October 11-12, 2011. Southern Rockies Fire Science Network.

"Disturbance Ecology: A high-to-low roadshow" based out of Laramie, Wyoming.

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Day 1. Pre-trip discussion and introduction.

Issues participants wanted to cover:

Mountain pine beetle, white pine blister rust, impacts of insects on fire regimes and fire behavior, management issues on the Medicine Bow National Forest, management of lodgepole pine forests, aspen regeneration in lodgepole pine forests, public affairs issues.

Day 1- Laramie Range. General disturbance ecology and management approaches in ponderosa and limber pine forests

Stop #1, Pole Mountain (?Megan confirm name)

Summary of management approaches on the Medicine-Bow National Forest – Frank Romero, District Ranger

Frank Romero: This is a multiple-use area where a lot of interesting things are happening. There is high recreational use (for example at the popular Vedauwoo climbing area) and there's also livestock grazing. There are a few large reservoirs and, therefore, diverse water users. The Forest is trying to get a prescribed burn program going. There are various other types of treatments underway, but no commercial harvest or wood production. Mountain pine beetle (MPB) has caused extensive mortality in both limber pine and ponderosa pine in this area. Public education efforts about MPB have been successful - people have learned a lot about the beetles. Some of the main questions people have for us right now are: "What's next? Why aren't you working way out in the woods as well as close to where people live and recreate? What is the mix of species that should be encouraged here long-term?"

Additional comments and discussion:

Question: Which species of pines were affected first by the mountain pine beetle in this area? We can see mortality in lodgepole, limber, and ponderosa pine.

Boyd Lebeda: The epidemic MPB populations became established in limber pine first, then apparently moved into ponderosa pine. Bob Cain: Lodgepole pine was hit hard here by MPB in the past two years. Bill Haagenson: We have seen some unusual things happen during this MPB epidemic. At low elevations, living snow fences that included some ponderosa pines have been hit by MPB! Clearly, the beetles don't read the textbooks.

Dennis Knight: Limber pine is a unique species. Its growth is slow relative to other pines. Its lifespan can be very long – up to 1600 yrs in Colorado! The tree's life history can be described as "Get established, then tough it out!" The bird Clark's nutcracker is responsible for much of the dispersal of this pine.

Seedlings are often found on rocky outcrops where seeds were cached. Seedlings require extra water and heat to get established. Peter Brown: Limber pine was formerly one of the most widespread conifers in the west (?when- Peter?). Then, following a warm/dry period, more lightning-caused surface fires occurred and ponderosa pine became more widespread.

Sara Albers: Limber pine is currently experiencing attacks and mortality from white pine blister rust as well as MPB. To investigate possible mitigation options, the Forest is involved in a study with Forest Health Management to examine the effectiveness of a) spraying trees in campground areas and b) removing cankers by pruning. This site might be a good candidate for out-planting of rust-resistant limber pine trees long-term. In general, the Forest favors allowing opportunities for natural regeneration whenever possible, but it is not known exactly what the regeneration potential will be here. We'll wait to see what comes in naturally, then go from there. In some campgrounds, limber pine had to be clear-cut, but some regeneration is already occurring.

The group examined a limber pine which had a single, dead, lower branch – Dennis was curious about the cause and suspected white pine blister rust. Bob Cain and Sky Stephens diagnosed twig beetles (Pityogenes spp.) These commonly cause "flagging" (death of individual branches) in mature live trees.

We walked to view a mixed stand containing lodgepole pine and ponderosa pine as well as some limber pine. Trees of all 3 species had been impacted by Ips, Pityogenes, MPB, and/or mistletoe to varying extents. The Med-Bow NF staff commented that this area has been cut by timber crews who removed trees that were red and dead from MPB, and it has also been opened up for firewood removal.

Bob Cain: It's important to take out young trees infected with mistletoe if you want a stand to regenerate with a maximum potential lifespan.

Jose Negron: There are some options for spraying individual trees; the main recommendation is carbaryl. However, remember that the EPA approves chemicals based on their safety, not on their effectiveness. And effectiveness varies from one area to another. Some products have worked in California with Western pine beetle, but have been less effective out here. Now that MPB populations are spreading into the Cheyenne area, there will be good opportunities to test and compare chemical treatment options locally.

Sky Stephens: We need to emphasize to the public that it is not possible to "stop" or "fix" this epidemic with treatments like spraying. We have to focus on preparing landscapes to be resilient in the future.

Jose: Vegetation management may be the key to mitigating future mortality. Many of the necessary decisions will be social ones and agencies will have different responses to them. We have to ask, "What levels of forest mortality can we accept?" and "What can we do between outbreaks to minimize the undesirable impacts of the next outbreak?"

Jose: A long-running (20+ yr?- Jose?) study in lodgepole pine forests at the Fraser Experimental Forest has been looking at how different levels of thinning affect forest regeneration, tree fall rates, and,

recently, MPB impacts . Thinning seems effective - the stands that were the most heavily thinned seem to have experienced less MPB mortality. The rate of trees falling in all the stands has been low. We haven't fully analyzed the data, and of course the experimental stands are small, but these findings are interesting.

Laurie: It is difficult to learn from the past in this case because MPB does not leave a clear long-term record in tree rings (like fire does!). Written records go back only so far, and are just a "blink of the eye" compared to the whole time period that could be relevant. By definition, we don't know much about which disturbances may have wiped out entire age classes of trees, because those trees are gone. All we know for sure is that currently, forest structure and types are very homogenous (after European settlement in the West) compared to previous periods of "shifting mosaics."

Peter Brown: Some data I collected in the Uintas suggests that MPB does create heterogeneity in forest composition and structure again. (MORE?- Peter?)

Mike Battaglia: An analogy that I use with neighbors or friends who are not scientists is that forests are like our 401Ks! We need to invest in effective management strategies for the long term, including mechanical treatments and fire, to sustain these large landscapes into the future.

Jessica Clement: How should we visualize the role and impacts of climate change?

Jose: Climate change is one of 3 key factors driving the current MPB epidemic. Warmer temperatures have allowed increased survival and reproduction of beetles. The other 2 factors are stand conditions (crowded, even-aged forests) and drought (which has increased tree stress and vulnerability to MPB attack.) The 3 factors are all related and have combined to make a "perfect storm." (Jose – confirm wording here!?)

Dan Binkley: Was there a definable "threshold" of forest structure and condition that was reached in the early 2000s that triggered the MPB population explosion?

Jose: We are analyzing that now!

Sky: At CSFS we get a lot of questions about the role of climate change, and my response is that we can't directly manage climate, but we can and should manage our forests to offset some of the negative potential impacts of climate change.

Dennis: We need to think about novel ecosystems and new dynamics.

Sara: I agree with Sky - we need to adapt our management strategies, focusing on areas and resources where we can make a positive change.

Chad Julian: When we plan and conduct treatments in the WUI, in Boulder County, we can get a lot of good work done by defining the WUI very broadly, and justifying that definition.

Jessica Clement: What is happening locally with collaborative projects?

Frank Romero: Some work is being done under the HFRA (Healthy Forest Restoration Act) authority. Most of our collaborative work is happening in lodgepole pine forest.

Dennis: In lodgepole pine, fire regimes can be mixed, depending on slope and aspect and presence of insect disturbance. Healthy forests do have – and should have - lots of dead trees! They should have a "salt and pepper" look. When I came here in the 1960s, the forest appeared almost "too" green at that time.

Mike Battaglia and Chad Julian: Wind and weather are key drivers of fire in lodgepole pine forests.

Laurie: Lodgepole may not have been present here before the 18th century. I'm involved in a long-term study (now in its 7th year) reconstructing 1000 years of tree ring chronology on the Front Range. This was the subject of my recent SRFSN webinar – the recording is available on SRFSN's website. (LAURIE – PLEASE CHECK THIS SUMMARY?). We got a lot of information from chunks of downed ponderosa pine that were 8-900 years old. We have determined that the lower tree line (in the Front Range) was around 8000-9000 feet until the 13th century, with ponderosa pine being the dominant species and a surface fire regime. During the pluvial period that ended around 1320, there was greater recruitment of ponderosa, which began to move downslope and had reached around 6000 feet by the 1500s. The mixed-conifer belt was similar to a "crush zone" in a car wreck – it was a band experiencing pressure from both above and below, moving up or down in elevation over time. So, major climate change happened in the 1300s, but species composition didn't change until the 1500s, when stand-replacing fires occurred, similar to the MPB epidemic now! We think that the 1840s were the beginning of the current "climate change" period, leading to big fires in the 1850s, which may have set the stage for our MPB epidemic by initiating stands in the late 1800s that were even-aged and vulnerable to MPB a hundred or so years later. If stand-replacing fires occur from now on, I predict that ponderosa might move up higher, and limber pine might be restricted to rocky areas with greater protection from fire, more water accumulation, and less competition.

Frank: Here on the Med-Bow, landowners have been supportive of mechanical treatments. We have a 125-acre prescribed burn plan approved and ready to go for wildlife benefits. In other areas we are focusing on NEPA clearance.

Bill Haagenson: 21 of the 23 counties in Wyoming have their CWPPs (Community Wildfire Protection Plans) in place. Most have identified priority acreage for fire and treatments.

There was a brief group discussion that management planning is much more challenging in roadless and/or wilderness areas, areas near reservoirs, etc. Daron Reynolds commented that "managed wildfire" is an option in Forest plans.

Back on the bus, group discussion continued.

Jessica Clement : Social science studies of public perceptions of management do reveal there is support for a range of treatment options. A study is currently underway of public responses to the MPB epidemic and public support for post-epidemic treatment options.

Jose: The species affected by an insect outbreak is important. Many epidemics have occurred in the past but with less attention – for example, nobody seems to care about subalpine fir!

We returned to the topic of "What is a "healthy" forest?" and agreed on the fuzziness of this phrase, given that many agents of mortality or disturbance are native species and/or naturally occurring processes. However, most agreed that exotic pathogens like white pine blister rust can be more confidently/accurately described as "unhealthy" components of the ecosystem.

Dan Binkley: It's important to be humble and realistic when making predictions and judgments, always emphasizing the evidence behind our statements.

Dennis: In my 1994 book on the Mountains and Plains, I proudly announced that MISTLETOE was the primary forest health issue facing us in the future! Although assessments of HRV (Historic Range of Variability) are not the only solution, I do recommend that we consider HRV reports as an important tool to help set and describe our forest health objectives.

Laurie Huckaby: A 2008 essay by Pete Fule emphasized understanding the evolutionary processes that created the ranges of ecological processes and species that we see today.

Sky: In some cases it is helpful to make analogies with public health, and emphasize that in most societies there are wide ranges of age cohorts, health issues, etc.

Dan Binkley: And healthy societies do include dead people!

Peter: We can see general impacts of recent climate change if we look beyond the MPB to the massive mortality in other tree species caused by other insects whose life cycles were affected by climate change - like pinyon Ips and pinyon pine.

Sky: In a sense, forests make "100 year bets" that conditions will be favorable throughout their lifespan.

Laurie: And history is written by the winners. Our records are censored – there may be many cohorts of trees in the past that we never know about because they left no trace. Our understanding of forest health will never be quite complete.

Day 2. Stop #1. Lodgepole pine forest (Location name?- Megan?)

Dennis Knight: In earlier work, I focused on the ecosystem/watershed function of lodgepole forests, and the question of how trees use nitrogen (N). Microbes and fine roots close to the soil surface latch onto N and immobilize it. There is a tightly knit nutrient cycling system that prevents N getting washed out of the soil during the spring snowmelt. Our studies investigated how fires, storms, and MPB affect the N cycling process (compared to clearcuts.) We simulated MPB impacts by girdling trees (with permission from USFS) and 5 years later, found they were still alive. The leaf area and root systems declined only gradually over this time. We concluded that the blue-stain fungus carried by MPB is responsible for blocking water/nutrient transport by trees and killing them. We confirmed this by cultiviating fungus spores and introducing them into some trees. The trees were dead and red within a year.

Even when 50% of basal area in a stand was killed by MPB, there was no increase in N in soil solution. In contrast, after a clearcut there is much greater release of nitrogen and nitrate into soils. We extracted root systems of trees killed by MPB and found they extended through at least a 4-meter radius around trees. Thus, when one tree died, its neighbors (including saplings) were able to absorb nutrients. We found lots of ectomycorrhyrizal fungi. This is clearly a forest type with an effective N conservation system.

Monique Rocca: My research group at CSU recently completed a study examining post-MPB forest succession on the West side of Rocky Mountain National Park (Diskin et al 2011, and MS theses by Matt Diskin and Kellen Nelson in 2010). We did a combination of field sampling and succession modeling for a 100-year time frame in FVS (the Forest Vegetation Simulator model). Depending on the initial species composition in the plots we measured, we found that 100 yrs after MPB mortality:

a) Lodgepole pine is likely to replace lodgepole pine in areas where it originally dominated the overstory and understory
b) Spruce and fir are likely to dominate the overstory if they were dominant in the understory
c) Aspen is likely to be released where it was present before and where overstory mortality of lodgepole was high. However, we found that many aspen areas had heavy browsing by elk, and aspen seedlings were having problems getting established.

Mike Battaglia: A recent study in the Fraser area (Collins et al 2011) also used field sampling and FVS modeling to examine the future of lodgepole stands that experienced MPB-caused mortality and then either salvage logging or no treatment. The salvage-logged stands were projected to return to lodgepole, but the untreated stands appeared likely to shift to spruce-fir with higher fuel loads, as Monique's group found.

Question: Are the MPB impacts finished in lodgepole pine stands like the one here, where there is a mix of red, grey, and still-green trees?

Bob Cain: Anti-aggregation compounds are released by MPB when their numbers have reached a certain level; this facilitates them "moving on" after affecting a given stand for a certain period of time.

Jose Negron: Mountain pine beetles are smart – they leave some trees for the next generations!

Paula Fornwalt: At GLEES (Glacier Lakes Experimental Station, near here), the spruce beetle has caused about a 90% decrease in basal area – higher than MPB in pines. In lodgepole plots with MPB mortality, a large release has occurred in the understory. We are seeing quite a bit of Canada thistle.

Frank Romero: Can researchers and others provide the locations of existing plots in studies or surveys on NF lands? The Med-Bow/Routt NF would be interested in an inventory of understory plots and conditions on NF lands. We would link it to the USFS data storage and management program FS Veg, to supplement photos and other data.

[Alan Owen mentioned he'd been involved in a Resource Information System (RIS) inventory on this district many years ago, and Frank replied they were using it!]

Discussion: How best to exchange information on existing work and data? Ideas:

a. Increase frequency of field trips
b. Require data to be entered in FSVeg
c. Clarify/circulate description of a common format for data (FS Veg or other)
d. Have research symposia where RMRS and other scientists provide updates to managers
e. Improve the information exchange process – encourage communication throughout a scientific study, rather than waiting for production of a final paper!
f. Dennis: Managers could consider requesting or commissioning specific reports, as Claudia Regan did for the "Historic Range of Variability" (HRV) reports in Region 2
g. Dan Binkley: Hold workshops for agency personnel and researchers that are more targeted/tailored to issues in a specific place/area
h. Daron Reynolds: Ask if latest field data can be fed into updates of Landfire
i. Megan Kram: Designate the SR FSN as officially responsible for some of these activities as part of its role?

Related topics:
Laurie Huckaby: I'm conducting an inventory of culturally modified trees. The signs are weird diamond-shaped scars about 1 m up from ground, where native people removed the bark and cambium tissue underneath, to be used as food. Medium-sized spruce trees might have 1-3 scars per tree. Most of the trees with these scars date from 1654-1820.

Paula Fornwalt and Laurie Huckaby: Description of stand and carbon dynamics at GLEES (?which species- Paula? Paula please check this summary also)
4 pulses of tree establishment have occurred, in the 1200s, late 1600s, 1700s, and late 1900s. Fluxes of carbon dioxide and water have been measured during the past 10+ years (?late 1990s- Laurie). According to those measurements, the forest functioned as a carbon sink until 2008, when it became carbon-neutral (equal amounts of carbon stored vs. released). However, since 2009 it has switched to being a carbon source. Researchers attribute this change to the high levels of tree mortality caused by insects. Fewer trees are present to respire and photosynthesize.

Pam Motley: How has fire risk in lodgepole forests changed after MPB?

Laurie: In the first year or two after trees die, their red and dead needles can contribute to faster spread of fire if there is an ignition. When needles have all dropped, this risk decreases. Later, growth of the understory and falling of trees create hazardous fuels conditions again. After about 25 years, if ignitions occur, there may be a greater risk of "catastrophic" fire (high burn severity across a large area).

Pam: Is there reason to do more, or different, management in lodgepole pine forests affected by MPB?
Boyd Lebeda: Yes. We need to manage fuel loads for the future, long-term as well as short-term.
Dan Binkley: No! I have the opposite perspective. The fire regime in lodgepole pine is driven more by weather than by fuels – it doesn't matter if trees are live vs. dead.
Boyd: During the recent Salt Fire (Summer 2011, Salmon-Challis NF Idaho), fire behavior did vary, based on the amount of fuels accumulation in mixed gray/red/green stands of lodgepole affected by MPB.

Mike Babler: What are the roles/options currently for "resource-benefitting" fires?

Daron: The way each fire is managed is a forest-by-forest discussion based on local priorities. Some communication happens across forests too. Here, we have found models and tools like WFDSS (Wildland Fire Decision Support System) and FSPro very helpful – we enter our inputs quite easily and get predictions on fire behavior, spread, and effects that have usually been quite accurate.
Kelle: Our ability to put fire on the ground and manage wild fire depends on resources. Our Forest Supervisor is supportive, but in some cases, like the Twitchell Fire(Summer-Fall 2010, Utah), if the fire goes on for a long time he takes some heat.
Frank: We are getting more interested in treating areas beyond the WUI.
Alan: What about maintaining treatments conducted in the WUI?
Frank: Yes, that's important too.
Paula: To address the Qs about fire and MPB issues, it would be good to identify several recent wildfires like the Churches Park fire near Fraser to look at. Most of the area burned in that fire in October 2010 contained MPB-affected lodgepole pine.
Mike Battaglia: My work in the Black Hills on fuel loading after different treatments in ponderosa pine led to reevaluating prescribed burn prescriptions. (?More? Ref?MIKE)
Jenny: We are hoping that researchers and managers can identify priority questions to propose for funding to JFSP through the consortium.
Chad Julian: My agency, BCPOS, has had positive experiences working with many of the researchers on the Front Range on our priority research/management questions. I have some of you on speed dial!
Mike Babler: We hope that everyone here, and all associated with the SRFSN, will send comments, Qs, and information about opportunities to collaborate to the SRFSN!

Bob Cain: Some final words on the MPB: The level of mortality we are seeing in the stand around us would translate to about 50 trees per acre in ADS. There may still be a "shadow" of delayed mortality after the main wave, due to secondary beetles hitting trees weakened by partial attacks. Research in the 1970s suggested that elevation and cold limited MPB. In the later 1910s- early 1930s, there was a very similar epidemic in the InterMountain region. There's a

very interesting summary from 1935 (?ref- BOB?). Because the current epidemic has been so huge, we have seen some weird things happening, maybe with sub-populations of MPB. The MPB are still attacking in mass numbers in some places.

Stop #2: Snowy area - name?- MEGAN

Bob Cain: We are seeing considerable mortality caused by spruce beetle here. Often, blowdowns due to wind facilitate this beetle's activity. Populations can build up from endemic levels in windthrown trees, then move into healthy standing trees when numbers are high. This beetle tends to hit older stands and larger-diameter trees. (Laurie Huckaby estimated the age of a dead spruce tree at this site to be around 400 yrs). Epidemic populations of spruce beetle move tree to tree and cause a high level of mortality in a stand. Unlike MPB, this species doesn't "leave much for the next generations!" Thus, the balance between spruce and fir has probably shifted back and forth over hundreds of years.

Dan Binkley: To play the devil's advocate, I suggest these kinds of assumptions (about spruce-fir succession dynamics) may be "stories" we develop based on our professional opinion but not on a lot of hard evidence. We need to be clear about this, both in the research-management community and with the public.

Jose Negron: The spruce beetle is a cold-loving insect with a 2-yr life cycle. There have been some recent reports of its life cycle accelerating to 1 yr in some sites.
Bob Cain: I think it will probably remain at 2 yrs on average in most places though. The way the spruce beetle impacts trees makes it hard to detect in the ADS surveys. Trees fade in a subtle manner and mortality is only obvious in the 2nd or even 3rd year after the attack. Other insects affecting the spruce-fir ecosystem are Western balsam bark beetle, which primarily attacks subalpine fir, and Western spruce budworm, a defoliator which attacks Douglas firs as well as true firs and spruce.

Mike Babler: What's the typical fire behavior in dead/dying spruce-fir forests?

Daron: One good example is from the Manti National Forest in Utah. Spruce-fir stands in this area were nicknamed "asbestos" because it was so rare for them to burn. One July fire in true fir forest burned in place for about 6 weeks. Then it moved out and into a beetle-hit area with a lot of blow-down, and moved much faster.
Chad: I sneaked onto the Big Fish Fire (2002 in NW Colorado, near Trappers Lake) and observed not much burning of downed wood, but a lot of burning of regeneration. There had been quite a bit of previous beetle-caused mortality in the different forest types in that area, including in spruce and fir.
Mike Babler and Mike Battaglia mentioned an upcoming webinar on insect-fire interactions hosted by RMRS on Oct 18 (This is now available online for downloading and listening: http://www.fs.fed.us/rmrs/presentations/future-forests/fire-risk/)

Jessica Clement: What will the future forest conditions look like in spruce-fir?
Dennis: It will depend on the management approach. If there's no active management, there will be a large increase in coarse woody debris, which some may consider a "wasted resource". However, CWD can benefit soils, provide habitat for many wildlife species, etc. Tree species composition will probably change.
Dan Binkley: Regeneration cycles will certainly differ within the same forests – there will be variation in both space and time. We need to line up some UW graduate students to study and answer this question!
Dennis: An important example and reminder is that the Yellowstone ecosystem was not "destroyed" by the large fires of 1988. Managers can try to encourage a holistic appreciation for forest cycles rather than an expectation of difficult and expensive actions after disturbance.
Mike: The intended use(s) of any given area on National Forest lands should be the factors driving the management plans there.
Sara Albers: Our biggest issue currently in spruce-fir forests is lynx habitat. In some places, we need to manage actively to speed up regeneration after disturbance, create structure for lynx and other wildlife, and protect watersheds. In other places, no management is the only option. Highway 130 is a scenic corridor where no management occurs. In WUI areas, we are exploring the best options for management after fuels reduction treatments.
Chad Julian: Fuels reduction can be challenging – often there is a tradeoff between reducing fire risk and improving regeneration.
Mike Battaglia: In high-elevation forests, fuels treatments and ecological restoration are not the same thing. To determine their options in those areas, managers have to focus on what fire behavior they can accept!

Question: How can aspen regeneration be promoted in beetle-affected forests?
James Fischer: Following treatments, you can use slash material to build fences 8 x 8 feet wide to keep elk out of stands and encourage aspen regeneration when there is no browsing. We have done work like this on the Trinchera Ranch (San Luis Valley, CO.)
Daron: The exclusion areas need to be large – 100+ acres – to be big enough to make a difference.
Dan Binkley: It might make sense to work with the Divisions of Wildlife on this topic, and suggest changes to their hunting and elk management policies in those areas.

Chad: Are fires or beetles the primary driver of change in spruce-fir ecosystems?
Jose: It could be either, or both!

Back on bus: Feedback from participants for planning next roadshow:
Positives:
- Great food, great logistics, everything ran smoothly.
- Excellent discussions happened not only at the stops, but on the bus among smaller groups, and during social events.

Suggestions:

- Prior to trip, ask participants to submit a brief bio that includes a list of their current projects so that everyone could learn more about each others' background and be aware of some additional topics to discuss with each other during the trip.
- Include more resource managers
- Request that the "local host" managers join the group in the bus instead of taking a separate vehicle
- Consider having multiple host agencies for the next trip
- Include more graduate students – especially those who may be open to ideas for thesis topics!
- Cover more stops during the 2 days of the trip if feasible, or consider expanding the time frame beyond 2 days. (However, some people said a 2-day total trip including travel time was about their limit.)
- Visit more active/past/future treatment areas on the ground (sites of prescribed fire, mechanical treatments, and/or wildfires).