. All data will be accessible through the Montana NRIS data portal and the LCMAP portal.
Data Management Budget:	Part of UM contract
Format:	Geodatabase and a minimum five category attribute table for final spatial layer.
Quality Checks:	▪ Producer's accuracy is a measure of the accuracy of a classification scheme, based on the percent of a validation set that is correctly classified. It measures omission error (underclassification). User's accuracy measures the reliability of an output map, and measures commission error (overclassification). These metrics will be calculated for the derived habitat layer. ▪ FGDC- and GIS Portal-compliant metadata will be included.
Exclusive Use:	Project data and associated products should be available publically at the end of the project. If a request to limit access for a period of time after project completion is needed, identify the length of time and the reason for the extension. (Requests of more than two years will not be granted.)
Restrictions:	none
Contact:	Kathryn Irvine, kirvine@usgs.gov 406.994.7492 Linda Vance, livance@mt.gov 406.444.3380 Sean Finn, swean_finn@fws.gov 208.426.2697

Curriculum Vitae of Principal investigators and Key University Collaborators

Integrating climate and biological data into land management decision models to assess species and habitat vulnerability: A collaboration for Greater Sage-Grouse and their habitats

Erik Beever

Kathryn Irvine

Gregory Pederson

Michael Reily

John Sheppard

Richard Sojda

Linda Vance

ERIK ALAN BEEVER

USGS-NOROCK, 2327 University Way, Ste. 2, Bozeman, MT 59715; (406) 994-7670; EBeever@usgs.gov

EDUCATION

Ph.D.	Ecology, Evolution, and Conservation Biology	Univ. of Nevada	Reno, NV, 89557	12/99
B.S.	Biological Sciences; High Honors	Univ. of California	Davis, CA, 95616	6/93

RECENT PROFESSIONAL EXPERIENCE (plus 7 earlier experience blocks)

Research Landscape Ecologist (GS-13), 11/10–Present, *USGS N. Rocky Mtn. Science Center, Bozeman, MT.*

(Status and Trends) Ecologist (GS-13), 10/07–8/10, *USGS Alaska Science Center, Anchorage, AK.*

Quantitative Ecologist (GS-12), 6/05–10/07, *NPS Inv. & Monit. Program, Great Lakes Network, Ashland, WI.*

Ecologist (GS-11), 7/00–6/05, *USGS Forest & Rangeland Ecosystem Sci. Center, Corvallis, OR*. {Postdoc under Dr. David A. Pyke, Research Rangeland Ecologist}.

Postdoctoral Fellow, 1/00–6/00, *Biology Department, University of Nevada, Reno, NV*. {Postdoc under Dr. Dennis D. Murphy, Conservation Biologist}.

Principal Investigator, Graduate Research Assistant, 8/94–12/99, *Program in Ecology, Evolution, & Conservation Biology, University of Nevada, Reno, NV*. Dissertation Advisor: Peter F. Brussard.

RECENT RELEVANT PUBLICATIONS (N_{total} = 57 since Dec. 1999, including 6 currently in review)

Beever, E.A., B. Mattson, M. Germino, M. Post Vanderburg, and J. Bradford. Landscape-scale conservation and management: Why? In what contexts? How? In preparation, *Conservation Biology* [To be submitted Dec. 2011].

Beever, E.A., and J. Belant, Editors. 2011. Ecological consequences of climate change: mechanisms, conservation, and management. CRC Press (Taylor and Francis Group). 314 pages.

Beever, E.A., and A. Woodward. 2011. Design of ecoregional monitoring in conservation areas of high-latitude ecosystems under contemporary climate change. *Biological Conservation* 144(5):1258-1269.

Beever, E.A., and C.L. Aldridge. 2011. Influences of free-roaming equids on sagebrush ecosystems, with a focus on Greater Sage-grouse. *Studies in Avian Biology* 38:273-290. http://sagemap.wr.usgs.gov/Docs/SAB/Chapter15.pdf

Beever, E.A., C. Ray, J.L. Wilkening, P.F. Brussard, and P.W. Mote. 2011. Contemporary climate change alters the pace and drivers of extinction. *Global Change Biology* 17(6):2054-2070.

Beever, E.A., R.J. Tausch, and W.E. Thogmartin. 2008. Landscape- and local-scale responses of vegetation to removal of horse grazing from Great Basin (U.S.A.) mountain ranges. *Plant Ecology* 196(2):163-184.

SUMMARY OF OTHER PROJECT-RELEVANT INFORMATION

- Peer reviewer for 30 scientific journals, 3 presses; grant reviews for NSF, numerous national, intern'l foundations
- Member of 5 scientific societies, 2 IUCN Specialist groups, and 2 research consortia/initiatives
- 83 scientific presentations (including 38 invited) in last 12 years, at local to international scales
- Current member of National Academy of Sciences panel investigating BLM Wild Horse & Burro program
- Field-research experience in 14 habitat types and ecoregions, including High Plains, sagebrush-steppe, salt-scrub
- Field-research experience with **plants** (point-intercept, gap-intercept, line-intercept, Daubenmire, biomass clipping), **soils** (field classification, penetrometer, analysis as covariates), **small mammals** (mark-recapture, fluorescent dye labeling), **ants** (field collecting, enumeration of mounds), **larger mammals** (aerial radio-tracking, pellet counts, scent stations, behavioral observation), **birds** (point counts, mist netting), **bats** (mist-netting, physiological studies), **amphibians** (field identification, dip-netting, call surveys, perimeter searches, occupancy modeling), **reptiles** (field capture, identification, and enumeration), and fishes (seining, electro-shocking, lab experiments).

Curriculum Vita

Kathryn M. Irvine (nee Georgitis)

EDUCATION

Ph.D. Statistics, Oregon State University, 2007
M.S. Statistics, Oregon State University, 2003 (GPA 4.0)
M.S. Ecology and Environmental Science, University of Maine, Orono, 2001 (GPA 3.97)
B.S. Biology, University of North Carolina, Chapel Hill, 1996 (GPA 3.98)

PROFESSIONAL EXPERIENCE

- Statistician, US Geological Survey, Northern Rocky Mountain Science Center, 1/2011-current
- Assistant Professor of Statistics, Department of Mathematical Sciences, Montana State University, 8/2008-12/2010

GRANTS AND CONTRACTS

Integrating local monitoring efforts among high elevation NPS parks to assess climate change impacts on grassland, shrubland, and woodland communities including sagebrush steppe communities,($47,546.54), National Park Service, 2011-2013.

Statistical Assistance on Sample Design and Data Analysis for Vital Signs Monitoring in the Greater Yellowstone Network Inventory and Monitoring Program, ($23,941.00), National Park Service, 2010-2013.

Integrated Analysis, Modeling, and Synthesis of the Impacts of Blister Rust and Mountain Pine Beetle Mortality to Whitebark Pine in the Greater Yellowstone Ecosystem, $50,000, Northern Rocky Mountain Science Center (NRMSC), co-PI with Megan Higgs 2009-2011

PUBLICATIONS (first author only)

Irvine, K.I, E.C. Dinger, and D. Sarr. 2011, A power analysis for multivariate tests of temporal trend in species composition. Ecology 92(10): 1879-1886

Irvine, K. and A. Gitelman. 2011, Graphical Spatial Models: a new view on spatial pattern. Environmental and Ecological Statistics. 18(3) 447-469. DOI: 10.1007/s10651-010-0146-8

Irvine, K. M. and Rodhouse, T. J. 2010, Power analysis for trend in ordinal cover classes: implications for long-

Irvine, K. M., A. I. Gitelman, and J. A. Hoeting. 2007, Spatial Design and Strength of Spatial Signal: Effects on Covariance Estimation, Journal of Agricultural, Biological, and Environmental Statistics, 12:450-469.

Irvine, K. M. and S. A. Woods. 2007, Evaluating Shading Bias in Malaise and Intercept Traps, The Journal of the Acadian Entomological Society, 3:38-48.

In Preparation

Irvine, K.I., et al. Incidence of Mountain Pine Beetle and White Pine Blister Rust in Whitebark Pine within the Greater Yellowstone Ecosystem, to be submitted to Journal of Forest Ecology and Management

Irvine, K.I. et al. A comparison of adaptive sampling designs and estimation methods for autologistic regression: a simulation study using a census of *Bromus inermis.* to be submitted to Environmetrics

BIOGRAPHICAL SKETCH
GREGORY T. PEDERSON

Research Ecologist
U.S. Geological Survey | Northern Rocky Mountain Science Center | gpederson@usgs.gov

(a) Professional Preparation

University of Arizona	School of Natural Resources	Ph.D.	2010
Montana State University	Environmental Science	M.S.	2004
Michigan State University	Botany & Zoology	B.S.	2000

(b) Appointments

2011-present Affiliate Faculty, Laboratory of Tree Ring Research, University of Arizona, Tucson AZ
2010-present Affiliate Faculty, Earth Sciences Department, Montana State University, Bozeman MT
21 Oct 2010 – Present
Research Ecologist, USGS Northern Rocky Mountain Science Center, Bozeman MT
26 Oct 2008- 21 Oct 2010
Ecologist (SCEP) – Student Trainee, USGS Northern Rocky Mtn. Sci. Center, Bozeman MT
2007-2010 PhD Student, School of Natural Resources and the Laboratory of Tree Ring Research, University of Arizona, Tucson AZ
2004-2007 Research Scientist, U.S. Geological Survey - Northern Rocky Mountain Science Center, and the Big Sky Institute at Montana State University
2001-2004 Research Assistant, Big Sky Institute - Montana State University

(c) Publications

Relevant Publications

Pederson GT, ST Gray, CA Woodhouse, DB Fagre, JS Littell, E Watson, BH Luckman, and LJ Graumlich. 2011. The unusual nature of recent snowpack declines in the North American Cordillera. *Science,* 9 June 2011: 1201570 333 (6040), 332-335. Published online 9 June 2011 [DOI:10.1126/science.1201570] http://www.nrmsc.usgs.gov/NorthAmerSnowpack

Pederson GT, ST Gray, TR Ault, W Marsh, DB Fagre, A Bunn, CA Woodhouse, and LJ Graumlich. *2011*. Climatic controls on the snowmelt hydrology of the Northern Rocky Mountains, USA. *Journal of Climate,* 24(6): 1666-1687. DOI: 10.1175/2010JCLI3729.1 http://nrmsc.usgs.gov/NRMsnowmelt

Pederson GT, LJ Graumlich, DB Fagre, T Kipfer, C Muhlfield. 2010. A century of climate and ecosystem change in Western Montana: What do recent temperature trends portend? A view from western Montana, USA. *Climatic Change*, 98: 133-154. DOI 10.1007/s10584-009-9642-y. http://nrmsc.usgs.gov/MTclimate

Ault TR, AK Macalady, **GT Pederson**, JL Betancourt, and MD Schwartz. *2011*. Northern Hemisphere modes of variability and the timing of spring across Western North America. *Journal of Climate*. *24*(15), 4003-4014. DOI: 10.1175/2011JCLI4069.1. http://nrmsc.usgs.gov/SpringOnset

Ault TR, JE Cole, JT Overpeck, **GT Pederson**, S St. George, B Otto-Bliesner, CA Woodhouse, C Dreser. In review. The continuum of drought variability in North America: a proxy-model comparison. *Journal of Climate*, submitted.

Other Significant Publications

Littell JS, ST Gray, **GT Pederson**, CA Woodhouse, A Hamlet. *In prep*. A network of streamflow reconstructions in the Columbia and Snake River systems, USA. *Water Resources Research*.

Saros JE, JR Stone, **GT Pederson**, K Slemmons, T Spanbauer and CE Williamson. *In press*. Merging neo- and paleoecological approaches to decipher the response of lakes to climate change over the last millennium. *Ecology Letters*.

Davidson JE, LJ Graumlich, E Rowland, **GT Pederson**, DD Breshears. 2012. Leveraging modern climatology to increase adaptive capacity across protected area networks. *Global Environmental Change*, pp. 1-7. 10.1016/j.gloenvcha.2011.10.002.

Muhlfeld CC, J Giersch, FR Hauer, **GT Pederson**, DP Peterson, CC Downs, DB Fagre. 2011. Climate Change Links Fate of Glaciers and an endemic alpine invertebrate. *Climatic Change Letters, 106*(2), 337-345. DOI 10.1007/s10584-011-0057-1

VITA
MICHAEL D. REILLY

225 N. Broadway
Bozeman, MT 59715
Phone: (406) 624-6533
Cell: (406) 579-0901

College of Business, Montana State University
Bozeman, MT 59717
Phone: (406) 994-2090
mreilly@montana.edu

PERSONAL DATA

Date of Birth: March 1, 1950 Place of Birth: Laramie, Wyoming
Married: Three grown children

EDUCATION

The Pennsylvania State University, Ph.D. November 1980, Major: Marketing
The Pennsylvania State University, MBA March 1976, Major: Marketing
The University of Delaware, BA May 1973, Majors: Psychology and Sociology

EMPLOYMENT HISTORY

Professorial
Professor of Marketing, Montana State University, 9/91 to present
Marketing Option Coordinator, Montana State University, 9/05 to 9/08
Visiting Professor, teaching Strategic Management at the International Business School at Vilnius University, Vilnius Lithuania, summer program 2001 to 2005
Associate Professor of Marketing, Montana State University, 6/84 to 9/91
Assistant Professor of Marketing, University of Arizona, 9/79 to 5/84
Instructor of Marketing, Pennsylvania State University, 9/78 to 6/79

Other
Co-founder and Partner, Northstar Consulting Group, Bozeman Montana, 4/99 to 1/04. This consulting group grew to $430,000 in revenue during my tenure there. I sold my half to my partner in January 2004.

Marketing Director, MSU TechLink Center a NASA-MSU Partnership in Technology Transfer and Commercialization. Full time (during Sabbatical) 96/97 Academic Year.

Consulting
Consultant to a large number of engagements over a 30+ year period, both at North Star Consulting and as an independent consultant. Specialties include B2B marketing analysis and planning, strategic marketing, and market analysis for new technology and products. Clients and have tended to focus on small and medium sized for profit enterprises, plus some large not-for-profits and government agencies. I've served as an expert witness in cases involving damage estimation, marketing diligence, pricing and taxation issues.

RESEARCH

Basic Marketing Theory, Entrepreneurship and Technological Innovation, Market Analysis for Innovations, Cultural and Social Influences on Consumer Buying. Over 20 referred journal articles and 30 refereed proceedings.

TEACHING

Thirty plus years teaching experience in Marketing and Management. Over 15 different courses. Winner of College and University teaching Awards.

Biographical Sketch—John W. Sheppard, Ph.D., FIEEE

Professional Preparation

- Southern Methodist University, Computer Science, B.S., *magna cum laude* (1983)
- The Johns Hopkins University, Computer Science, M.S. (1990) and Ph.D. (1997)

Appointments

- RightNow Technologies Distinguished Professor and Associate Professor, Department of Computer Science, Montana State University, Bozeman, MT, 2008–present.
- Associate Research Professor, Department of Computer Science, The Johns Hopkins University, Baltimore, MD, 2008–present.
- Assistant Research Professor, Department of Computer Science, The Johns Hopkins University, Baltimore, MD, 2005–2008.
- Corporate Fellow, ARINC Incorporated, Annapolis, MD, 1986–2005.

Selected Recent Publications (selected from over 150)

- Liessman Sturlaugson and John W. Sheppard, "Sensitivity Analysis of Continuous Time Bayesian Networks Using Perturbation Realization," submitted to *International Conference on Uncertainty in Artificial Intelligence*, March 2012.
- Jesse Berwald, Tomáš Gedeon, and John Sheppard, "Using Machine Learning to Predict Catastrophes in Dynamical Systems," *Journal of Applied Computational Mathematics*, Vol. 236, Issue 9, March 2012, pp. 2235-2245.
- Brian Haberman and John W. Sheppard, "Overlapping Particle Swarms for Energy-Efficient Routing in Sensor Networks," *Wireless Networks*, Online First, Springer, December 2011.
- Douglas Galarus, Rafal Angryk, and John Sheppard, "Automated Weather Sensor Quality Control," to appear in *Proceedings of the Florida Artificial Intelligence Symposium (FLAIRS)*, 2012.
- Karthik Ganesan Pillai and John W. Sheppard, "Overlapping Swarm Intelligence for Training Artificial Neural Networks," *Proceedings of the Swarm Intelligence Symposium (SIS)*, 2011 IEEE Symposium Series on Computational Intelligence, Paris, France, April 2011.
- Hasari Tosun and John Sheppard, "Incorporating Evidence Into Trust Propagation Models Using Markov Random Fields," *Proceedings of the 3rd International Workshop on Security and Social Networking (SESOC)*, IEEE International Conference on Pervasive Computing, March 21, 2011, pp. 336-342.
- Shane Strasser, John Sheppard, Michael Schuh, Rafal Angryk, and Clemente Izurieta, "Graph-Based, Ontology-Guided Data Mining for D-Matrix Model Maturation," *Proceedings of the IEEE Aerospace Conference*, Big Sky, MT, March 2011.

Synergistic Activities

- Direct the MSU Numerical Intelligent Systems Laboratory, performing research on numerical, semantic-based methods for artificial intelligence and machine learning. Currently advise nine graduate students (seven Ph.D. and two M.S.).
- Serve as subject matter expert for the Department of Defense Automatic Test System Framework Working Group defining standard interfaces for ATS based on semantic definitions and semantic interoperability.
- Serve as official liaison between the IEEE Computer Society Standards Activities Board and the IEEE Standards Coordinating Committee 20 (SCC20) on Test and Diagnosis for Electronic Systems.
- Serve as Working Group Chair of the SCC20 Diagnostic and Maintenance Control Working Group.
- Developed novel model-based diagnostic algorithms and created associated semantic models that led to adoption of multiple IEEE and IEC standards. Resulted in election as an IEEE Fellow "for contributions to system-level diagnosis and prognosis."

Richard S. Sojda, Wildlife Biologist
Northern Rocky Mountain Science Center – USDI Geological Survey, Bozeman, MT
Affiliate - Departments of Ecology and Computer Science, Montana State University
Science Coordinator - Great Northern Landscape Conservation Cooperative
Branch Chief - NOROCK Climate, Land Use, and Decision Support
Fellow, International Environmental Modelling and Software Society [elected 2011]

Expertise:
- integration of climate science and landscape conservation
- waterfowl and wetland ecology
- public land management
- decision support, ecological ,modelling, artificial intelligence: multiagent systems, machine learning, expert systems, Bayesian belief networks

Education:
B.S. 1974. Cornell University. Natural Resources; M.S. 1978. Iowa State University. Wildlife Biology; Ph.D 2002. Colorado State University. Forest Sciences.

Professional Experience:
- 96-present: Wildlife Biologist, current position
- 90-96: Wildlife Biologist - Information Transfer Center, USFWS/NBS, Fort Collins, CO
- 79-90: National Wildlife Refuge System, various positions as Wildlife Biologist and Assistant Refuge Manager (MO, KS, IA, NE, MN, VA, MD, DE)
- 74-76: Regional Extension Specialist, NY Sea Grant, Cornell University, Brockport, NY

Selected Publications:

Sharp, J.L., R.S. Sojda, M.C. Greenwood, D.O. Rosenberry, and J.M. Warren. 2012. Statistical classification of vegetation and water depths in montane wetlands. Ecohydrology.

Greenwood, M.C., R.S. Sojda, J.L. Sharp, R.G. Peck, and D.O. Rosenberry. 2011. Multi-scale clustering of functional data with application to hydraulic gradients in wetlands. Journal of Data Science 9:399-426.

Sojda, R. S. 2007. Empirical evaluation of decision support systems: needs, definitions, potential methods, and an example pertaining to waterfowl management. Environmental Modelling and Software 22(2):269-277. [Best Decision Support Paper Award, 2007]

Sojda, R. S. 2004. Empirical evaluation of decision support systems: concepts and an example for trumpeter swan management. *In*: Pahl-Wostl, C., Schmidt, S. and Jakeman, T. (eds) iEMSs 2004 International Congress: "Complexity and Integrated Resources Management". International Environmental Modelling and Software Society, Osnabrueck, Germany. http://www.iemss.org/iemss2004/proceedings/iEMSs2004_vol2.pdf .

Sojda, R. S., J. E. Cornely, and L. H. Fredrickson. 2002. An application of queuing theory to waterfowl migration. in: Rizzoli, A. E., and A. J. Jakeman. eds. Integrated Assessment and Decision Support: Proceedings of the First Biennial Meeting of the International Environmental Modelling and Software Society 1(2):232-238.

D'Erchia, F., C, Korschgen, M. Nyquist, R. Root, R. Sojda, and P. Stine. 2001. A framework for ecological decision support systems: building the right systems and building the systems right. U.S. Geological Survey, Biological Resources Division, Information and Technology Report USGS/BRD/ITR-2001-0002. 50 pages.

Biddle, P. B., D. H. Cross, D. P. Jennings, R. S. Sojda, and R. C. Solomon. 1995. Information needs and technology applications of Department of Interior natural resource professionals. Wildlife Society Bulletin 23:(4)627-630.

Kirby, R. E., J. K. Ringleman, D. R. Anderson, and R. S. Sojda. 1992. Grazing on national wildlife refuges: do the needs outweigh the problems? Transactions of the North American Wildlife Natural Resource Conference 57:611-626.

Linda Vance, Ph.D. Senior Ecologist/Spatial Analysis Lab Director Montana Natural Heritage Program (http://mtnhp.org) P.O. Box 201800, 1515 East Sixth Ave., Helena, MT 59620-1800 (406) 444-3380 (Helena); (406) 243-5196 (Missoula); (406) 437-1083 (Mobile) (406) 444-0266 (fax) livance@mt.gov

EDUCATION:

2004:	Doctor of Philosophy (Ph.D), University of California, Davis, Conservation Ecology.
1980:	Master of Laws (LL.M.), York University, Osgoode Hall Law School, Downsview, Ontario, Canada.
1977:	Bachelor of Civil Law (B.C.L), McGill University Law School, Montreal, Quebec, Canada.
1974:	Diplôme d'études collegiales (D.E.C.), Dawson College, Montreal, Canada.

RECENT EMPLOYMENT:

10/ 2007-	Senior Ecologist/ Spatial Analysis Lab Director, Montana Natural Heritage Program, U of M
05/05-10/07	Ecologist/Projects Manager. Montana Natural Heritage Program, U of M.
5/03-6/04	Ecologist/herpetologist, Forest Service Pacific Southwest Research Station
9/2000-3/03	Director, Biological Sciences Programs, University Extension, University of California at Davis
1/00-9/00	Interim County Director and Farm Advisor (50% time), University of California Cooperative Extension

RECENT REPORTS

Vance, L.K.. 2012. The Rocky Mountain ReMAP Project: Assessing the Range of Natural Variability in Minimally-Disturbed Rocky Mountain Wetlands. Report to the United States Environmental Protection Agency Office of Research and Development. Montana Natural Heritage Program. Helena, MT. 45 pp. plus appendices

Vance, L.K., C.Tobalske, U. Langner and E. Colaiacomo. 2012. A Remote Sensing Classification of Riparian Vegetation and Disturbance Along Montana's Large Rivers. Report to the United States Environmental Protection Agency Office of Research and Development. Montana Natural Heritage Program. Helena, MT. 60 pp. plus appendices

Vance, L.K., and U. Langner. 2011. SPOT 5 Classification of Sage Grouse Habitat Suitability in the Upper Powder River Basin of Wyoming. Report to the Bureau of Land Management, Buffalo, Wyoming.

Newlon, K.R. and **L.K. Vance**. 2011. A Reference Wetland Network for Assessment and Monitoring of Montana's Herbaceous Wetlands. Report to the United States Environmental Protection Agency. Montana. Natural Heritage Program, Helena, MT. 23 pp. plus appendices.

Vance, L.K. 2009. Assessing Wetland Condition with GIS: A Landscape Integrity Model for Montana. A Report to the Montana. Department of Environmental Quality and the Environmental Protection Agency. Montana Natural Heritage Program, Helena, MT. 23 pp. plus appendices.

Vance, L.K. 2009. Geographically isolated wetlands and intermittent/ephemeral streams in Montana: Extent, distribution and function. Report to the Montana Department of Environmental Quality and the U.S. Environmental Protection Agency. Montana Natural Heritage Program, Helena, MT.

Vance, L.K., and C. Tobalske. Upper Clark Fork Sage Steppe and Grassland Classification and Modelling. Report to the Montana Department of Fish, Wildlife and Parks.

RECENT PRESENTATIONS:

Hendricks, P., S. Lenard and L.K Vance. Riparian cottonwood versus Russian Olive: the significance for bats- A pilot study. Montana Chapter Society for Conservation Biology 4th Annual Research Symposium, Missoula, Montana, November 17, 2011

Vance, L.K. . A remote sensing approach to characterizing riparian integrity along the Yellowstone and Missouri Corridors (poster). Montana Chapter American Water Resources Association Annual Conference, Great Falls, Montana, October 6, 2011.

Vance, L.K. Classification of Lentic Riparian Systems.. Society for Rangeland Management Annual Conference, Billings, Montana, February 9, 2011.

Vance, L.K., K. Newlon and J. Lemly. Using Remotely-sensed Imagery to Select Wetland Reference Sites. National Water Quality Monitoring Conference. Denver, Colorado, April 28, 2010.

PROFESSIONAL MEMBERSHIPS AND APPOINTMENTS

Appointed member, Montana Land Information Act Advisory Council, 2011-2013
American Society for Photogrammetry and Remote Sensing (Regional Director, RMR, 2011-)
Montana Association of Geographic Information Professionals (President, 2010-2011)

Letters of Support

Integrating climate and biological data into land management decision models to assess species and habitat vulnerability: A collaboration for Greater Sage-Grouse and their habitats

Bureau of Land Management

Great Northern LCC

Montana State University, Department of Computer Science

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Montana State Office
5001 Southgate Drive
Billings, Montana 59101-4669
www.blm.gov/mt

In Reply Refer To:

March 1, 2012

Dr. Jeff Morissette, Director
North Central Climate Science Center
U.S. Geological Survey

Dear Dr. Morissette –

This letter is to express support on behalf of the Bureau of Land Management (BLM) for the following proposal submitted by Dr. Richard Sojda: *Integrating climate and biological data into land management decision models to assess species and habitat vulnerability.*

The BLM is very interested in building stronger collaborations with the Charles M. Russell National Wildlife Refuge, the U.S. Geological Survey, university scientists, and other resource management partners in north central Montana with a focus on landscape-level management and adapting to climate change. This is especially important due to the high value resources of the region, increasing change in the region, and growing public interest in those resources.

This proposal is extremely relevant for this collaboration as it will establish a valuable foundation in terms of synthesizing needed data layers and applying climate models to address common priority management questions. We will do our best to participate in project development and implementation in order to leverage limited resources and translate research results into the management context. We appreciate the USGS' efforts to do the same.

I apologize for the tardiness of my letter, but hope that it will be considered in your decision making process. Please feel free to contact me at (406) 896-5012 or kkitchell@blm.gov.

Thank you very much!

Katherine Kitchell
Associate State Director
Bureau of Land Management
Montana/Dakotas

THE GREAT NORTHERN
Landscape Conservation Cooperative

March 5, 2012

Dr. Jeffrey Morisette
Director, DOI North Central Climate Science Center
U.S. Geological Survey
Fort Collins Science Center
2150 Centre Ave., Building C
Fort Collins, CO 80526-8118

Dear Dr. Morisette,

We would like to convey our support for the proposal: 'Integrating climate and biological data into land management decision models to assess species and habitat vulnerability' submitted by the USGS Northern Rockies Science Center. This project supports the broad goal of the Great Northern LCC through data integration and evaluation of monitoring methodologies, climate analysis of sage habitats and will provide useful information to partners supporting Sage Grouse and sage-steppe system conservation.

Specifically, this project fits criteria for high priority science needs which include (but are not limited to): 1) vulnerability of natural resources to climate change and other landscape stressors; 2) improved resolution of information important to landscape-scaled ecotype, habitat and resource changes; and 3) development of tools that will be available to conservation managers to improve conservation delivery decision-making and information needs.

Sincerely,

Yvette Converse
Coordinator, Great Northern Landscape Conservation Cooperative

Letter of Support

John Sheppard to: morisettej

Cc: Richard S Sojda

03/05/2012 08:32 AM

Show Details

History: This message has been replied to and forwarded.

Jeff,

The purpose of this email is to indicate my strong support for your proposal and project titled, "Integrating climate and biological data into land management decision models to assess species and habitat vulnerability." As we begin to develop strategies and methodologies for advanced scenario analysis, your project will provide much needed data and supporting models that could help bootstrap the larger effort. This project will also provide a mechanism for improving communication and collaboration between key stakeholders and experts in the areas of decision support, scenario planning, ecological modeling, climatology, and wildlife biology. My team within the Numerical Intelligent Systems Laboratory of MSU Computer Science Department stands ready to support your work as the need arises.

Regards,
John W. Sheppard

--
John W. Sheppard, PhD
RightNow Technologies Distinguished Professor
Department of Computer Science
Montana State University
Bozeman, MT 59717
V: +1 406 994 4835
F: +1 406 994 4376
E: john.sheppard@cs.montana.edu, jsheppa2@jhu.edu, jsheppa2@gmail.com