Introduction to the North Central CSC Liaison Team with the Great Northern LCC

Geneva Chong, Tabitha Graves, Kathi Irvine, Greg Pederson, Todd Preston, David Wood

USGS Northern Rocky Mountain Science Center
NC CSC Draft Revised Mission:
To provide the best possible climate science to Department of Interior land managers & provide university and USGS researchers an opportunity to work with an engaged and proactive applied management community.
Liaisons to facilitate the integration of climate science into management decision making.

- Improve communication between managers and scientists to:
  - recognize managers’ needs;
  - work with scientists to develop the information to meet those needs; and
  - connect the information with the manager’s decision making process.
• Climate data
  – including maps, time series graphics
  – consultancy on model, emissions, and downscaling choices.

• Remote sensing products and analysis
  – Including expertise on drought, fire, and phenology data sets

• Ecological response modeling
  – Correlative Species Distribution Modeling
  – Quantitative Scenarios through state and transition modeling

• GIS services to combine data and models

• Collaboration and support of extramural proposal writing

• Training sessions through the National Conservation Training Center

• Collaboration on analysis and visualizations through the USGS Resource for Advanced Modeling
USGS Liaisons between the North Central Climate Science Center and Landscape Conservation Cooperatives – Meet the NOROCK-GNLCC Liaison Team!

Geneva Chong, NC CSC Liaison coordinator
Tabitha Graves, Wildlife and Planning
Kathi Irvine, NABat transferability
Greg Pederson, Paleohydrology & adaptation
Todd Preston, UAV applications
David Wood, Scale and ecosystem function
Kathi Irvine, NABat transferability
Tabitha Graves, Wildlife and Planning
Greg Pederson, Paleohydrology & adaptation
Todd Preston, UAV applications
David Wood, Scale and ecosystem function
Collaborative Monitoring: The NABat story

Kathryn (Kathi) M. Irvine, Research Statistician
NOROCK

kirvine@usgs.gov

Tom Rodhouse, NPS, Quantitative Ecologist

Preliminary data, please do not cite.
Survey design and program vision (Loeb et al. 2015)
“Wings across the Americas” research partnership award
OR, CO, NE, NC, SC, AZ, ID, CA, TX, BC implementing NABat

Preliminary data, please do not cite.
Little brown bat predictions (pr. of occurrence)

Little brown bat simulated 10-yr decline (pr. of occurrence)


Preliminary data, please do not cite.
Sampling Design- 10 x 10 km grid

Preliminary data, please do not cite.
Using a Master Sample to Integrate Stream Monitoring Programs

David P. Larsen, Anthony R. Olsen, and Donald L. Stevens, Jr.

The need for aquatic resource condition surveys at scales that are too extensive to census has increased in recent years. Statistically designed sample surveys are intended to meet this need. Simple or stratified random sampling or systematic survey designs are often used to obtain a representative set of sites for data collection. However, such designs have limitations when applied to spatially distributed natural resources, like stream networks. Stevens and Olsen proposed a design that overcomes the key limitations of simple, stratified random or systematic designs by selecting a spatially balanced sample. The outcome of a spatially balanced sample is an ordered list of sampling locations with spatial distribution that balances the advantages of sim-


Preliminary data, please do not cite.
Creating a “Master Sample”  
(Larsen et al. 2008)

Facilitates X-boundary Collaboration!

- Every sample unit is arranged in “GRTS order” and attributed by jurisdiction

Preliminary data, please do not cite.
Preliminary data, please do not cite.
Current Research & Development
(making collaborative monitoring a reality)

- Guidance for implementing the master sample for collaborative monitoring (T. J. Rodhouse & K.M. Irvine ESA presentation 2017)

- *Bayesian Integrated Analysis Methods*

- *Web tool development for delivery and archiving of NABat master sample design (FORT & mr.org)*

All of these products are transferable to other taxonomic groups of interest that don’t obey boundaries
Thanks!
Optimal design for research, monitoring, & planning

More bears for your buck

Tabitha Graves    tgraves@usgs.gov
Alberta Grizzly Bear Management Units

Stenhouse, Royle, Hooten
N = 47- 133

Costs: $500 K to $850 K

Is there a less expensive approach?
Optimal Sampling

Determine efficient sampling design based on management goals

- Increased precision (multiple ways of calculating this)
- Minimize cost
Optimal Sampling

Determine efficient sampling design based on management goals

- Increased precision (multiple ways of calculating this)
- Minimize cost
- Spatial coverage
- Balance of these

Population questions

- Occupancy
- Abundance
- Connectivity planning

Preliminary data, please do not cite.
2004 Spatial Capture Recapture Results

N (analysis area) = 81.2 (67.4-102.9, CV=0.109)
N (study area) = 36.2 (31.39, 45.5)

Prior Data

Preliminary data, please do not cite.
Basic Design

Just eliminated the very poor habitat cells - 157 cells

Preliminary data, please do not cite.
Basic Design

Simulated with estimate from 2004 and 2X 2004 because some thought population increasing

Preliminary data, please do not cite.
No Helicopter Design (109 cells)

No traps in white cells
1 trap in light gray cells
2 traps in dark gray cells (better habitat)

Preliminary data, please do not cite.
• Results unbiased
• At low N, a few cases where not ‘enough’ information

Preliminary data, please do not cite.
- No helicopter design has higher variance
- But still unbiased
- Does it matter to management whether estimate is 36 versus 50?

Preliminary data, please do not cite.
Benefits of optimal sampling

- Less expensive, more efficient
- Increases precision
- Can meet changing goals
- Can tie in with adaptive management – goal may be to monitor results of changes in management

Preliminary data, please do not cite.

tgraves@usgs.gov
Multi-century perspectives on current and future streamflow in the Missouri River Basin

Greg Pederson

U.S. Geological Survey | Northern Rocky Mountain Science Center
Montana State University | Earth Sciences Department

gpederson@usgs.gov

In collaboration with:
Marketa Elsner, Patrick Erger, Subhrendu Gangopadhyay, Jordan Lanini, Stephanie Micek, Gerald Benock, Katherine Dahm, David Trimpe, William Cole, Larry Dolan, Russell Levens, James Heffner, Atilla Folnagy

aUniversity of Arizona, Tucson, Arizona; bUniversity of North Carolina at Chapel Hill, NC; cPrairie Adaptation Research Collaborative, Regina, SK; dUniversity of Minnesota, Minneapolis, MN; eMontana State University, Bozeman, MT; fU.S. Geological Survey; gLamont-Doherty Earth Observatory, Columbia University, Palisades, NY; hThe City College of New York New York, NY; iU.S. Bureau of Reclamation; jMontana DNRC
IMPORTANCE

- Flood Control
- Navigation
- Irrigation
- Power generation
- Municipal supply
- Fish and Wildlife
- Riparian Vegetation
- Recreation
GOALS

- Develop long records (1000+yrs) of total water year flows at collaborator/manager selected stream gage locations
- Use the records to test and optimize current flow management operations with State and Federal Water Managers
- Contextualize projections of future streamflow and snowpack change with paleohydrologic records

*Project Website:* [Missouri River Paleohydrology Project](#)
TREE RINGS
32 Upper | Headwaters & 18 Main Stem | Lower Basin Gages
All Naturalized or Estimated Unregulated Flow Records

Preliminary data, please do not cite.
~23 Stakeholder Selected High-Quality Gage Records

Selected as Target Inflow and Outflow Records

Preliminary data, please do not cite.
Reconstructed Streamflow at each Target Gage will be routed through a RiverWare flow management model constructed by the BOR & State.

Preliminary data, please do not cite.
374 Tree-Ring Chronologies from 20 Species
Approximately 116 of the Chronologies are new or updated
All Chronology Start Years By Elevation

Time Span

All Chronology Start Years

Preliminary data, please do not cite.
## Preliminary Results

<table>
<thead>
<tr>
<th>Gage</th>
<th>CV R Squared</th>
<th>CV Prediction_Error</th>
<th>Start Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIGHORN RIVER NEAR ST. XAVIER, MT</td>
<td>0.84</td>
<td>254.31</td>
<td>722</td>
</tr>
<tr>
<td>WIND RIVER BELOW BOYSEN RESERVOIR, WY</td>
<td>0.81</td>
<td>162.86</td>
<td>722</td>
</tr>
<tr>
<td>MISSOURI RIVER NEAR LANDUSKY MT</td>
<td>0.81</td>
<td>992.39</td>
<td>769</td>
</tr>
<tr>
<td>NORTH PLATTE RIVER NEAR NORTHGATE, CO</td>
<td>0.79</td>
<td>69.75</td>
<td>380</td>
</tr>
<tr>
<td>MADISON RIVER BELOW ENnis LAKE NEAR McaLlISTER, MT</td>
<td>0.79</td>
<td>115.27</td>
<td>680</td>
</tr>
<tr>
<td>SMITH RIVER NEAR EDEN MT</td>
<td>0.76</td>
<td>59.98</td>
<td>986</td>
</tr>
<tr>
<td>MILK RIVER AT NASHUA MT</td>
<td>0.76</td>
<td>157.06</td>
<td>1104</td>
</tr>
<tr>
<td>JUDITH RIVER NEAR MOUTH, NEAR WINIFRED, MT</td>
<td>0.76</td>
<td>29.04</td>
<td>769</td>
</tr>
<tr>
<td>MISSOURI RIVER AT FORT BENTON, MT</td>
<td>0.74</td>
<td>796.50</td>
<td>769</td>
</tr>
<tr>
<td>GALLATIN RIVER AT LOGAN, MT</td>
<td>0.73</td>
<td>106.51</td>
<td>680</td>
</tr>
<tr>
<td>MISSOURI RIVER AT TOSTON, MT</td>
<td>0.73</td>
<td>441.34</td>
<td>680</td>
</tr>
<tr>
<td>MADISON RIVER NEAR THREE FORKS, MT</td>
<td>0.73</td>
<td>124.36</td>
<td>1014</td>
</tr>
<tr>
<td>SUN AT GIBSON RESERVOIR NEAR AUGUSTA, MT</td>
<td>0.71</td>
<td>78.73</td>
<td>1062</td>
</tr>
<tr>
<td>MUSSELshell RIVER AT MOSBY, MT</td>
<td>0.71</td>
<td>107.03</td>
<td>1027</td>
</tr>
<tr>
<td>MARIAS RIVER NEAR CHESTER, MT</td>
<td>0.71</td>
<td>124.63</td>
<td>1154</td>
</tr>
<tr>
<td>YELLOWSTONE RIVER NEAR SIDNEY, MT</td>
<td>0.71</td>
<td>1287.93</td>
<td>882</td>
</tr>
<tr>
<td>SOUTH PLATTE RIVER AT SOUTH PLATTE CO</td>
<td>0.70</td>
<td>62.40</td>
<td>379</td>
</tr>
<tr>
<td>SHOSHONE RIVER BELOW BUFFALO BILL RESERVOIR, WY</td>
<td>0.69</td>
<td>110.00</td>
<td>680</td>
</tr>
<tr>
<td>MUSSELshell RIVER AT HARLOWTON, MT</td>
<td>0.68</td>
<td>41.86</td>
<td>986</td>
</tr>
<tr>
<td>SUN RIVER NEAR VAUGHN, MT</td>
<td>0.66</td>
<td>132.27</td>
<td>682</td>
</tr>
<tr>
<td>YELLOWSTONE RIVER AT CORWIN SPRINGS, MT</td>
<td>0.65</td>
<td>319.27</td>
<td>769</td>
</tr>
<tr>
<td>TETON RIVER NEAR DUTTON, MT</td>
<td>0.64</td>
<td>34.72</td>
<td>1154</td>
</tr>
<tr>
<td>RUBY RIVER NEAR TWIN BRIDGES, MT</td>
<td>0.64</td>
<td>38.28</td>
<td>769</td>
</tr>
<tr>
<td>TETON RIVER AT LOMA, MT</td>
<td>0.64</td>
<td>41.64</td>
<td>987</td>
</tr>
<tr>
<td>JEFFERSON RIVER NEAR THREE FORKS, MT</td>
<td>0.64</td>
<td>338.55</td>
<td>769</td>
</tr>
<tr>
<td>BIG HOLE RIVER NEAR MELROSE, MT</td>
<td>0.64</td>
<td>161.17</td>
<td>818</td>
</tr>
<tr>
<td>BEAVER HEAD RIVER AT BARRETT, MT</td>
<td>0.63</td>
<td>55.88</td>
<td>1062</td>
</tr>
<tr>
<td>TONGUE RIVER AT MILES CITY, MT</td>
<td>0.61</td>
<td>91.83</td>
<td>675</td>
</tr>
<tr>
<td>DEARBORN RIVER AT CRAIG, MT</td>
<td>0.60</td>
<td>41.21</td>
<td>882</td>
</tr>
<tr>
<td>CLARKS FORK YELLOWSTONE RIVER NEAR BELFRY, MT</td>
<td>0.58</td>
<td>109.23</td>
<td>722</td>
</tr>
<tr>
<td>POWDER RIVER NEAR LOCATE, MT</td>
<td>0.45</td>
<td>162.37</td>
<td>1307</td>
</tr>
</tbody>
</table>

**Average**

<table>
<thead>
<tr>
<th>CV R Squared</th>
<th>CV Prediction_Error</th>
<th>Start Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.69</td>
<td>213.98</td>
<td>853</td>
</tr>
</tbody>
</table>
Preliminary Results

JEFFERSON RIVER NEAR THREE FORKS MT

MADISON RIVER BELOW ENNIS LAKE NEAR MCALLISTER MT

GALLATIN RIVER AT LOGAN MT

Preliminary data, please do not cite.
Preliminary Results

**MISSOURI RIVER AT TOSTON MT**

**MISSOURI RIVER AT FORT BENTON MT**

**MISSOURI RIVER NEAR LANDUSKY MT**

---

Preliminary data, please do not cite.
20th Century In Perspective

Mean Relative Upper Basin Flows

Preliminary data, please do not cite.
Notable Long-Duration Droughts

Mean Relative Upper Basin Flows

Preliminary data, please do not cite.
Notable Long-Duration Droughts

Preliminary data, please do not cite.
Notable Long-Duration High Flow Periods

Mean Relative Upper Basin Flows

1960 - 1990 Pluvial

Preliminary data, please do not cite.
Long-Duration Drought Risk

How Do Recent Drought Magnitude & Intensities Compare?

Preliminary data, please do not cite.
- Reconstructions show the potential for runoff variability outside the bounds of observations (wetter, dryer or both).
- Hydro modeling based on future climate scenarios suggesting a potential for greater flooding and more intense droughts.

After Lutz et al. 2011 and Littell et al. in press

Preliminary data, please do not cite.
SUMMARY

Historic Observations and Paleo-Streamflow & Snowpack Records Demonstrate:

➢ A Sticky System (Wet/Dry conditions can last years to decades)
➢ Temperature and Precipitation play an important role, sometimes moderating drought & sometimes intensifying drought
➢ Expect all of these relationships to continue into the future

Preliminary data, please do not cite.
SUMMARY

Future Projections of Streamflow & Snowpack Suggest:

➢ Increased cool season precipitation
➢ Flat to decreasing summer season precipitation
➢ More rain less snow
➢ Low snowpack and earlier melt out and runoff
➢ Increased potential for mid-winter flooding
➢ Lower summer flows
➢ Counterintuitively, increased total water year flows

These patterns are already apparent in the observed snow and streamflow data – So it’s safe to start planning for this…
More forthcoming work on the MRB...

See: Missouri River Paleohydrology Project for more project information, data and publications.
Unmanned Aerial Systems (UAS)

Todd Preston
Mission Examples

• Wildlife
  – Sandhill Cranes
  – Trumpeter Swans
  – Whitetail deer

• Geological
  – Fault Scarps
  – Paleontological Surveys
  – Abandoned Mine Inspections

• Vegetation
  – Invasive Species
  – Productivity (NDVI)
  – Vegetation Mapping

• Hydrological
  – Groundwater Discharge
  – Sediment Transport
  – Fluvial Morphology
FAA Regulations

• Most flights flown under the DOI blanket COA
  – Access to all class G airspace
  – Aircraft within line-of-sight
  – No ceiling limitation
  – 24 hours notice (NOTAM)
  – Night flights
Current Systems

- 3DR Solo

- Falcon Unmanned
  - Falcon Fixed Wing
  - Falcon Hover

- Pulse Vapor 55 Helicopter
Selected Sensors

- Pentax Ricoh (Natural color)
- MicaSense RedEdge 3 (Multispectral)
- FLIR Vue Pro R (Thermal)

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.
Data Products

Orthoimagery
Data Products

Multispectral
Data Products

Thermal
Data Products

3D Terrain Models

Credit: NPS / Avery Locklear
Data Products

3D Terrain Models
Additional Information

Todd Preston
tmpreston@usgs.gov
406-994-5034

National Unmanned Aircraft Systems Project Office
uas.usgs.gov
BLM Projects
Prepared in cooperation with the Bureau of Land Management


Open-File Report 2016–1207

U.S. Department of the Interior
U.S. Geological Survey
Current role

Synthesis

Bridging the Science–Management Divide: Moving from Unidirectional Knowledge Transfer to Knowledge Interfacing and Sharing

Dirk J. Rout¹, Kevin H. Rogers², Harry C. Biggs³, Peter J. Ashman¹, and Anne Sergeant⁴

Five principles for the practice of knowledge exchange in environmental management

M.S. Reed⁵, L.C. Stringer⁶, I. Fazey⁷, A.C. Evely⁸, J.H.J. Kruijssen⁹

How can we improve information delivery to support conservation and restoration decisions?

Nathaniel E. Seavy · Christine A. Howell

The effect of scientific evidence on conservation practitioners’ management decisions

Jessica C. Walsh,¹ Lynn V. Dicks, and William J. Sutherland
Research Goals

• How do multiscale drivers interact to regulate ecological processes
• Apply these models to objectives, restoration, and monitoring

• Rangeland productivity and composition
  • High spatial and temporal variability
  • Variation across scales
  • Quantitative connections between scales
Regional Precip and Temp  Soils

Disturbance Regime

Steppe  Short Grass  Mixed grass

Preliminary data, please do not cite.
Regional Precip and Temp

Disturbance Regime

Soils

Perennial grass

Early shrub steppe

Late shrub steppe

Annual or introduced grasses

Recent Precipitation and Temperature

Land Management

Disturbances

Agriculture

Invasives

To Preliminary data, please do not cite.
Productivity

Year T-3 Precip
Year T-2 Precip
Year T-1 Precip
Year T Precip

Low Frequency Drivers
(Climate, Geology, Disturbance Regime, etc.)

Land Cover

Productivity