Bromus REEnet meeting summary
February 23, 2010
Salt Lake City, Utah

USDA AFRI project "*Exotic* Bromus *grasses in agroecosystems of the western US: REEnet synthesis of current and future invasions, impacts, and management*"

Participants and others in attendance: Sheryl Atkinson, Julie Beckstead, Jayne Belnap, Michael Bowers, Bethany Bradley, Matt Brooks, Cynthia Brown, Mark Brunson, Jeanne Chambers, Carla D' Antonio, Maria Fernandez-Gimenez, Sean Finn, Marshal Frasier, Matt Germino, Stuart P. Hardegree, Jeremy James, Beth Leger, Tom Monaco, Steve Novak, Mike Pellant, David Pyke, Cindy Salo, Kristina Schierenbeck, Linda Schueck, Eugene Schupp, Roger Sheley, Brenda Smith, John Stark. Moderated by AJ Martinez.
Participating by teleconference: Maria Fernandez-Gimenez, Jay Arnone, Tom Ziarello
REEnet Participants not in attendance: Richard Mack, Jim MacMahon

Objectives

- Review project objectives
- Share information on participants' research
- Demonstrate website and database and obtain feedback from participants
- Discuss information gaps and needed syntheses
- Obtain agreement on focal areas for project
- Obtain agreement on group products
- Develop linked working groups
- Determine action items
- Determine meeting frequency and develop agenda for next meeting

Introductions, sharing information on participants and their research

Here is a summary of the associated groups, with links. Notes on each participant are found at the back of this document, starting on pg 9.

GBRMP (Sean or Stuart H),
http://greatbasin.wr.usgs.gov/gbrmp/
GBRI (Mike Pellant):
http://www.blm.gov/id/st/en/prog/gbri.html
EBIPM (Roger Sheeley & Tom Monaco):
http://www.ebipm.org/
Sage STEP (Gene Schupp or Mark Brunson):
http://www.sagestep.org/
Native seed increase (Mike Pellant):
http://www.fs.fed.us/rm/boise/research/shrub/greatbasin.shtml
http://www.fs.fed.us/rm/boise/research/shrub/images/GBNPSIPimages/GBNPSIPbrochure2009.pdf
Rocky Mountain Cheatgrass Management Project (Cini Brown):
http://rmcmp.agsci.colostate.edu/
NSF Global Invasion Network (Steve Novak and Kristina Schierenbeck),
http://www.invasionsrcn.org/
NSF NEON (Eugene Schupp):
http://www.neoninc.org/

Thoughts from Lunchtime Discussion

- We usually talk about replacing BRTE with more desirable species, but we need to remember that managers often must manage a mix of BRTE and desirable species and they need tools for doing that.
- Ranchers in many areas rely on BRTE for dependable early spring forage; not everyone wants to eradicate it.
- We need to remember that not all effects of BRTE are negative; if we're truly impartial scientists, perhaps we should be talking about the net effects of BRTE. Many granivores use Bromus seeds, ranchers rely on it for early spring forage, etc. What are the economic and ecological benefits of Broumus species? Do any T&E species use it (similar to Southwest Willow Flycatcher and tamarisk)?
- Looking at why Bromus *isn't* in some areas could shed light on how to manage.
- Focusing on Bromus can make us lose sight of what we want: healthy, functioning plant communities. We need to remember to focus on what we want.
- Early spring grazing to control BRTE does not seem to be a viable option in the Great Basin, but evidence from California indicates that it may be more effective there.
- Annuals rely on a soil seed bank; we can't overlook the importance of Bromus seedbanks.
- Much of the Bromus work has been done on BRTE; how extendable is this to other Bromus?
- Individual researchers traveling to visit each other can get a great deal of work done; should this be part of REEnet?

Presentation of REEnet website—Linda Schueck

- Definition of a successful website—Number of hits? Success in accessing info? What will users do with the site?
- Objectives (from proposal)
- Features—what are the critical things this website should do for the user?
    - Table of data about grasses—locations, characteristics, etc
    - Search occurrence locations on a map?
    - Bibliography?
    - Images? Link images to locations on a map?
    - Working groups?
    - Participant's list?
    - Diagram of links among institutions and people? Mind mapping program available at http://www.thebrain.com.
- Can present data in summary tables so users don't get hit with everything at once. Parent/child (one to many) tables help organize material retrieved.
- GBRMP website uses Community of Science keywords; will continue that on Bromus REEnet site.
- Matt will ask Catherine to email the group to ask everyone to submit a description of what they do plus 5 people to invite to join the network.
- GBRMP has an Information Management Working Group that develops communications tools to help land managers find the experts they need. Also used by Congressional staffers, etc.
- Perhaps three tiers of publications on the website:
    - Bromus in the title or keywords

- Bromus is a response variable, not in title or keywords; but how to make these searchable?
- Research that relates to Bromus issues

Questions about REEnet website:

- Can database access papers that not only have Bromus as a keyword, but that are relevant to Bromus but don't contain keyword?

Presentation of REEnet Database—Cini Brown and Sheryl Atkinson

- Purpose—to facilitate research on Bromus invasions and provide a central location for this information. The database itself is meant to be a means of conducting research by allowing queries that will identify patterns.
- Functions—allow information about Bromus spp characteristics (search by country, state, or county) and other species that interact with Bromus
    - There are about 150-170 spp of Bromus, including non-invasive ones
    - Soil properties associated with Bromus spp
    - Current projects/people/organizations
- References and bibliography links all information
- Data sources—peer-reviewed journals, technical bulletins, etc
- Suggestions already received
    - Inclusion of maps
    - Include both occurrence locations and abundance
    - Searchable bibliography (including theses, gray lit/white papers, agency reports, etc)
    - Ability to search by topic
    - Ability to search by type of study (field, greenhouse, etc.)
    - Ecological amplitudes
    - Information about history of invasion
    - Allowance for meta-analysis
    - Database of Bromus and fire (may have to be separate database)
    - Database of herbarium specimens (more being digitized and made available on line; many herbaria have records online without images)
    - Inclusion of comment/discussion area as a way to maintain contact with, and learn from, stakeholders. Perhaps a "call and response" format to collect semi-quantitative information from ranchers.
    - Tap into citizen scientists
    - Link to NRI data on Bromus occurrence?
    - Linking to GBRMP databases would be ideal, but difficult as need web services.

- Might be useful to look at similar websites to see what has worked best.
- Current state—looking at available information, requirements for database, preliminary design, working with USGS SRP field station on web interface
- Center for Evidence Based Conservation (http://www.cebc.bangor.ac.uk/) has developed process and weighting factors for evaluating usefulness of non-peer reviewed material. It would be ideal to automate the evaluation process, but there are challenges to the approach.
- Future plans
    - Use Microsoft Access to make database accessible
    - Develop internet interface

• Please help!

Focal objectives of REEnet: A review from proposal—Matt Germino

1. Communication with the public needs to be at the forefront
2. Original idea was to bring together people from different disciplines to share research on Bromus—improve communication and coordination among researchers
3. Identify conceptual framework and address gaps in knowledge that should be examined

{This progresses into the discussion of how to divide up into groups…}

- Large projects can be cumbersome; ideal may be a large project with semiautonomous subunits that can function independently and complete projects on their own.
- NIFA funding focus is fewer large projects to tackle large problems.
- Grant writing is not the main focus of Bromus REEnet; the network itself is very valuable, but we should also be poised to respond to RFAs.
- Must remember to focus on measurable outcomes in proposals, for example, "75% of land managers are using the tool we developed," or, "We reduced the area where Bromus is a main focus of management by 25%."
- Must remember to maintain areas that are currently functioning, so we don't lose them, too. Must also think strategically to maintain connectivity of sage grouse habitat, etc.
- Important to include managers from the start. The perception of some (vocal) BLM managers to new research projects is, "Here they go again! The scientists are telling us what we need again."
- On the other hand, when ARS got feedback on what research land managers wanted, they found that ARS projects were quite close.
- Understanding the factors that lead to resistance and resilience is very important but difficult to establish quantifiable outcomes.
- Getting user buy-in early is very important. Cini's Rocky Mountain Cheatgrass Management Project used focus groups to build models, which gave them credibility from the start.
- BLM papers can be a good, and citable, source of information on what land managers want.
- The Fire in North American Deserts Workshop, etc. are also good sources.
- Including NRCS people in Bromus REEnet might be a way to include land managers from the start.
- Perhaps, "Land managers agree that they're part of the research process" could be an outcome.
- It may be helpful to divide outcomes into short, medium, and long term outcomes.
- Researchers can't control what ultimately happens on the ground, so we need a very strong link with land managers to overcome that.
- The Cooperative Ecosystems Study Unit asked managers what they wanted: identify knowledge gaps and provide a management system with and easy to use delivery platform that comes with help understanding it and getting started.
- Technology transfer could be an outcome.
- The BLM found that managers want to build relationships with and have direct contact with researchers. They think that much of the information is available, although there are gaps. Managers prefer web-based information.
- Important to understand how managers make decisions; Maria is working on this.

Sub-group meeting results

An important immediate need is a post-meeting discussion about incorporating the socio-econ dimensions, noting that all of these individuals could not be present on weds, and the telecom connection was not useful.

Mark Brunson contacted the leadership after the conference with a few notes on how the human dimension expertise (Frasier, Brunson, Fernandez-Gimenez) in the group could be best used. As a matter of chance Marshall, Mark and Maria were not able to be present on Wednesday afternoon when the groups were being made. He was not sure the group had a good handle on which working group(s) could benefit from human dimensions expertise. The group discussion led to placing Maria, Marshall and Mark in Group 4, allowing that other groups may need to consult them. However, Mark contends that that doesn't seem to take particularly broad advantage of their science.

For example, the work Mark does on feedbacks between human and natural systems fits well into discussions of resistance and resilience. In fact Mark notes that he uses a resilience framework as a conceptual basis for a lot of my research and outreach these days. Mark suggests that our understanding of Bromus distribution (Group 1) would be greatly enhanced by a better understanding of how human activities influence Bromus distribution — something ecologists do study, but not as much as one might think (e.g., note the paucity of peer-reviewed literature documenting influences of recreation on cheatgrass distribution/abundance, for example) -- but also by why those activities have the impacts they do and the likelihood that they can be altered in ways that would influence the level or trajectory of impacts.

Mark makes the following point, "It appears to me that people assume social science is most useful once tools have been identified and help is needed in "using public education for acceptance," which is where Group 4 comes in. I do have strong opinions on this. Every time someone said yesterday that we need to do better education to get landowners or citizens to change their behavior, I wanted to protest that lack of knowledge is a relatively minor influence on why people behave in ways that increase the spread of invasive species, and it would be useful to have those discussions when the time is more appropriate. But that's not the only place where social *science* can make a strong contribution."

The socio-econ members might consider joining the groups below, or potentially forming a separate group for this important need.

Group 1—Changing distributions of invasive species

- **Group members:**
  Bethany Bradley, Matt Germino, Steve Novak, Kristina Schierenbeck, (Beth Leger, Jayne Belnap, Cini Brown). Would a socio-econ member be willing to join?
- **Goal:** understand the factors affecting changing distributions at large, regional scales
- **Objectives:**
  - Improve regional scale models of current and future distributions
  - Increase awareness of need for improved modeling
  - Quantitative comparison of different modeling approaches (eg. bioclimate envelope vs. process based)

• Determine what spatially explicit data exists on Bromus occurrences for validating models, consider whitepapers or proposals for this need
• Syntheses will consider how we can know distributions now and in future (remote sensing), biogeographical controls and dispersal, population and evolutionary/genetic constraints, physiological and epigenetic/plasticity relationships to climate, relative importance of abiotic (climate) and biotic effects, large-scale feedbacks that affect change in distribution.

• Develop concepts and designs for experimental approach (large scale)
    • Sensitivity of population dynamics (life stages) and relationship to climate
    • Plan climate manipulations at edges of distributions
    • Observational transects along disturbance gradients to tease apart effects of climate and disturbance
    • Establishment/transplant studies along elevational gradients

• Other potential participants?
• Additional modelers, also consider Robert Clinger, Mike Coughenour, Dick Mack, Nancy Glenn, Beth Leger, Susan Meyer, Nancy Huntly, Steve Knick, Louis Provencher

• **Action plans/deadlines:**
    • Begin a synthesis document that serves as a template for a possible review paper submitted later (eg. ~in year) for publication (eg. on the topic of suitability of *Bromus* for range modeling) and posting to website – Matt
    • Arrange a personal meeting with Matt and Mark Brunson, and possibly a group conference call by mid April. - Matt
    • Outreach to landscape/regional modelers—Bethany
    • USGS proposal for integrated modeling paper w/ new focus on cheatgrass and support of group—Bethany is PI
    • Timeline: ~2 weeks for outline, ~1 month have strawman web document with folder of pdfs of relevant publications

Group 2—Resistance, resilience, and transitions

• **Group members:**
Carla D'Antonio, Matt Brooks, Gene Schupp, John Stark, Jeanne Chambers, Cindy Salo, Jayne Belnap, Roger Sheley. Consider socio-econ members here and adding objectives for socio-econ resistance resilience?
• **Goal:** to create tools that managers will use to assess resistance, resilience, and the likelihood of transitions
• **Objectives:**
    • Examine how systems differ in resistance and resilience (across/within ecoregions, ecological types)
    • Understand changes that alter resistance, resilience, and their interacting ecological effects
        • Climate, land use, fire, grazing, management activities
    • Understand ecological memory (history)
    • Website
        • Define resistance, resilience and other issues
        • Use visuals (including Whisenant's step model)
        • Include conceptual frameworks of ecology (fluctuation resources, niche theory, etc)

- Synthesis of existing quantitative framework of info (esp. for all habitats in Great Basin, Colorado Plateau, Mojave, Columbia Plateau)
- Evaluation of applying it to larger spatial scale (plots to landscapes)
- Possibly bring in focus groups of managers to query them about their knowledge/insights to determine if concepts/findings align with their perceptions
- Turn synthesis of information into management recommendations
- Synthesis would identify knowledge gaps and work towards proposal focused on critical experiments
- Perhaps keep R and R and transitions separate? Can focus on resistance to Bromus, but resilience is a more general response to disturbance. Check literature and decide
- Other people to include: Rick Miller, Peter Weisberg, Susan Meyer, Steve Knick, Mike Wisdom, Andy Thode, Mary Beth Hennessey, Curt Deuser (Lake Mead), Karen Prentice, Doug Shinneman, Dave Pilliod, Todd Esque, Jim Grace

- **Action plans/deadlines:**
  - Provide verbiage for definitions for the webpage (resistance, resilience, and transitions) by late March
    - Jeanne Chambers initiates, draw upon relevant PDFs, sent to Linda/Sheryl
  - Synthesis paper
    - Matt and Jeanne—pull together info about red brome from project in southern Nevada Science Synthesis for Southern Nevada Public Land Management Act (SNPLMA) Projects}—with Burton Pendleton's assistance
    - Region-wide—Roger Sheley's will recruit an ARS postdoc to undertake majority of effort; he'll write request for a post doc for next funding cycle next summer.
    - Outline of synthesis paper for comments—Matt (late March)
  - Database on REEnet website—add data into resistance/resilience folders
    - Jayne will check USGS (upper Colorado, Wyoming) and will talk to Linda
    - Jeanne will check USFS data archive
  - Invest in grant-writing workshop—fall 2010 (instead of symposium)
    - Need to invite social scientists/economists to help understand how people make decisions, barriers to adoption, best ways to communicate

Group 3—Monitoring and adaptive management

- **Group members:**
  Mike Pellant and David Pyke
- **Goal:** synthesis of current knowledge
  - Tools used: NRI, FIA, weed database, EFR, Restoration
  - Tools proposed: BLM ecoregional assessments
  - Spatial scales: landscape, rapid assessment, detailed project level assessment
- **Objectives:**
  - Assess capabilities for monitoring
    - Evaluate current methods for assessing and monitoring
      - Invasive bromes at multiple scales (from remote-sensing to ground-based methods)
      - Accuracy/precision of techniques, statistical reliability, consistency among land ownerships
  - Current state of soil survey and state transition models, who, when completed, etc

- Determine current databases available and evaluate their usefulness (try to link them)
- Interdisciplinary multiscale experiments combining research, mgmt, extension
    - Connections between assessments and genotypes of invasive species—yield genotypes of natives and invasives that cohabitate
- Other individuals to include—NRCS NRI, USFS FIA, BLM AIM, and ecoregional assessment reps, TNC, USGS EROS (landfire), Hines Foundation and SRR reps, NPS vital signs

- **Action plans/deadlines:**
    - Synthesis info on assessment/ monitoring tools
    - Timeline—six months (August 2010?)

Group 4—Appropriate restoration tools

- **Group members:**

  Julie Beckstead, Cini Brown, Stuart Hardegree, Jeremy James, Tom Monaco, Brenda Smith, Beth Leger, Mark Brunson, Maria Fernandez-Gimenez, Marshall Frasier
- **Goal:** assess/synthesize appropriate tools for restoration
- **Objectives:**
    - Synthesis of quantitative projects (e.g. rangeland seeding in invaded areas)
    - White paper about the approach to management and restoration needs
        - Including social dimensions, agencies, prof societies, etc
    - Research proposal to identify gaps
    - Broaden expertise to include social dimensions
- **Action plans/deadlines:**
    - Synthesis paper
        - Develop methods for doing synthesis based on personal experience (~end of April)
        - Collect literature (~mid-May)—diff topics assigned to various group members
        - Manuscript for submission (~ 1 year, March 2011)

Group 5—Communication and technology transfer

- **Group members:**

  Linda Schueck, Sheryl Atkinson, Sean Finn
- **Goal:** provide REEnet group information to members and the public
- Other potential members: people that work in outreach and data communication (i.e. data specialist, web designer, etc)
- **Action plans and deadlines:**
    - Get public website out—Linda (<30 days of collaborative site, end of March)
        - Meeting notes, timelines, etc
    - Get timelines onto collaborative site—Sean (end of this week)
    - Database—Sheryl (<30 days, end of March for initial stage, June/July for web publication)
        - Controlled vocabularies for queries
    - When database has content, it will be incorporated into public website (May 31/over summer)

Future REEnet meetings:

- Proposal planning meeting (or effort, via telecom)—late summer 2010
- Next meeting—Proposal Writing Workshop October 2010
    - Decide leaders of subgroup to participate, other participants to invite

• Third meeting—depending on proposal outcome (funded or not)

Other notes:

• Matt will call Michael Bowers—discuss future RFPs
• Catherine, Cindy Salo, and Sara Kaiser will put notes together
• Matt, Cini, and Jeanne will write a 1pg synthesis which will be mailed to extended group

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Information sharing: Poster/research descriptions from Tuesday AM:

Several individuals' research descriptions are missing: Cindy Salo, Julie Beckstead, Brenda Smith, Marshall Frasier, Sean Finn, Maria Fernandez-Gimenez . The research interest and Publications document should cover every person however.

• Jeremy James, ARS Burns
• What are the basic physiological responses of plants to N availability? If we reduce N, weed abundance will not be decreased because N efficiency is high even in low N environments.
• Meta-analysis shows promise for answering this question, particularly for annual grasses (including cheatgrass). Annuals maintain competitive advantage

•Mike Pellant, BLM Boise
• Great Basin Restoration Initiative (GBRI) http://www.blm.gov/id/st/en/prog/gbri.html• This is a USDI BLM led effort. It provides a proactive approach to restoration through fire management and reseeding natives. The goal is to build resiliency in our ecosystem
• Can livestock grazing manage fuels (including cheatgrass)? Other methods of cheatgrass control including herbicides, etc
• Ecoregional assessments of threats including cheatgrass risk assessment
• FWS Landscape conservation cooperative (LCC) for the Great Basin is developing with BLM as the lead agency. www.fws.gov/science/shc/lccbulletins.html

• Great Basin Native Plant Selection and Increase Project (with Nancy Shaw) Brochure handed out - http://www.fs.fed.us/rm/boise/research/shrub/images/GBNPSIPimages/GBNPSIPbrochure2009.pdf • Increasing availability of native plants and success in planting them—seedbed ecology
• Currently looking at climate change and native plants—where native plants occur, collecting them at the warmer end of their range to anticipate climate change

• Stuart Hardegree, ARS Boise
• Research interests: plant and soil water relations; germination, emergence and establishment processes of rangeland plant species; fire rehabilitation and restoration of Intermountain rangelands; prescribed fire; juniper hydrology and management; ecology and physiology of native and non-native perennial species, annual weeds, and woody invasive species.
• Currently participating in the ARS Ecologically Based Invasive Plant Management program http://www.ebipm.org/.

- Specific current research projects include: hydrothermal-germination response models for rangeland plant species; weather and climate applications for resource management; rangeland rehabilitation and restoration in the Boise foothills and Snake River Plain National Conservation Area; LiDAR remote sensing validation for inventory and modeling of western juniper distribution and invasion trajectories; hydrologic impacts of western juniper on watershed hydrology and erosion processes; and landscape-scale prescribed-fire impacts on watershed processes.

- Tom Monaco, ARS Logan
  - Identify ecological and physiological mechanisms used by invasive weeds in extensive field and greenhouse experimentation by applying a broad array of physiological instrumentation and methodologies including infrared gas analysis, leaf fluorescence, herbicide injury, and soil nutrient analysis
  - Identify and characterize desirable plant materials that are best adapted to combat invasive weeds using comparative physiology and morphology of leaf and root structures in search of key plant traits to perform desired ecological functions on disturbed rangelands
  - Through cooperative research with plant breeders, facilitate efficient release of improved plant germplasm for use on semiarid rangelands by designing intensive and extensive experiments to characterize promising plant traits
  - Working with land managers in NW Utah to see what they have been doing to control cheatgrass and maintain perennials. In doing so, learned about site history, which is important to consider

- Jayne Belnap, USGS Moab
  - Triage—how do we predict invasion?
    - Resistance to invasion (soil nutrients)—in hot dry deserts, P controls where annual grasses invade; in the Great Basin, mostly K that controls invasion.
    - Ecosystem impacts of invasion in grassland near Moab—soil food webs are destroyed, and larger impacts are experienced in wet years.
    - Manipulative experiment in plots--warming lamps and rainout shelters to examine the climate change impact on cheatgrass. Results show that cheatgrass has higher biomass in warmer conditions, but at 2 degree increase native grasses are dying

- John Stark, USU
  - Role of plants influencing C and N in soils (biochemical properties)
    - Examine sites established by fire—general idea is that there is greater N where cheatgrass is present.
      - Questions to investigate: does cheatgrass establish in high N areas, or is it a product of cheatgrass growth? How do you reestablish a native plant community and what are the plant-soil relationships?
      - Reseeded areas in soil microbe depleted areas—cheatgrass DOES stimulate N production, and there is a positive feedback of nutrient availability (mechanisms still not well known)

- Carla D'Antonio, UCSB
  - Impacts of cheatgrass invasion in salt grass communities where soil crusts were degraded
    - What is the role of soil crusts? They are important in promoting resistance to invasion, though climate had an effect

- Also investigating mycorrhizal associations with *Bromus*
- *B. diandrus* in California—monitoring plots ungrazed for 15 yrs
  - Richer soil is rapidly invaded after exclusion, and invasion persists no matter the climate (resilient to environmental variation)
  - Now investigating how plant litter buffers the seed bed against climate variation. Also looking at use of grazing as a management tool to promote natives and decrease *Bromus*

- Steve Novak, BSU
  - Examines bigger picture issues with cheatgrass invasion in N America, but also worldwide (with Dick Mack and others)
    - What does cheatgrass do in its native range? In France, it is difficult to find—maybe it has been eliminated through succession.
    - How are cheatgrass genotypes influenced by climate change? It has a high level of genetic structure (so we can reconstruct invasion events)—many native range genotypes co-occur and are phenotypically plastic. Also, populations have high levels of genetic diversity (from multiple introductions)

- Gene Schupp, USU
  - Plant population ecology—factors limiting plant recruitment both in rare and invasive species (focus on early life stages)
  - Experimental manipulations of competition with varying levels of soil nutrients and mycorrhizal relationships
  - Role of granivore communities on cheatgrass invasion and response of plant community

- Beth Leger, UNR
  - PEP talk: we can get this weed! (cheatgrass)
  - Interested in growing/maintaining material for restoration in invaded systems, especially native plants that are competitive with cheatgrass (and they DO exist)
  - Genotyping cheatgrass (454 sequencing SNP markers)—this allows for finding variability in cheatgrass (which is highly selfing) and analyzed genes that code for various functions (e.g. seed dormancy, salt tolerance, etc)

- Linda Schueck, USGS SRFS
  - Information management and delivering data to the public realm—to inform people about researchers in the western US. Database implementation to store land treatments—could allow people to query fire locations, etc

- Mark Brunson, USU
  - Research interests: how "the public" perceives issues related to rangeland wildfire, fuel hazard reduction, and related management practices on Great Basin rangelands, understanding perceptions and decision processes among range managers themselves
  - SageSTEP is a multidisciplinary experiment across western US http://www.sagestep.org/
    - Apply land management treatments (e.g. prescribed fire, removing juniper, applying herbicide, etc) to reduce fuels and restore/maintain native bunchgrass communities from encroachment or invasion
    - All treatments have been applied, and goals for the year ahead (year 6)—measurements of birds, plants, soil, hydrology, economics, socio-political (perception of treatments)

- Large outreach program, moving into monitoring program for long-term maintenance

- Kristina Schierenbeck, CSU Chico
  - Global invasions network (GIN)—developing models for monitoring plant population growth. http://www.invasionsrcn.org/
  - Propogule pressure.
  - Multiple origins of *B. magritensis*, identifying pathways for invasion

- Matt Germino, ISU
  - Causes and ecosystem impacts of plant community change
  - For Bromus, tendency to focus on biophysical aspects…. energy balance and evapotranspiration, ecohydrology, ecophysiology
  - Stability of grass-dominated landscapes (*B. inermis, tectorum,* etc to secondary invaders)
  - Fire effects, such as on wind erosion

- Bethany Bradley, Princeton
  - Biogeography—using landscape and regional scale spatial distributions to learn more about invasion risk
    - Creating models for future invasion risk—remote sensing of an invaded landscape, relate geographically and add information about anthropogenic disturbance, soils, etc
    - Relating invasion to climate change shifts—hypotheses for designing experiments in those areas in addition to regional management

- David Pyke, USGS Corvallis
  - Research interests: population ecology of native and invasive plants in the Intermountain West, monitoring protocols for ecosystem integrity on wildlands, and restoration ecology of native plants on disturbed and invaded lands
  - BLM fire rehabilitation projects—should be revisited to collect data on their current status
  - Comparisons with unburned, unseeded sites (which are stratified by elevation and precipitation)—look at the drivers of formation in these communities
  - Review of literature on fire rehabilitation
    - Aerial seedings are not effective
    - Livestock grazing impacts on cheatgrass (to adjust stocking rates)
    - Bacterial and fungal communities in the soil

- Sheryl Atkinson, CSU
  - Database idea from Global Invasions Network—distributions for Bromus, non-invasive species of Bromus
  - See Bromus REEnet database presentation notes (below)

- Jeanne Chambers, USFS Reno
  - Resistance and resilience of systems to cheatgrass—how resource availability is affected by interactive effects of grazing, fire, environmental gradients
    - Effects of repeated fire—can repeated fire be used to decrease N availability by increasing C:N ratios? What are the effects on cheatgrass establishment and biomass and on establishment of native species?
    - Contributions of legumes to N in soil and interactions with other species—how do legumes affect establishment and abundance of cheatgrass and native species?

- Effects of resource and propagule availability on cheatgrass establishment, growth and reproduction
- Effects of *Bromus* invasion on mycorrhizal communities over gradients of fire and invasion
- Feedback mechanisms associated with post-fire invasion, surface litter accumulation and nutrient cycles

- Matt Brooks, USGS Yosemite
  - Mediterranean annual grasses, Schizmus and cheatgrass—effects of competition and N.
  - Mojave desert—susceptibility to altered fire regimes caused by cheatgrass, assess risk to better inform managers
  - Prioritize susceptibility to BRTE invasion (and altered fire regimes), treatments to maximize success, climate variables

- Roger Sheley, ARS Burns
  - Strengthen the ecologically-based invasive plant management (EBIPM) framework as a decision-making system for cheatgrass management for annual grass-dominated or threatened ecosystems through the incorporation of detailed outcomes resulting from the use of existing weed management tools in specific combinations and locations
  - Working with cheatgrass, develop new ecological principles that contribute to the basis of EBIPM by investigating the potential interactions among management approaches, site availability, species availability, and species performance during restoration of cheatgrass-dominated rangeland

- Cini Brown, CSU
  - Mechanisms that control the coexistence of plants and the effects of species diversity and plant community composition on ecosystem characteristics such as productivity, resource abundance, and invisibility
  - Current research includes studies of invasive plant species' range limits, grassland invasions and restoration, and the effects of global environmental change
  - Research that tests ecological theory while addressing practical conservation and management issues