Multi-party Monitoring for the Uncompahgre Plateau Collaborative Restoration Project

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Table of Contents

Background on the Uncompahgre Plateau Collaborative Restoration Project……2

Goals and Objectives for the Uncompahgre Plateau Collaborative Restoration Project……..4

Approach to Multi-party Monitoring……6

Protocol for Uncompahgre Mesas Monitoring Plots……8

Protocol for Aspen Browse……10

Protocol for Burn Canyon……..12

Protocol for Biomass Assessment……14

Protocol for Weeds……16

Protocol for Riparian……17

Protocol for Landscape Scale Monitoring……..19

Protocol for Q study……..21

Appendix with detailed protocols……22

Background on the Uncompahgre Plateau Collaborative Restoration Project

The Forest Service and partners for the "Uncompahgre Plateau Collaborative Restoration Project" are working to enhance the resiliency, diversity, and productivity of a priority landscape in the Rocky Mountains. The Plateau is located within five counties on the Western Slope of Colorado and includes key watersheds that feed the Colorado River. This Project builds on previous landscape-scale collaboration on the UP, and applies a science-based ecosystem approach to restore vital forest health and the communities of western Colorado. "Relationship building" on the Grand Mesa, Uncompahgre and Gunnison National Forest (GMUG) has yielded many acres of NEPA-ready projects, and action has begun. This "Uncompahgre Plateau Collaborative Restoration Project" is cradled in science, creates jobs while supporting local industry; reduces fuels and ultimately restores a landscape that will support large-scale beneficial fire. Adaptive management based on locally informed evidence guide our actions, and monitoring is fundamental to improving our work. We aim to eventually reduce forest management expenditures (including wildfire suppression costs); support local industry; and promote new economic opportunities. This project develops active management of forests and rangelands, and creates greater resiliency to natural and man-caused disturbances; this progress will be particularly important if future climates shift toward warmer, drier conditions.

This Uncompahgre Plateau Collaborative Restoration Project will include active restoration projects on 160,000 acres of NFS lands from 2010 through 2020. These treated areas will influence fire risks across 500,000 acres of the Plateau (out of a total 1.5 million acres). Treatments will include include: prescribed burns, mechanical treatments, timber harvesting, invasive species treatments, re-vegetation with native seed, trail and road relocations to reduce sediment, riparian restoration, and improvements for Colorado River cutthroat trout. Multi-party monitoring efforts are planned for 68,000 acres.

Cooperative relationships on the Western Slope of Colorado have been developing over the past 15 years beginning with the formation of the Public Lands Partnership and Uncompahgre Plateau Project (UP Project) in the mid-1990s. Strong bonds and trust have been created among community members, public land managers, environmentalists, academia, agency researchers, recreation groups, local governments, energy industry, ranchers, timber companies, and the general public. As of 2010, we have 86, 700 acres of NEPA-ready forest restoration and WUI projects; a native seed program with many species of grasses and forbs ready to apply to the landscape; an existing and active invasive species eradication program; a Travel Management Plan and Fire for Resource Benefit Plan in place; and we still retain the two largest remaining Forest Products Industries in the State to make this effort economically possible. The Uncompahgre Plateau Collaborative Restoration Project is the next step in engaging everyone in the future of this landscape.

The landscape strategy will apply the UP Project's model "Uncompahgre Mesas Collaborative Forest Restoration Demonstration Project" (Unc Mesas Project) as a guide for future restoration efforts on NFS lands. This model, which has brought numerous diverse partners together, effectively working in a manner of trust, is partially responsible for the large amount of NEPA-ready acres in this proposal and provides collaboratively-developed restoration guidelines, which will be used for future proposed restoration projects. The Unc Mesas Project, which is one of the largest projects included in this proposal, was developed with the guidance of the Colorado State University's Colorado Forest Restoration Institute (CFRI) and includes 17,000 NEPA-ready acres of mixed confer and ponderosa pine, critical to restoring natural fire regimes on the Plateau. The Unc Mesas project will be expanded upon substantially over the next 10 years, with 78,000 acres of new NEPA planning to begin in 2012.

Several proposed projects offer critical fuels reduction treatments along two energy corridors. Tri-State Generation and Transmission Association (Tri-State) operates a 115 kV transmission-class line that delivers

power to local and regional energy providers such as Delta-Montrose Electric Association (DMEA) and San Miguel Power Company. The other corridor includes a 345 kV line owned by Western Area Power Association (Western). This line primarily transmits power originating from federal hydro-generation facilities in Colorado and transports this energy to high demand areas from Nevada to California. This line is an important component of the national grid of power lines supplying energy to areas with critical needs. These power line projects have NEPA-ready acres that support WUI areas of critical power line infrastructure.

The UP Project's Native Plant Program has been a national leader in development of native seed production. Comparison and production studies have resulted in the collection and propagation of 13 species of native seed (grasses and forbs), which have now been released to commercial growers. As seed is produced, it will be available for restoration projects on the Uncompahgre and Colorado Plateau. These species are considered key components of native ecosystems in the Colorado Plateau area. There are currently three Coordinated Weed Management Area Plans on the Uncompahgre Plateau landscape. These Weed Management Plans use multiple techniques to control the spread of invasive noxious weeds, including chemical and biological control measures critical to restoration and preventive measures to control invasive species.

The towns of Montrose and Delta lie at the base of the Plateau and are home to the last remaining large sawmills in Colorado. Intermountain Resources, located in Montrose, processes everything brought in from two states. Delta Timber utilizes most of the aspen cut in Colorado and is important to work on Sudden Aspen Decline. A locally sustainable supply of wood products from the Western Slope is critical to the economics of the Intermountain mill and meeting forest health and safety objectives (bark beetle issues) across the State of Colorado.

The GMUG National Forests completed the Uncompahgre Plateau Travel Management Plan in 2002, and its vision is important to restoration efforts across the Plateau. Proposed treatments include decommissioning 130 miles of road, relocating 1.5 miles of road to benefit riparian habitat, and erosion control on 100 miles of trails. All travel management decisions have been made and are ready for implementation.

Previous NFS restoration efforts on the Uncompahgre Plateau have been limited and concentrated around private inholdings and infrastructure to provide fuels reduction, WUI protection benefits and mule deer habitat enhancement. In addition, several weed management areas have been intensively treated for invasive species, including spotted knapweed, yellow star thistle, and others. In 2004, NEPA analysis for Spring Creek/Dry Creek Landscape was completed and fulfilled a variety of on-the-ground restoration and vegetation management treatments. These combined treatments, totaling 20,000 acres on NFS, BLM and private lands, represent a major success for active management at ambitious scales. The work supported by the Collaborative Forest Landscape Restoration Program will build on this success to dramatically enhance the future forests, woodlands, and rangelands of the Uncompahgre Plateau.

Goals and Objectives for the Uncompahgre Plateau Collaborative Restoration Project

Our collaborations over the past decade and a half led us to a set of six goals for improving the future landscapes of the Uncompahgre Plateau:

1. Enhance the resiliency, diversity and productivity of the native ecosystem on the Uncompahgre Plateau using best available science and collaboration.
2. Reintegrate and manage wildfire as a natural landscape scale ecosystem component that will reduce the risk of unnaturally severe or large crown fires.
3. Restore ecosystem structure, composition and function to encourage viable populations of all native species in natural patterns of abundance and distribution.

4. Preserve old or large trees while maintaining structural diversity and resilience; the largest and oldest tress (or in some cases the tress with old-growth morphology regardless of size) should be protected when feasible from cutting and crown fires, focusing treatments on excess numbers of small young trees where this condition is inconsistent with Historical Range of Variability (HRV) conditions.
5. Reestablish meadows and open parks and re-establish grasses, forbs, and robust understory communities.
6. Manage herbivory. Grass, forbs, and shrub understories are essential to plant and animal diversity and soil stability. Robust understories are necessary to restore natural fire regimes and to limit excessive tree seedling establishment. Where possible, defer livestock grazing after treatment until the herbaceous layer has established its potential structure, composition, and function. Project partners will work with the CDOW to manage big game populations to levels that will contribute to successful restoration treatments.

Specific treatment objectives for the major vegetative communities within the project area as well as examples of proposed types of projects include:

Sagebrush. Restoration treatments are needed to improve the understory, increasing available forage for both wildlife and domestic livestock. The GMUG will work closely with the CDOW to target key Gunnison sage-grouse habitat areas as well as take advantage of biomass potential of pinyon-juniper in reestablishing key openings. At least 1,800 acres of sagebrush treatments are planned in the next decade, mostly with mechanical treatments.

Pinyon-Juniper (PJ). The PJ cover type is currently the largest cover type on the Plateau. A comparison between 1937 and 1994 showed that PJ expanded into areas formerly dominated by shrublands and grasslands, and the density of PJ stands has increased. These changes have decreased the amount of available forage for both wildlife and domestic livestock and have degraded habitat for Gunnison sage-grouse. The landscape restoration project plans to reduce fuels and enhance the patchy mosaic of vegetation types (and ages) by masticating trees on 2,500 acres. The treatment units will also be designed to reduce invasion into other cover types.

Mountain Shrub (MS) (oak/service berry/mountain mahogany). Mastication projects with follow-up prescribed burning are proposed on 7,000 acres to mimic natural fire disturbances, and result in a patch mosaic with 10 to 15 percent of MS in early seral stage. The resulting mosaic will improve forage and grazing and also limit the size of large crown fires when they occur.

Ponderosa Pine (PP). Restoration in the PP cover type will reduce tree density by cutting large numbers of small-diameter trees relative to larger trees; improve spatial heterogeneity possible; protect old-growth ponderosa pine; increase long-term structural diversity (within stands and across landscapes); and create fuel conditions that reduce the likelihood of uncharacteristically sever fires, by reestablishing the high-frequency, low-intensity historic fire regime. Both commercial and noncommercial treatments will be accomplished with mechanized equipment. Post-harvest prescribed fire will be used as part of our strategy to reintroduce fire as an active part of the landscape. We will design treatments to reduce surface and ladder fuels, create conditions favorable to the growth of grasses, forbs, and shrubs, and then to continue using wildfire as a management tool to maintain these ecosystems. 7,700 acres of PP treatments are NEPA-ready, and over 15,000 acres of PP treatments are proposed for the decade.

Mixed Conifer (MC) (Ponderosa Pine/Aspen/Douglas Fir/Blue Spruce/Engelmann Spruce/Sub-alpine Fir). Restoration treatments in the MC cover types will reduce tree density and develop more open conditions

characterized by multi-age structure and multi-species tree composition. Treatments will increase diversity of forest structures within stands, including variety in spatial arrangement of residual trees and development of small (0.1 to 0.5 acre) meadows. Because the future is expected to be hotter and drier, treatments will create conditions favorable to Douglas-fir, ponderosa pine, and aspen regeneration over blue spruce. Prescriptions will generally favor the perpetuation of aspen on the landscape by encouraging regeneration. Both commercial and noncommercial treatments will be accomplished with mechanized equipment. Most areas will receive follow-up broadcast burning. The fire regime in the cooler, moister mixed-conifer forest was undoubtedly a less-frequent mixed severity regime; fire in places would creep through mixed conifer forest, consuming little fuels and killing only small trees while in other areas torching and killing groups or patches of large trees. The reduction in surface, ladder and canopy fuels will result in a lower risk of stand-replacing fire and will create the conditions necessary to reinitiate the historically safer, mixed-severity fire regime. Over 4,000 NEPA-ready restoration projects include the Unc Mesas Project and treatments along Western power lines; over 11,000 acres of MC treatments are included in this proposal.

Aspen. There is an urgent need to treat aspen stands. Only one-fourth of the stands are younger than 90 years which are predominantly 80 to 120 years old and therefore less resilient to Sudden Aspen Decline (SAD). SAD is a relatively recent phenomena, not described by regional insect and disease experts until 2007. Foresters estimate that approximately 37% of the aspen cover type on the Plateau is impacted by SAD; about one-fourth of the standing aspen trees on the Plateau are dead. Mortality is having the greatest impact on medium-size trees (3-9" dbh); this combines with the dramatically low rates of establishment of new aspen trees to create a high risk of major reductions in aspen on the Plateau. Young aspen trees are rare across the Plateau, as are young stands of aspen. Approximately 11,000 acres of NFS aspen projects are planned, including over 600 NEPA-ready acres. Restoration treatments in other vegetation types will also favor aspen, but severe browsing may pose a severe challenge.

Spruce-Fir (SF). The Plateau has very few young spruce-fir forests; historically we expect young (<75 years) stands would have comprised 20 to 70% of the spruce-fir forests of the Plateau (varying in response to major fires across decades). Although any single acre of spruce-fir forest would not be outside the historical range of variation that would have been common for spruce-fir forest, the overall landscape of the Plateau is probably well outside historical conditions. The near-absence of young spruce-fir forests results in a low diversity in age, size and seral conditions, with large implications for wildfire spread and insect/pathogen outbreaks. The potential for biomass utilization and stewardship contracting are excellent, providing both an opportunity for restoring a missing part of the forest landscape and provided funds (from commercial harvests) to help offset the cost of restoration work in the ponderosa pine and mixed-conifer. Approximately 4,000 acres of SF are proposed for treatments, of which 550 acres are NEPA-ready in 2010.

Approach to Multi-party Monitoring

Monitoring is a vital component of our landscape restoration approach. We need to know how effective restoration treatments achieve our objectives, and whether any unintended outcomes (such as proliferation of noxious weeds) developed. We have developed a "multi-party" approach to monitoring that ensures high quality information that supports high confidence among all collaborators. The three key pieces of our monitoring approach are:

1) Collaborative development of goals and specific objectives for each major project;
2) Collaborative design of general approaches to monitoring, leading to detailed designs by appropriate experts and stakeholders on behalf of all collaborators;

3) Conducting field measurements; sometimes these are performed by agency personnel as part of normal operations, and other times by combinations of agency personnel, outside experts, and stakeholder volunteers.
4) Synthesis of monitoring data to inform all collaborators about what we have learned, and to support insightful discussions about what we might modify to improve our restoration work.

Our multi-party monitoring approach will evolve as we gain experience working together. Baseline data will be recorded prior to treatments. Monitoring will continue periodically over 15 years, following completion. Permanent transect markers will be established to continue monitoring efforts indefinitely. Colorado Forest Restoration Institute (CFRI) will compile, analyze and store the monitoring data.

In the early winter of 2011, all collaborators were invited to discuss our monitoring priorities for this year, based on anticipated funding. We also tentatively decided that an "all hands on deck" monitoring meeting should occur at least once during the winter, and once (in the field) during the summer. Many important details will need to be developed and addressed throughout the year, so we will use an Monitoring Guidance Committee (MGC) for operational details. The MGC will include key Agency personnel, the Colorado Forest Restoration Institute, and other key people needed for particular projects. The work of the MGC will be very transparent, with prompt communication to all stake holders about issues, decisions, etc.; everyone's input is welcome at all times, though no one is asked to volunteer for all the time-demanding tasks.

For 2011, we began with expectations that available funding would support progress on 12 projects (see other UP documents for details):

- Uncompahgre Mesas Monitoring Plots
- Aspen Browse
- Unroaded old-growth on Unc Mesas
- Website Development
- Data depository for all stakeholders
- Burn Canyon
- Biomass Assessment
- Weeds
- Travel Management
- Riparian
- Q-Study

However, the actual level of funding appears to be less than half of the anticipated amount, so our discussions led to decisions to support projects with at least partial funding:

- Uncompahgre Mesas Monitoring Plots
- Aspen Browse
- Burn Canyon
- Biomass Assessment
- Weeds
- Riparian
- Landscape Scale Monitoring

The rest of this update report summarizes goals, objectives, protocols, and other plans for each project.

Project name: Uncompahgre Mesas Monitoring Plots

Leadership people:
Tony Cheng (CFRI), Mica Keralis, Dan Binkley (CSU), Tim Garvey (USDA Forest Service)

Overall goals and objectives:
Restore ecosystem structure, composition and function.
For ponderosa pine type forests, these goals include:
20 to 90 ft^2/acre, often clumped (20-100 ft. radius) with mini-meadows; uneven-age structure, fostering old, large trees.
For mixed-conifer type forests, these goals include
25 to 130 ft^2/acre basal areas; clumped in some places (20-100 ft radius), but not everywhere; some mini-meadows (0.1 to 0.5 acres), uneven-age structure, favoring Douglas-fir, ponderosa pine, and aspen regeneration

Objectives for 2011 monitoring:
The objectives this year focus on completing the pre-treatment monitoring report. Subsequent monitoring is planned for 2, 5, and 10 years after treatment

Key questions to be examined:
Did treatments move the ecosystems toward the restoration goals?
Were any unintended consequences important (such as invasive weeds)?
How might the efficiency and effectiveness of the treatments be improved in the future?

Protocol:

Spatial scale of the area under consideration
17000 acres

General approach
Active restoration treatments envisioned for up to half (or more) of the area, substantially modifying landscape-scale structure and function (including fire hazard)

Locations to be assessed
Eighteen half-acre plots established in three cover types (ponderosa pine, mixed conifer, and spruce) clustered in 6 stands:

Stand	Cover Type
77-052	Ponderosa pine
75-137	Ponderosa pine/spruce
77-161	Spruce-fir
77-135	Warm-dry mixed conifer
77-134	Warm-dry mixed conifer
77-137	Cool-moist mixed conifer

Measurements to be taken at each location
Five categories of data overstory, tree regeneration, understory, fuel characteristics, and photo points
The overstory was classified of trees greater than 4.5-inches at diameter breast height (DBH). The species, DBH, tree status, crown base height (CBH), crown class, presence of insect or disease, and location was collected for each tree in the plot. Trees were located on a central y-axis, running south to north, to the nearest foot and placed in 10-feet distance classes along the x-axis, running east to west. The x-axis coordinates were assigned the mid-point value of each class and were then randomized within each class to remove the regularity created by the distance classes. Percent canopy

cover was recorded at the same ten locations as the understory Daubenmire quadrat frame locations, described below.

Trees less than 4.5" DBH were tallied on four 1/300th acre, 6.8-feet radius, circular plots. The plots were located along the center axes at 45-feet from plot center in the north, east, south, and west directions. Seedlings were classified as trees less than 4.5-feet tall and saplings were greater than 4.5-feet tall and less than 4.5-inches DBH. Seedlings and saplings were tallied separately and by species.

The Daubenmire method was used to collect vegetative attributes of forbs, graminoids, and shrubs. Ten sub-plots were located within the half-acre plot. Five plots were placed on the y-axis and 5 plots were placed on the x-axis. The percent area cover was recorded for each species and vegetation functional group present within the quadrat. Percent ground cover of bare mineral soil, rocky material, litter, and live basal vegetation was estimated. The presence or absence of moss on soil, lichen on soil, elk pellets, deer pellets, and cow pie was recorded. The average-estimated height was recorded for forbs, graminoids, and shrubs. A digital photo point documenting the quadrat was established at all 10 locations.

People engaged in measuring (agency, volunteers, etc.)

Mica Keralis (CSU), Tony Cheng, Jessica Clement (CFRI), Tim Garvey (USDA Forest Service), and UP collaborative volunteers

Data management plans

Data are stored as Excel files and .jpg photo files

Data archiving plans

Data will be archived at CFRI

Plan for communicating findings to collaborators, line officers

A pre-treatment report will be prepared, describing the general approach, protocols, and initial findings. The report will be posted on the UP and CFRI webpages.

Findings will be presented at the annual UP CFRLP collaboration meeting, as well on summer field trips.

Project name: Aspen Browse

Leadership people: Dan Binkley (CSU), Bill Romme (CSU), Tim Garvey (GMUG)
Overall goals and objectives:
1. Determine how substantial the effects of browsing on aspen regeneration (to tree-size recruitment)
2. Determine to what extent browsing impacts result from cattle versus deer and elk?
3. Determine the pattern of browsing impact across the Plateau, and are there any apparent explanations for the pattern (elk populations within local areas; season of use by elk or cattle; basic site factors (such as elevation, forest type, conifer basal area)
4. Determine how recent patterns of aspen regeneration differ over the course of the past 200 years? Does aspen regeneration improve in the future, both inside and outside exclosures?

Objectives for 2011 monitoring:
1. Followup monitoring of aspen regeneration in exclosures set up in 2010
2. Measure aspen response to exclosures established in clearcuts over the past 15 years
3. Install new exclosures with small fenced areas (excluding elk and cattle) within large areas fenced electrically (excluding only cattle).

Key questions to be examined:
See #1-4 under goals and objectives

Protocol:

Spatial scale of the area under consideration: entire Plateau where aspen trees occur.

General approach
Multiple approaches:
A. Plateau-wide survey with prism cruises (in 9 plots/ triangle location) to determine aspen size and age structure.
B. Plateau-wide survey to quantify aspen regeneration (vertex plots of prism triangles)
C. Various exclosures to determine ability of aspen suckers to develop into tree-size classes, in intact stands (pure aspen, aspen-conifer) and SAD-affected stands (pure aspen, aspen-conifer)
D. Exclosures established in the past in clearcuts will be measured to demonstrate the impacts of browsing on aspen regeneration.

Locations to be assessed
A. 50 or more triangle plots chosen randomly across the Plateau for aspen size/age/regeneration quantification
B. 12 exclosures established in summer 2010 (chosen to represent stand conditions described in C). These will have to be near roads so fence panels can be carried in.

Measurements to be taken at each location
A. Triangle plots: aspen basal area and stem dbh (both living and dead); qualitative aspen regeneration for 9 points of each triangle; measurement of aspen sucker numbers by height class in 3 fixed-area plots in each triangle location.
B. At each of 12 exlcosures, measure number of aspen suckers by height classes inside and outside, early and late in the growing season; measure aspen suckers by height class in 6

plots along a transect extending from each exclosure to document browsing impacts (and if possible, time of browsing).

C. Locate previous and current exclosures in aspen clearcuts, and measure the density and size classes of aspen that are (or were) protected in exclosures and control areas nearby.

People engaged in measuring (agency, volunteers, etc.)

Summer 2010: Dan Binkley, Bill Romme, Tim Garvey, and 3-person crew from CSU (Ben Lowrance, Drew Derderian, Attia Alsanousi), with help from volunteers, and high school crew.

Summer 2011: Dan Binkley, Bill Romme, Tim Garvey, Megan Matonis (CSU PhD student) and volunteers

Data management plans

Data entered and analyzed in Excel spreadsheets; synthesized and reported by Dan and Bill

Data archiving plans

Copies of master data sets will be stored with Dan, with Bill, with the Ouray District, and with CFRI.

Copies of photos from each exclosure will be stored in the same locations

Plan for communicating findings to collaborators, line officers

Presentations at UP collaborative meetings
Summary report with major findings (2-4 pages)
Detailed report (perhaps a CFRI publication)
Scientific journal article.

Project name: Burn Canyon

Leadership people:
Art Goodtimes (San Miguel County); other key people have been Mary Chapman and Steve Shrock (Public Lands Partnership), Julie Korb (Ft. Lewis College), and Sonya LeFebre (CSU)

Overall goals and objectives:
Burn Canyon, located within the GMUG National Forests, was significantly charred during wildfires in 2002. The USFS made plans for a salvage logging sale, including three million board feet of wood that could be harvested from the landscape. The sale was a high-profile issue for national and state environmental groups who were concerned about the potential for ecological damage. Instigated by the PLP and lead by Art Goodtimes (San Miguel County Commissioner), a multi-party monitoring partnership was formed,, including environmental groups, agency personnel, and members of the PLP and community. The initiation of this long-term monitoring project helped prevent appeals to the timber sale. The project have been funded by grants from the Ford Foundation and the National Forest Foundation and from contributions from the Colorado counties of: San Miguel, Ouray, Montrose and Delta. The initial (4-year) response of vegetation was reported in: "Burn Canyon Understory Monitoring Report 2003-2006" by Sonya Le Febre and Maria Fernandez-Gimenez (http://www.publiclandspartnership.org/plp/burn_canyon/Burn%20Canyon%202006%20Report%5B1%5D.pdf), and the economic impacts of the salvage operation were estimated in: "Estimated economic impacts of the Burn Canyon Fire salvage sales" by Dennis Lynch (http://www.publiclandspartnership.org/plp/burn_canyon/Burn%20Canyon%20Econ%20Study.pdf)

The continuing goals for the project focus on long-term ecological monitoring of the effects of salvage logging sales in Burn Canyon after the 2002 wildfire.

Objectives for 2011 monitoring:
To document the recovery of vegetation ten years after the wildfire, and the wildfire+salvage logging.

Key questions to be examined:
How has the vegetation developed since the last measurement (4 years post fire, in 2005)?
How has vegetation recovery differed (if at all) between the burning and the burning+logging treatments?

Protocol:

Spatial scale of the area under consideration:
30,000 acre area impacted by the Burn Canyon fire.

General approach
Measure plant diversity along permanent transects using Daubenmire frame plots

Locations to be assessed
Four permanent plots in the burned area; four in the burned+logged area; and 1 in an unburned, unlogged reference area.

Measurements to be taken at each location

Twenty 20cm x 50cm Daubenmire plot frames will be located at 5-foot intervals along each of three, 100-foot transect in each treatment. In each frame, data were collected on the canopy cover of understory species using the Daubenmire cover class method, and on species frequency. Data on the percent cover of litter, bare soil, and downed wood will also be recorded.

People engaged in measuring (agency, volunteers, etc.)

Art Goodtimes will oversee the work in collaboration with Sonya LeFebre

Data management plans

The same data forms and protocols will be used as in previous measurement periods. Excel spreadsheets will be used for data analysis.

Data archiving plans

The long-term archiving of data will be the responsibility of the Colorado Forest Restoration Institute (CFRI), though other people will also retain copies.

Plan for communicating findings to collaborators, line officers

A summary report will be prepared by the investigators, and posted on the webpages for the Uncompahgre Partnership; the Public Lands Partnership; and CFRI.

The results will be presented at UP meetings, including one or more field trips to the Burn Canyon site.

Project name: Biomass Assessment

Leadership people:

Nate Anderson (Univ. Montana), J. Greg Jones (Rocky Mountain Research Station), Carmine Lockwood (USDA Forest Service)

Overall goals and objectives:

To reduce the uncertainty surrounding the costs, productivity and financial feasibility of biomass energy, providing the information needed to develop bioenergy systems that use forest biomass as feedstock.

To determine public opinions and issues that might constrain biomass utilization

To foster a multi-stakeholder collaboration on the Uncompahgre Plateau. The biomass supply chain is firmly anchored to public lands on the supply side and private enterprise on the feedstock logistics and conversion side. Cooperation between public land management agencies, private contractors, forest products companies, and energy producers will be critical in developing biomass markets tied to bioenergy.

Objectives for 2011 monitoring:

Ed Butler (UM) and Dr. Woodam Chung (UM), will prepare the regional road network dataset for input into the transportation network optimization program Network 2000, and conduct a transportation network analysis. The output of this analysis will include a dataset of least cost transportation routing from all treatment units on the Plateau to specific utilization facilities and will be used as a model for biomass transportation costs for the Plateau. Outputs will also include an isocost countour map for each facility showing the average cost of incremental increases in biomass demand.

A field team led by Dan Loeffler (UM) will conduct a work study on one or more biomass operations on the Plateau or in the region. The objectives will be to quantify biomass yields (i.e. timber volume □ biomass predicted = biomass delivered + biomass retained on site) for critical cover types and treatment regimes. The team will also be available for forest measurements to augment or clarify data provided by GMUG foresters.

Dr. Anderson will work with Dr. Battaglia and GMUG foresters to combine spatial vegetation models with forest stocking data and biomass yield estimates for specific treatments on major vegetation types for harvestable units across multiple ownerships. This stock model will be the basis of spatial biomass flow models. Flow models will combine stocks with transportation network analysis and specific demand scenarios currently being developed by Jones and Anderson.

Key questions to be examined:

What is the potential sustainable supply of biomass-for-energy that could be obtained from the Uncompahgre Plateau?

What are the potential costs and values that would determine the sustainable supply?

What are the spatial aspects of the supply (where is it, and what issues influence potential operations)?

Protocol:

Spatial scale of the area under consideration

The portion of the Uncompahgre Plateau accessible by roads and available for silvciultural operations

General approach
Synthesis of currently available information, coupled with some on-site assessments

Locations to be assessed
Plateau wide

Measurements to be taken at each location
Primarily information already available regarding supply
In the future, would be meshed with monitoring assessments of the impacts of stand restoration treatments that provided the biomass for energy generation

People engaged in measuring (agency, volunteers, etc.)
Nate Anderson (Univ. Montana), J. Greg Jones, Mike Battaglia (Rocky Mountain Research Station), Carmine Lockwood (USDA Forest Service), Jessica Clement, Tony Cheng (CFRI)

Data management plans
Dr. Anderson will be responsible for managing and synthesizing project information

Data archiving plans
With Dr. Anderson at the University of Montana, and in the GMUG databases

Plan for communicating findings to collaborators, line officers
The final report will be published, and provided on the UP and CFRI websites
The findings will be reported at the annual UP CFLRP collaboration meeting, on fieldtrips, and in other situations as they become available.

Project name: Weeds

Leadership people:
Kelley Liston, Briand Hoefling, Barry Johnston (USDA Forest Service)

Overall goals and objectives:
To minimize invasive species on the Plateau, through early identification and treatment of new hotspots, and sustained efforts to impede expansion from other sites.

Objectives for 2011 monitoring:
Continue with weed monitoring/treatment programs as in previous years
Focus on assessing recent restoration treatments to determine impact of restoration on invasive weeds

Key questions to be examined:
Where are critical invasion hotspots?
How do restoration treatments affect success of invasive species?
How might restoration treatments be modified to reduce invasive risks?

Protocol:

Spatial scale of the area under consideration
The entire Uncompahgre Plateau

General approach
Occular monitoring during routine travel on the Plateau
Soliciting observations from livestock permittees and others
Develop a "10 Least Wanted" booklet to broaden the number of people who can help identify new hotspots

Locations to be assessed
Wherever knowledgeable staff and volunteers travel

Measurements to be taken at each location
Location, species, and notes on extent

People engaged in measuring (agency, volunteers, etc.)
USDA Forest Service staff; county weed experts; permitees; other volunteers

Data management plans

Data archiving plans

Plan for communicating findings to collaborators, line officers
Summary report on "State of the Weeds on the UP", updated annually (??)
Presentation at annual UP CFLRP collaborators meeting

Project name: Riparian

Leadership people:
Clay Speas, Barry Johnston (USDA Forest Service), Robin Liston (Delta High School)

Overall goals and objectives:
To assess the current condition and trend of streambanks, channels, and streamside vegetation
To determine if livestock grazing management strategies and other land management actions are making progress toward achieving the long-term restoration goals and objectives for streamside riparian vegetation and aquatic resources.

Objectives for 2011 monitoring:
Implement MIM protocols for initial assessment of two reaches of Dominguez Creek
Provide summer internships for local high school students, informing them about career potential in natural resources.

Key questions to be examined:
What is the current condition of the riparian ecosystems in each reach?
What factors have contributed to any observed problems?
What management opportunities need further work to achieve restoration goals?

Protocol:

Spatial scale of the area under consideration
Initially the project focuses on two reaches of Dominguez Creek, with plans to expand to other riparian systems on the Uncompaghgre in the future.

General approach
Using the MIM protocol, the project will assess seven indicators of long-term riparian condition:

1. Greenline composition
2. Woody species height class
3. Streambank stability and cover
4. Woody species age class
5. Greenline-to-greenline width
6. Substrate
7. Residual pool depth and pool frequency

Protocol details can be found in: http://www.rmsmim.com/Portals/2/MIMdoc.pdf

Locations to be assessed
Two reaches of Dominguez Creek

Measurements to be taken at each location
(7 indicators above)

People engaged in measuring (agency, volunteers, etc.)
Clay Speas, Kelley Liston (USFS)
Robin Liston (Delta High School teacher) and students

Data management plans

Excel spreadsheet (part of MIM protocols)

Data archiving plans

Data will be archived in the GMUG database, and also at the Colorado Forest Restoration Institute.

Plan for communicating findings to collaborators, line officers

Students will present findings to the CFLRP Monitoring Group

A written summary report will be posted on the webpages for the Uncompahgre Partnership and CFRI

The results will be presented at UP meetings, including one or more field trips.

Project name: Landscape Scale Monitoring

Leadership people:
Carmine Lockwood, Tammy Randall-Parker (USDA Forest Service), Pam Motley (UP), Art Goodtimes (San Miguel County), Dan Binkley (CSU)

Overall goals and objectives:
Enhance the resiliency, diversity and productivity of the native ecosystem on the Uncompahgre Plateau using best available science and collaboration.
Reintegrate and manage wildfire as a natural landscape scale ecosystem component that will reduce the risk of unnaturally severe or large crown fires.
Restore ecosystem structure, composition and function.
Preserve old or large trees while maintaining structural diversity and resilience.
Reestablish meadows and open parks and re-establish grasses, forbs, and robust understory communities.
Manage herbivory. Robust understories are necessary to restore natural fire regimes and to limit excessive tree seedling establishment.
Evaluate the landscape-scale changes brought about by restoration treatments, including both the local scale (treated stands) and landscape scales (such as fire propagation potentials).

Our initial guiding questions include:
- How can stand-level restoration treatments, and other stand treatments, be used to interrupt the spread of fires?
- How extensive are invasive weed problems across the Plateau, and how can their spread be contained (and reversed) across the landscapes?
- How is vegetation changing in relation to disturbances (treatment, roads, fires, climate change)? We have a lot of interesting data but we are not developing an integrated set of landscape-scale insights from the information.
- We know that fire was more frequent and extensive on the Plateau prior to 1880. The UP collaborators agree that an increased role of fire is a key goal for landscape-scale restoration, but how much more fire (and what sorts) do we need?
- How resilient are the functional processes of the Plateau's ecosystems? Are historical and current conditions sustainable if the climate sifts?
- What is missing from the plateau? Is the Plateau lacking in young forests? The 2005 GMUG assessment likely has a majority of the information we need, but the we need to create a clear interpretation of this information for our landscape goals.
- How effective are various treatments at achieving stand-level goals, and at influencing landscape-level issues?
- What are the implications of our current populations of deer, elk and livestock for the future ecosystems of the Plateau, and how will restoration activities impact the ability of the ecosystems to support animals?

Objectives for 2011 monitoring:
To develop the overall strategy to implement the 10-year goals and objectives

Key questions to be examined:
How can we effectively assess the impacts of stand-level treatments on landscape-scale features such as fire hazard, wildlife habitat, and economic resource development?

Protocol:

Spatial scale of the area under consideration

The entire Uncompahgre Plateau

General approach

The approach for this initial phase is consultation with other CFLRP groups (including the Ecological Restoration Institute at NAU); and discussions among UP collaborators

Develop a Steering Committee to facilitate the overall work of the CFLRP collaborators:

1. To oversee the multi-party monitoring efforts of the UP CFLRP Project to ensure that the overarching goals/objectives of the project are being met and that stakeholders are adequately represented in the process.
2. Serve as a contact for their agency/organization regarding the workgroup's activities and issues/opportunities that may arise.
3. To review and comment on the UP CFLRP Multi-Party Monitoring Plan and annual work plans.
4. To provide feedback to the USFS on the prioritization of implementation and monitoring projects on an annual basis.
5. To assist in brainstorming ways to incorporate local communities in multi-party monitoring efforts.

Locations to be assessed

In the initial phase we will rely on the vast amount of information already available in the GMUG databases.

Measurements to be taken at each location

No new measurements at this time

People engaged in measuring (agency, volunteers, etc.)

Steering committee (Tammy Randall-Parker, Pam Motley, Art Goodtimes, Dan Binkley, others)

UP agency personnel, conservation groups, and volunteer citizens

Data management plans

Under development; likely based on using USDA Forest Service FACTS database

Data archiving plans

Under development; likely based on using USDA Forest Service FACTS database; additional data archiving with CFRI is likely.

Plan for communicating findings to collaborators, line officers

A broad suite of approaches will be used, including field trips, an annual meeting that covers progress and develops plans, various reports and outreach products.

Project name: Q Study

Leadership people:
Nate Anderson (Univ. Montana), Jessica Clement (CSU), Pam Motley (UP)

Overall goals and objectives:
Develop a biomass-focused Q-study to inform inform economic analysis of biomass energy opprotunties on the UP. The emphasis is on characterizing the spectrum of attitudes and interests of key stakeholders involved in regional public discourse on biomass and biomass utilization.

Objectives for 2011 monitoring:

Key questions to be examined:

Protocol:

Spatial scale of the area under consideration

General approach

Locations to be assessed

Measurements to be taken at each location

People engaged in measuring (agency, volunteers, etc.)

Data management plans

Data archiving plans

Plan for communicating findings to collaborators, line officers

APPENDIX

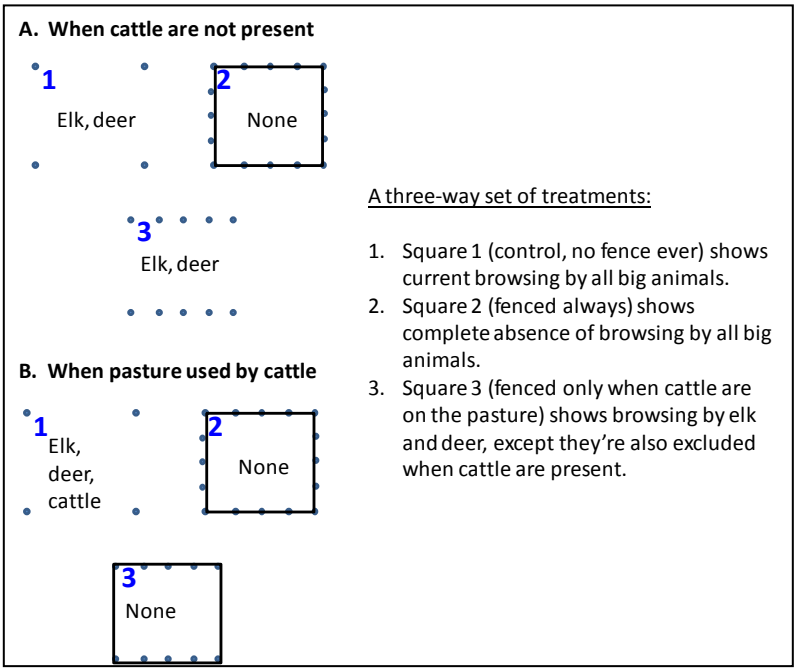
Aspen browse protocols

Project #1. Small exclosures

Small exclosures using hog wire (32 feet x 32 feet, or similar) will be used to find out 1) what level of browsing occurs from all big animals together (Plot 2 minus Plot 1 in the diagram), and 2) what level occurs when elk and deer browsed but never cattle (Plot 3 minus Plot 1). This isn't a perfect test for the effect of elk and deer, as they would also be excluded for the window of time when cattle are present; but we don't think this will confuse the overall story.

This triplet design will be placed in 12 locations:

- 3 aspen stands with SAD problems;
- 3 aspen stands without SAD problems;
- 3 in mixed aspen/conifer
- 3 in post-restoration treatment areas



The exact locations will be developed with conversations with interested permitees. We will aim to have a good distribution across early season, mid season, and late season pasture use by cattle. .

These new exclosures would add to exclosures the Forest Service already established in clearcuts (8-10 years ago) and restoration areas (WAPA); our field crews would also assess the aspen responses in these older exclosures.

Measurements:

A. Photo points for each square, repeated seasonally for some, at least annually for all squares.
B. Aspen regeneration counts: For each square:
   1. Number and height of aspen stems (coming out of the soil, not each twig) in each square;
   2. Number of aspen leaders (vertical twigs) browsed and unbrowsed; evidence of whether browsing was done by cattle or elk/deer.

Measurements would be repeated at the beginning and end of the growing season; if possible, also before and after cattle are on the pasture.

UP Aspen Project, Project #1: Exclosure data sheet

Location: _____

Date: _____

Photo point location: _____

_____

Height of each aspen Plant (clump, not twig)	Plot 1 (unfenced) Browsed	Not browsed	Plot 2 (always fenced) Browsed	Not browsed	Plot 3 (fenced if cattle) Browsed	Not browsed
< 30 cm (1 foot)						
30 cm–60 cm (1-2 ft)						
60 cm–1 m (2-3 ft)						
1–1.5 m (3 – 4.5 ft)						
1.5 –2.0 m (4.5 – 6 ft)						
2 m–3 m (6 – 9 feet)						
>3 m (>9 feet) (list dbh's)						

Pasture surveys before and after cattle use

Most of the pastures are used for only one month during the growing season, offering a chance to characterize aspen shoots before and after cattle are on the pasture. The palatability of aspen to cattle may differ through the growing season (either because the tastiness of the aspen changes, or the availability of preferred food changes). The basic approach for this project will be 6 sampling plots along a transect running from each of the exclosures in Project #1. Transect s will run at a random angle from a chosen baseline point (in an area with decent aspen presence), with plots every 50 m (50, 100, 150, 200, 250 and 300 m). Plots will have a 5.7 m radius (= 100 m^2); if a plot would contain fewer than 5 aspen stems (coming out of the soil, not twig tips), the plot would be enlarged to 8 m radius (200 m^2). If the larger plot would not contain 5 aspen stems, then the plot center would be shifted higher on the transect (by 10 m intervals) until a plot with enough aspen is found. The overall length of the transect may need to be extended in some cases. The center of each plot will be marked with a wooden stake

Measurements:

A. Each plot will be sampled 4 times: beginning of the season (before new aspen growth, if possible), before cattle come onto the pasture; soon after cattle have left the pasture; and at the end of the growing season.

B. Number of bud-tipped vertical shoots in the plot; number of browsed (no bud) vertical shoots

C. Record any apparent evidence of cattle vs. deer/elk browsing:

1. Visual signs on the twigs that would differentiate between the browsers
2. Visual signs of low, medium, and high amounts of fresh (current year) cowpies, deer pellets, elk pellets, in the vicinity of each plot, and along the transect overall.

UP Aspen Project, Project #1 data sheet for browse transects at each exclosure

Location: _____ **Transect Visit # (if known):** _____ **Date:** _____

Associated Exclosure Coordinates: _____

Transect starts from _____

Team: _____ **Compass Declination:** _____

Radius Rule: Use a 5.7m radius unless less than 5 stems (a stem is an individual if it is one inch away from a neighboring stem where it comes out of the soil) are found. The radius can be extended to 8.0m if < 5 stems found.

Height Class ↓	Point →	**50 m Alt: _____**	**100 m Alt: _____**	**150 m Alt: _____**	**200 m Alt: _____**	**250 m Alt: _____**	**300 m Alt: _____**
< 1 ft	Browsed						
	Unbrowsed						
1-2 ft	Browsed						
	Unbrowsed						
2-3 ft	Browsed						
	Unbrowsed						
3-4.5 ft	Browsed						
	Unbrowsed						
4.5-6 ft	Browsed						
	Unbrowsed						
6-9 ft	Browsed						
	Unbrowsed						
> 9 ft	Browsed						
	Unbrowsed						
	Radius (5.7m or 8.0m)						
	Direction from start or prev. point						
	Type of this year's scat seen						
	Level of scat						

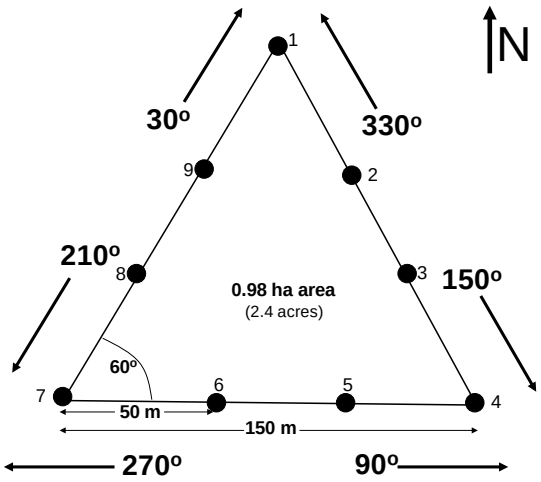
Project #3: Regeneration and age structure survey across the Plateau

We will characterize aspen regeneration at random locations across the plateau, using GIS for sample point locations. At each point, nine subsample points will be used, in a triangular design (the triangle

brings the field workers back to the starting point, keeping travel time lower than linear transects…). We plan on 60 points (more if time allows), which would allow some investigation of patterns across the Plateau (north to south, elevation, conifer basal area, etc.)

Measurements

A. Aspen and conifer (by species) basal area will be determined with a prism (probably 5 BAF for aspen, 20 for conifers). Diameters of "hit" aspen will be measured for dbh, and cores will be taken to determine age. Conifers will be tallied for basal area, but not measured for diameter or cored.
B. Aspen regeneration (< 2.0 m tall) will be counted within an 5.7-m radius (100 m^2), noting if the stems are 0-0.5, 0.5 to 1.0 m, and 1.0 to 2.0 m. Plots with very high numbers of regenerating stems maybe estimated in rough classes (10-20 stems, 20-50 stems, >50 stems).



C. For each aspen stem, degree of past browsing will be noted (evidence of heavy browsing, multiple, forking stems, etc.), as well as current season browsing.

UP Aspen Project: data sheet for VERTEX plots in triangle survey

At the each vertex of the aspen triangle sites, install a 5.7-m radius plot to quantify level of regeneration (how many) and extent of browsing. If no aspen regeneration present, make a note and move on (do not shift plot to another place). Browsing definition: for these plots, we want to know if browsing appears to be holding the aspen back from becoming trees (NOT just this season's browsing, like in the exclosure study). So a "browsed" aspen would show a shape indicating repeated browsing (multiple stems, dead twigs, etc.); a "unbrowsed" aspen may have a single or multiple stems, but these would be largely straight without evidence of crooks and nips and dead twigs that would indicate several years of chomping.

Location: _____

Date: _____

Height of each aspen Plant (clump, not twig)	Vertex 1		Vertex 2		Vertex 3	
	Browsed	Not browsed	Browsed	Not browsed	Browsed	Not browsed
< 30 cm (1 foot)						
30 cm–60 cm (1-2 ft)						
60 cm–1 m (2-3 ft)						
1–1.5 m (3 – 4.5 ft)						

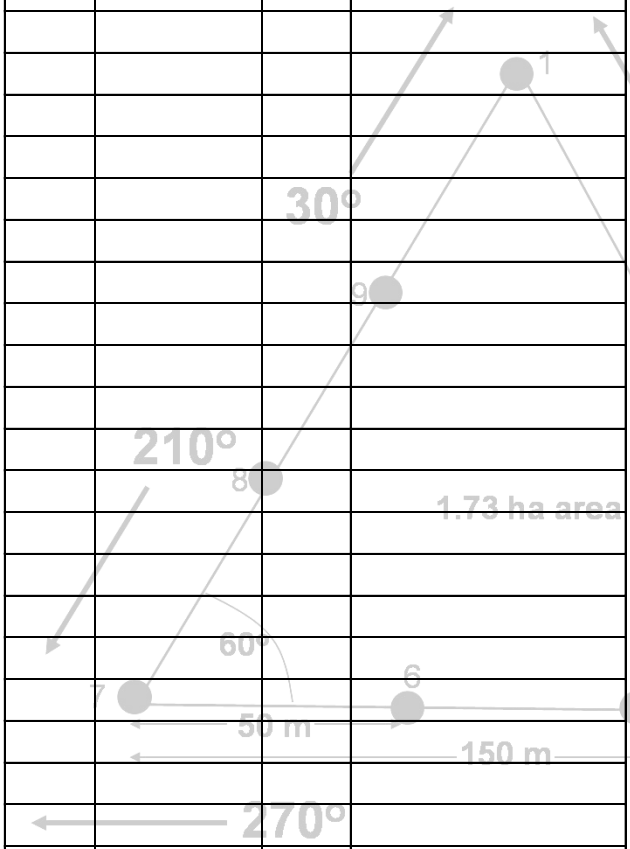
ASPEN Age Structure Survey Uncompahgre Plateau

(core codes: Grid; Plot; Tree numbers; for all-species table, record number of prism "hits")

GRID Number:_____ Date:_____

Aspens to core BAF _____ All-tree BAF _____Crew: _____

Plot # (1-9)	Cored Aspen# within plot (1, 2, 3…)	DBH (cm)	Notes (rot, etc.?)



Plot 1	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 2	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 3	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 4	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 5	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 6	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 7	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 8	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other
Plot 9	Aspen	Ponderosa
	D-fir	Spr. ____ Blue ____Eng.
	Fir	Other

General notes on browsing level on aspen regeneration: 1 = little; 2 = about half show signs of browsing; 3 = most suckers browsed); other notes:

Map of aspen triangle locations sampled in summer 2010