Bark Beetle Technical Working Group Meeting Notes
Wednesday, November 4-5
Fort Collins, CO

Attendees

Jose Negron, Bob Cain, Cynthia Snyder, Rich Hoffstetter, Sky Stephens, Rebecca Powell, Tom Zegler, Javier Mercado, Iral Ragenovich, Bill Ceisla, Beth Willhite, Deb Allen-Reid, Roy Mask, Colleen Keys, Liz Hebertson, Brytten Steed, Stephen Clarke, Jason Moan, Monica Gaylord, Connie Mehmel, Robbie Flowers, Tom Eckberg, Tom Eager, John Schmid, Kurt Allen, Bill Schaupp, Jim Blodgett, Joel Egan, Matt Hansen, Steve Mata, Darren Blackford, Rob Progar, Jim Kruse, Justin Hof, Dan West, Darrell Ross, Mike Battaglia, Anna Schoettle, Christie Cleaver, Sparkle Malone, Laurie Huckaby. Video teleconference attendees: Joel Mcmillin, Phil, Barbara Bentz, Amy Gannon, Mike Johnson, Andy Graves.

- Welcome, housekeeping items, local information, etc. Cain and Negron
  - Beth Willhite reported on 2013 Notes, Mission statement and Action Items.
    - Bill Schaupp took 28 pages of handwritten notes in 2013 that Brytten provided to the group for comment before posting.
    - Bill Schaupp agreed to take notes again in 2014 and Bob Cain will provide summary for posting along with Bill's handwritten notes. Robbie Flowers will post final notes.
    - Mission statement was read by Beth and discussion included adding taxonomists and providing input to leadership or line officers. Stakeholders are defined as public and others. Changes are voted on and pass.
    - Action Items from 2014
      - Briefing papers for research funding situation and research needs. Darren Blackford presented a handout of items to cover and things to do. There was a conference call in February that generated a briefing paper and more detailed letter to USFS Research.
      - Develop a spreadsheet of BBTWG completed projects, based on Carl Jorgensen's Priority Projects spreadsheet. Brytten volunteered to pull this together. Jose suggested tying in with STDP. Originally the BBTWG priority list advised FHP funding opportunities but funds are down and connection with STDP is broken. STDP priorities differ. BBTWG project priority list needs to get out to directors and be available for whatever funding opportunities arise. May not always fit Researcher's program direction but other opportunities such as evaluation monitoring (EM) etc. should be explored.
      - Combine BBTWG and WNADWG in Fort Collins – Done. R2 and RMRS host.
    - New Action Items from discussion
      - *New Action item: Get to know your EM/STDP representative and get them involved in supporting these projects.* Other issues: Need a "why" statement to inform decision makers; there is no mechanism to update the list (update top three annually?); perhaps add a ranking point to STDP; more than one priority list has been developed (WBBRG, Negron et al 2008 Five research needs in the West….); FEEDBACK through EMAIL Brytten will coordinate but FHP will need to populate this database

- *New Action Item* Brytten agreed to set up an example Database of what's been done. Joel M. agreed to help starting with current work and perhaps add older work.
- *New Action Item* Come to the BBTWG with three priorities and updated spreadsheet with what is being done.
- *New Action Item* - Talk to FHTET (Beth, Robbie, ?) about need for tech support
- *New Action Item* – Let Robbie Flowers know your suggestions for the website. Look into 503 compliance needs.
- *New Action Item* – Get Directors input for letter regarding FHTET's role interacting with field/ support/ priorities. May not need letter but informal communication.
- *Continue to explore best options for virtual meetings* – This meeting was held the RMRS in FT Collins because of VTC access and was well attended virtually. VTC attendees are asked to give feedback on how it worked out for them.

WO update from Tom Eager representing Bob Rabaglia

- Acres treated accomplishment is being largely carried by gypsy moth slow the spread activities. Bark beetle activity generally declining nationally (FHTET top five included bear damage)
- www.barkbeetles.info is up and emphasizes keys, photos and lots of information
- FHP Budget Breakdown
  - Salary and Technical Assistance are about 55%
  - Survey and Monitoring are < 5%
  - Methods Development is about 6%
  - Treatments are about 35%
- National Early Detection-Rapid Response System (EDRR) – 10 states funded in 2014. Most activity in CA, NY, FL, GA, TX, PA are surveyed annually 4 additional states for 2015 are not yet selected. No new spp. found in 2104 except for one in Puerto Rico. Also identifying a fungal association on an ambrosia beetle and doing taxonomy work with polyphagous shot hole borer.
- Verbenone on-line database – Judy Adams has retired and this database has little data entered since. This was a topic in 2013 and has continuing issues. *Action Item – get access to BBTWG, revive it and get a password available.* New deployment techniques may improve results; need to have better definitions for success.
- Bark Beetle Taxonomy Trainings – In 2014 there was a session in FL that was well attended and another that Jim LaBonte hosted in MT. High interest in hosting one in Ft Collins.

<u>Research Updates</u>

- Western Bark Beetle Research Group
- Matt Hansen reported on three RMRS Logan bark beetle projects. See Bill's handwritten notes for details.
  - 30 year old diameter limit cuts were reexamined (Shoshone plots – Kurt Allen assisted). Study results have been submitted to Forest Science.

    - Fuel loading following bark beetles and snag fall rates (Accepted in Forest Science). Snag fall rates quantified (mostly from base w/in 8-10 years)
    - Evaluation of potential spruce beetle repellents in cooperation with Synergy Semiochemical and Steve Munson (1 out of 15 compounds may have potential based on antennal activity).
- Barabara Bentz reported on 3 studies.
    - Looked at MPB threat to Great Basin bristlecone pines. MPB hits were in limber pine rather than *P. longaeva*. Other pests may be more important such as a wood borer and dwarf mistletoe. See Bill's handwritten notes for detail.
    - She also provided a response (American Naturalist) to questions about why mountain pine beetle bivoltinism does not occur contrary to report by Mitton et al. (See voltinism comments by Rich Hoffstetter in Bill's notes).
    - Barbara also covered studies on how long woodpeckers forage on killed trees and if there is a preference for whitebark or limber pine by MPB in mixed stands.
- Liz Hebertson presented information on much of which can be found in "Jenkins, MJ, Hebertson, E.G., Munson, A.S. 2014 **Spruce Beetle Biology, Ecology and Management in the Rocky Mountains: An Addendum to Spruce Beetle in the Rockies.** *Forests* **2014**, *5*(1), 21-71. Some details in Bill Schaupp's notes and observations from Matt Hansen include the following: a summary of spruce beetle outbreaks beginning in mid to late 1980s. Some places >90% mortality of susceptible trees. Still active where haven't run out of host. Munson attributes the start of it all to a large landslide on Wasatch plateau. Look at disturbance history! Epidemic and endemic population prefer fresh fallen (Wallen Rafta 2004) When/where host material is produced influences success of brood (Heberton and Jenkins 2007). Synchronous eruptions of pockets widespread rather than discrete. Not all disturbances result in outbreaks. This initiated construction of outbreak chronologies warming temp, past fire exclusion, suppression, decreased forest management. Extensive use of dendrochronology. Outbreak somewhere on landscape every 17-19 years; specific location ~75 years. 750 years ago outbreak of equal severity on Wasatch Plateau (pollen in lake beds). Historic outbreaks associated with warm temps in late fall and warm winter temperatures. Large scale outbreaks related to positive AMO (Atlantic Multidecadal Oscillation) and high summer vapor pressure deficits climate and host tree stress. Fits well with temp thresholds (Hansen and Bentz) switch to more univoltine. Matt – warm summer, early flight can complete generation by fall (Schmid showed, they reinforced). Diapause induction prepupae $\leq 15^0$ c for > 40 days models used now to predict % univoltine to risk rate univoltive and semivoltine population same reproductive capacity but according to Wallin and Raffa these populations keep going at outbreak even when temperature not optimal. Behavior, heritable, {endemic beetles more attracted to stressed trees as outbreak increases more are attracted to terpenes in healthy trees} and amplified by higher population density, others: host condition stand susceptibility(necessary) this is fundamental. Natural enemies, woodpeckers, medetera, fungi and associates, antagonistic and beneficial.

Green sanitation drives woodpeckers to residual infested trees and pushes birds to impact more heavily. Matt: cannibalism is probably #1 source of mortality, they eat each other as much as phloem (eggs in cluster). Leptographium abietinum still major bluestain, it makes ergosterol (nutrient) – Benty/Six. But other fungi less well known role (Trichoderma kills). Bacteria also play a role, some in oral secretions of SB with pack around galleries (inhibits fungal growth, perhaps). Ecological implications – A LOT. Fuels alterations alone do not increase susceptibility of spruce-fir stands to wildfire. Management must consider how mortality influences fire suppression operations and safety. Also looked at management impact to fire, but control plots still highest crown fire. Bark beetle management - Prevention: silviculture, get in ↓% spruce and ↓ basal area before outbreaks. Suppression: sanitation/salvage has to be timely and early; even if late, get spruce regeneration in blast zones…if lots of advanced regeneration, don't need to expose mineral soil/sanitize-salvage. Cut blocks too big? Can happen, if too big in unmanaged, will have to plant. Uneven age strategy with ~ 2 acre maximum size cuts. Advanced regeneration brings it back faster; in litter there is a fungus which kills spruce seedlings, but not subalpine fir, 3-500 years to get spruce back. Trap tree- VERY expensive, hard to do…be near road. Spill over risk is very high. $825/tree per trap tree overall, one person 10 hour day with log wizard can do one tree!!! Carbaryl still best preventive (fall treatment get 2 years) may have to prune; hydraulic needs; have to pretreat/protect things in campground. ≥20" DBH is too big for ground spray. Emamectin benzoate, etc. NOT OK so far, new formulations are being looked at. Pheromone treatments, no effective one yet. Direct suppression is such a problem that developed recreation sites must be treated. Huge list of challenges (Bill too tired to copy☺), no idea where this is going can't manage Goshawks and Lynx at same time in same place.

Review of work since 1977, not to replace spruce beetle in the Rockies, contains this info and more = Munson, Hebertson and Jenkins (order?)

- Jose Negron, RMRS and Laurie Huckabee (RMRS-ecologist)

Reconstructing historical MPB activity above 10,000 ft. elevation. Recent climate change has affected beetles, which some presumed to be never above 10,000 ft. Sample down logs and get death dates…exceeded their expectations! 5 sites on Arapaho-Roosevelt NF, subjective selection, old sites with old logs (death date) and sample surrounding trees for release date. Had to have some bark, exit holes, galleries and if found, blue-stain breakage at 1-4 feet above ground (stuff on ground rotted; stubs stayed). Lodgepole is not so easy/sensitive to age with dendrochronology vs. spruce or ponderosa, so they used nearby ponderosa ring chronology to secure death dates. Growth release not best with rings (change in stand structure), recent releases showed up but many LPP codominants did not show release…asymmetrical. 1522 was oldest death date and some living dated back to 1580s. 1910-1916 death dates at ~ 10,500 feet established in late 1500s. Also a 1700s…and 3 ponderosa remnants with fire scars, earliest dates to 1368, live D-F to 1522 > relic ponderosa from medieval warm periods, southern most site…something caused shift over

to LPP. Next site similar, also 1500s pulse and some old P Pine with fire scars. Northern site 10-15 years earlier (1890-1908) with MPB, trees a bit older/larger from earlier origin, oldest site, converting to spruce. Another site – (1909-1921) recruitment period, still saw MPB also establishment events late 1600s and late 1700s. Final site (in middle) – nothing 1910-1916 MPB part, younger, 1700-1800s established, smaller trees hit in 1940s outbreak no pondo some limber.

There is considerable mortality in all sites from current episode. Type conversion may occur there due to climate change. The past reveals the future? Existing trees persist but young trees need favorable climate right then after a disturbance. Will expand to western slope. Understory LPP was what responded, prob. was sparse.

- Jose: vegetation management and MPB in the Black Hills, Kurt Allen and Blaine Cook's brain child. Will stand density reduction treatments mitigate MPB mortality?
    - Small plots (John Schmid's great work) done. Big landscape scale makes this unique.
    - Treatments done during epidemic.
    - Treatment areas are timber sale units (50-300 acres). Always uncut parts in any sale ∴ nice opportunity to have paved areas. Heavily managed forest, treated last 10 years. MPB started ~2000 or so.

	Treated	**Untreated**
PP-BA	42.8 (2.4)	114.2 (4.4)
QMD	13.23 (0.3)	12.7 (0.3)
Shoot for 60 to 70 BA but sanitation lowers that tree spacing focus (20-25 feet), across all diameter cut		
% PP-BA Killed	6.2 (0.02)	36.8 (0.3)

    - We recognize that we can't stop epidemic. We're choosing where to protect = a difference. Some places lost it all; some controls have surprisingly survived. Lessened, didn't stop epidemic – still lots of green, sanitation played a role (~50,000 trees/year infested taken to the mill). Big impact on the landscape. Still get benefit even though done during epidemic. Fresh log decks and stumps actually attract MPB(see of mman in 1950s PP trap tree paper). Epidemic done in most of plots. Some hits in treated, sure, but overall it works.
    - Thinning/sanitation probably protected adjacent untreated stands by removing MPB and lowering beetle pressure.
    - Next question – What is right size to treat? Does cutting 10 acres matter? 100 acres – yes.
    - Mike B. – BH-NF adds volume fast; at 70 feet^2/acre will become susceptible sooner than 40 feet^2/acre.

- Jose – Tree fall rate at Fraser Experimental Forest 1970s treatments to different densities on flat ground = Large west – wide free fall database. As a group let's do it! Also group idea – get big database.

- DFTM/DFB – with Ann Lynch and Jose Negron and me: published: Forests 5:3131-3146 (2014). One reviewer denies the fire suppression impact. How will climate change effect ecology of defoliators? 1st DFTM outbreak/changes in stand structure in southern California, Tom Coleman.

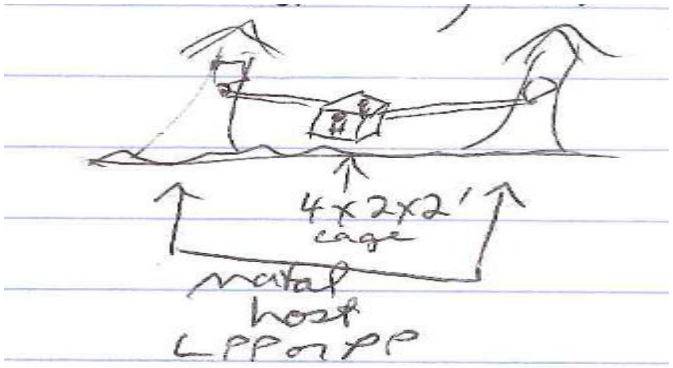
- Javier Mercado – revision of Hylurgops, here 6 years was in Puerto Rico, phoretics on MPB (Forest Service)
  MPB – Mite fungal associations in northern Colorado, being trained as entomologist now (Taxonomy on the side), mites, nematodes, fungi and bacteria.
  Phoretics search.
  Host search: gut yeast metabolize a penine to verbenone.
  Host detoxification: G. clavigera feeds on limonene – a qualitative defense compound against MPB, breeding niche enrichment: (missed)
  Phoretics ≠ carrier host effect, SB < nematode eating mites > nematodes < SB
  Blue-stain: MPB – no G. clavigera = no reproduction (Paine and Six in 1998)
  Mites + blue-stain: SPB > T. ips > O. minus < SPB
  Carrier host effects can vary antagonistic or mutualistic maybe the phoretic biota may relate to bark beetle population epidemics. E.g. Red turpentine beetle in North America – 3 spp.; Leptographium, procerum, wagneri, terebrantis; in china – 11 spp.; L. procerum + 5 Leptiographium spp. + 4 Opphiostoma spp. + (?)
  Interactions are not well known. Mites on MPB are fungivores, predators and omnivores. Studied in CO in 1960s and 1970s but didn't sample other than P Pine and other data gaps; they're working on data gaps, esp. phoretic strategies, other hosts, blue-stain on location of body, by sex and year, also mite V.S. beetle blue-stain species carried to trees. Fires wiped out some of his sites in CO, has transects, P Pine, Limber and Lodgepole. People usually collect under the bark, but six research shows MPB under bark differ in % blue-stain V.S. flying MPB, so he collects adults outside trees arriving on trees. [> 400 MPB, > 200 associated insects, > 1,500 mites.] 3 days after 1st kwon attack. One e.g. tiny mite on muscles under wing (Hofteller helped him) Tarsonemus endophloeus.

  As the outbreak subsided, it was hard to find beetles in 2013. Mite load per beetle may have effect (Missed some species). Taronemus ips fungal disperser. Stain shows blue–stain spores, esp. in sporotheca structure. Javier shows different species and distributions. Couldn't show mite transfer to clerids (surprise) or other associated species. Also looked at Dendroctonus murryane and not find some mites; also RTB and Medeters and braconids. Some similarity perhaps with Pseudoips mexicanus.
  Blue stain fungi on MPB:
  Ophiostoma montium + Grosmannia elaverga also in Canada Leptographium longiclavatum (no sexual form found) new report. 1st place outside Canada, Javier reports L. longiclavatum in CO (he uses morphology). Molecular stuff is harder for taxonomy.
  Ophiostoma montuim carrying mites high % of their carrier MPB also had O. m. on elytra V.S. way less O. m. on elytra of MPB with mites without O. m. ∴ Mite carries blue-stain to MPB, right? Also found maybe new fungal association from mites. A Ceratocystiopsis sp. 1. Mites carry fungal sexual spores of O. montium more often than the MPB. "Is this important? Probably so".
  SUMMARY

New blue-stain in CO, mites 5 phoretic mite sp. Incl. new genus, mites do carry BS + montuim, 3 S amt. contributed not significant in this study. Overall BS freq. on MPB-mite complex decreased 2012-2013, O. m the most, as MPB population goes down.
2014 Could only find arriving MPB on limber, no PP or LPP
Future? mites drive BS genetic variabilities. BS decline 2013 on MPB pop. on beetles O.M. tolerates warmer; other 2 do better in cooler temps. Preliminary #s indicate MPB on PP differ from those arriving on limber based on what they carry…load of mites same on male and female, but differ in 4 species. NO pattern to explain hypothesis.

- Dan West presented PhD study on MPB impact adjacent on alternate pine hosts?" host selection between LPP and PP ~ 8500 feet is ecotone in CO. (Manycoauthors/coworkers)MPB moving east to west, will it crash or switch? Old ADS maps back to 1950s, any transition? NO pockets, yes, nothing big. Looked at reports, too, because ADS record had big gaps. Again, no shift. Literature had 2 papers. 1) Richmond 1933, MPB selected PP 2:1 over LPP and 2) Wood 1963, PP, SP and JP, no support for natal host preference (Contra Hopkins). Manipulative XPTS: no preference. Field observations: Stay where they are…Observed. Baker et al 1971, MPB in mixed LLP-WBP-SAF, no transition; Diana Dean 2007 + some speculation for natal pref., but higher mortality limber in mixed LPP-LP. Beetles behaved, moved from east to west across plots/transects at ecotone. 19 sites, 3 reps/site, 57 transects 171 plots; also fixed radius 1/20th acre. 2x/year surveyed every tree on every ½ acre. Most plots 1:1, PP:LPP 2004-2007, then 2008-2011. Anything published, anecdotes, they called around, got 0.

  Largest % mortality in 10-15" DBH class (both PP and LPP), lots of survivors. PP mortality predicted well by LPP and PP mortality previous yr. LPP mortality only predicted by previous LPP mort. Mortality rate fastest at first, then declined/flattened.



Every 6 days and reared for 5 weeks PP and LPP bolt in each, 45 days at 72^0 generation complete. Peeled logs, logs similar in diameter, phloem thickness and area.
2x - MPB entered from LPP V.S. PP
2x – MPB chose PP over LPP
2x – ex. PP V.S. LPP ∴ fecundity is the same.

Tree defense cut out of equation, it's a buffet. 1st female entering/mating makes pheromone so choice bioassay of chunks sunk in wax 32 replicates, 4x/day took data;

after 48 hours they either die or enter. Prefer ponderosa A-LOT 1^0 attraction! But Why? Measured lots of beetle size: beetles coming from or preferring PP are LARGER. Total lipid content didn't differ between hosts…it's just size. Looked at individual fatty acids, no difference between natal source. Maybe it's just a coincidence, LPP and PP epidemics? Maybe they emerge sooner from warmer PP? 30 each PP and LPP, collected emergence cages 2010 and 2011, highly synchronized, no diff. between hosts at 8,600 feet.

Sex ratio also didn't change by host over time, 2:1, female to male early then to 1:1, female to male late ∴.it really did seem they moved into PP from LPP.
Oleoresin 24 hour/period, flow and content, 3 sites, preformed host defenses
PP has ~ 4x the resin flow V.S. LPP
Total monoterpenes don't matter
LPP has way more limonene (folic to bbtlz)
Differ but what does it mean?:
Δ-3 carene
β – phelanderene
myrcene and α phelanderine
Carbohydrates: glucose, fructose, sucrose same, xylose more in PP; Pinitol more in PP, known as feeding stimulant in other organisms.
Climate correlation? Based on climate regions of CO. Palmer drought index very different between PP and LPP regions. 2007-2009 mild/severe drought in PP, coincident with ADS data and blow up in PP mild/normal in LPP until 2011, wet then drought.
Summary
PP and LPP mortality levels same across years MPB 2:1 in PP without defense, no diff in brood prod in cut logs or phenology or sex ratio.
{Missed some}
Why now? No idea. Passive traps don't work for beetle pressure closest polygon, ADS, didn't work. Defense/drought differences, maybe, maybe not.

- Rich Hofstetter: (Handout) note 14 papers listed.
  Bark beetles: Biology and ecology of native and invasive spp. due out in January. >600 pgs. ~30 authors. Can buy at WFIWC.
  1. Beetle "smash" = get beetles, freeze them, punch hole to phloem, put beetle in and put core back in smashing the beetle
  - much slower mortality this way, fungi only
  - action of larvae accelerates death rate

  Tried to match species between baited and smash trees<150-200 attacks on treated tree will kill>100 attacks/m^2. Covered trench with plastic then dirt. Collected resin and phloem thru time, could analyze.
  Characteristics of foliar fade, when is it really dead? What color? They bait trees in AZ and can't get them killed! Thus, plus cost, the stress due to thinning.

2. Viruses of bark beetles: next generation genetic sequences, enrich DNA, huge variety, insect, fungal and bacterial viruses
3. Acoustic research on all sorts of insects. Natural history: how does a bark beetle hear and with what do they hear. Extraordinary sensitivity of technique frequencies change, pattern doesn't, can differentiate WPB and MPB. Playbacks do affect behavior; very sensitive! Also can hear a 1mm coffee borer walking on coffee cherry berry or dragging paintbrush across a leaf.
Works in lab/phloem sandwiches, bolts but NOT in trees. The radio doesn't affect.
EAB didn't work- EAB larvae or cerambrycids, no effect on EAB or woodpeckers.
Will try recordings in trees to see if that really is how woodpeckers find larvae.
4.5 k tone slowed brownish-green mold (Korean paper) but not with bark beetle fungi, couldn't replicate that result, maybe sound alters environment? Ultrasound can purify water.
(Not a hand out)↓
5. Technique for studying arthropod and microbial communities within free issues
A new visual/video journal, "How to make a phloem sandwich" is available form Rich Ips: Discoveries- Female mates again after laying an egg, she lays, she clicks, he comes, and they mate. This may be why male keeps gallery clean. Play wrong sound and she plugs the gallery.
6. WPB pheromone signal compared with SPB
- catch more SPB in WPB lure
- differs from farther east
- WPB pheromone components differ California Vs. Arizona a LOT
- >50% of time male makes mistake, comes out chaos at moment, no stability, same pheromone brings in both WPB and SPB, doing job with one species

7. Mite-microbial interactions (Javier and Jose and others)
8. Bark beetle book, dedicated to Don Bright

- Jeri Lyn Harris- Forest Health Monitoring Evaluation. Monitoring (Handout 2010-2014 projects)
  - FHM change – Borys gone to PNW; Bob R and Rob Cruz trying to cover (in flux for a while FY15)
  - 5 FHM regions each sends 5 in to compete
  - handout: 2010-2014, bulk of projects awarded to west, focus and criteria listed
  - Fire funding removed; now have climate change, aerial survey, unusual weather events, invasives, fire disturbances, validating risk map (esp. at smaller scale, states) and tree mortality. Interior west R1-4 and 8 states.

  Focuses on aspen and "focus on margins" projects on 5 needle pines. Annual priority issues. Ties to Forest Health Monitoring issues (see Natl. reports) e.g. ADS. Also some other cost/economics issues. 3 year max, shorter is better, ≤$100,000. Practical field-

oriented research no “philosophical” interest. 508 compliance is a coming requirement [ADA law as amended]
Sept 30 is deadline to submit programs to mega-region lead. Still connected to FIA, but as budgets shrink, the P-3 remeasures may not happen.
Brytten- Shows call letter for STDP, EM and FSPIAP has web links
STDP: What about using outline proposals first? Brytten only one to do that (R1/4) 2 pages for everything not incl. budget
EM – Jeri Lyn _ 4 pgs., please no method detail or graphics or citations (say available on request). Sometimes on west coast ask for update. STDP needs some methods/technology

- DFB in Idaho -2014- Tom Eckberg (and Gina Davis) windstorm in Clearwater valley = 2010 in November inf. in 2011 then ADS in 2012 self-funded, north of Orophino. Flight monitoring paired with temperature at 4 sites operational mass trapping 8 sites (24 traps), 2 sites 6 traps and 4 sites 12 traps.
  I – button temp loggers
- >230,000 beetles caught with some spillover into DF and Larch
- Enhanced and regular lure didn’t seem to differ spillover
- Poor performance in western larch; one ppine hit hard by RTB
- Operations liked mass trap – do it where you can manage them- over flowing cups made believers out of some foresters 16,000-18,000 beetles
  Darryl R: BUT we don’t really know what killing lots of beetles means, nothing in literature…same with ips with Norway catching millions and not knowing if it worked.
  Nancy S.: Thinks she sees declining trends near traps…commonly recommends 2-3 year trapping…said when done for fewer years, ration rebounded she thought. Add to other activities. This is a big research need! Don’t get ahead of the research with technology. Tom’s trying to just concentrate in one small area.
- MCH deployment, esp. in public areas and near seed trees 25 acre, also 65 acre park/visitor center- Worked.
- Did some trap trees near Lake Pandoreille, felled in fall, checked next year but Spring ones not, 2 years.
- Lethal trap trees= trap trees fill up and MCH drives more away…spray Permethrin (Tenguard) lower 12’; another treatment; Beauvaria treatment screens under tree along stem to
- Permethrin didn’t repel (Carbaryl might have), killed some cleids. Did well.
- Beauvaria no good.

- Tom Eckberg in CO on family land 35 acre “We tried everything” at Cherokee Park MPB≤1974-1982 started in PP; 2007-2012 MPB started in LPP.
- Trees small but not young
- In 2011 trees hit by MPB fell by this year

- firewood, scenic, ecology=values
- Wave of MPB came their way
- Tenguard Astro ornamental label; onyx forestry label

2009 Sprayed trees around cabin; cut back salvage green info.; 2010- debarking, more spraying, mire solarizing, Dad speaks to rod assn. Larime CO. takes heavy handed "control MPB (and lots else) or else we'll do it and bill you but IF it comes off federal land not your fault," well letters stopped as beetles came in. Poured diesel on some logs. Kept at it, tried verbenone, hired a professional sprayer debarking (slow but satisfying) $11/tree to spray, built his own sprayer, landowners paid ~4-11,000 per property, >350 trees sprayed did some planting, even some verbenone.

VERDICT: plenty of green trees still, sprayed trees not hit, spraying is tedious, direct control prob. not worth it but felt good, his parents moved. State program described (Eckberg's got some cost share)

NOTE: DFB- Streaming unreliable (Amy G.) and they don't use in contracts (Felled lots of trees).

- R. Progar and Chris Fettig work and proposals

1) SPLAT-VERB, LLP and MPB described product (organic and biodegradable)
    a. Dose/response: 4 treat, 1 control: 7g pouch and 7-5-3g. Splat baited each tree. Check next year. N=30/treat individual tree 3-6 hits on treat, 29/30 control hit
    b. Stand level treatment; 5 treats 5 reps before flight complete survey to exclude currently used grid pattern. 5-1 acre plots/treat.

    "Likely to die" – pitch tubes around tree, frass ring. Need still wait 'til spring, fairly flat area, plenty green tree hit in area.

    BA is >250 ft^2 with ~10 DBH. Not worked up yet. Are pouches easier to use? Smaller point sources?

    "Splat- Verb Plus" – Munson, Lia, Danny, Chris, Rob, Lassen and Umatilla. 5 reps/1 acre/each place baited in center of plot, complete census before, 2-5 hits per plot or nearby as background. WPB in PPine will resurvey 2015. Aromatic when applied, weeks later volatized – is this formulation problem? Sent samples back, may be gone out. FAILED both places. Will repeat.

    WPB+"SPLAT-VERB-PLUS" proposal submitted both area and individual tree treatments maybe not able to use baits where populations building. Sandy Kegle lead. LOTS of cooperators. Combine verbenone and sanitation to protect small stands. 5 years running sites across west biggest differences 20-30% between control/treat, MS done, cooperators reviewing.

    SO what about more point sources of verbenone? Dave Warkarchuck brought this up last year: What about doing this: cannonball [pouch] V.S. shotgun [many smaller pouches] with same amt. of AI? OR reduce verbenone and add green leaf volatiles. Took full day to pull down the pouches from a study…don't need to pull down splat. Cost/acre is a bit higher for splat. Use more, price goes down. Less than 2

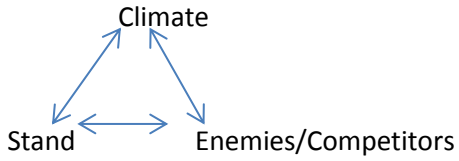
pouches/free. 1 year, bears ate some splat; a better formulation this year, less splat fell off the tree.

- Cliff Bradley- [remotely from Missoula office] - gives presentation NSF grant, MT BioAgric., One – (MBAI) working with all sorts of beetles across west.
  Fungal Biopesticides
  Cordyceps, Beauvaria, metar/imperfect stage usually what's used; drill thru cuticle, blastospore replicates, bug dies, grow out, sporulate. Can be relatively selective. Regulated by EPA as biopesticide ($500,000/per) some products sold worldwide for agriculture. Now have NSF grant and MT dept. commerce (small). Not yet labelled for forestry. Idea maybe add natl. products to increase efficacy (e.g. chemical increases wandering prior to boring, longer exposure to spores) doing lab bioassays with seem to sort well by dose – SP, RTB and DFB and MPB in the mix. Field trials 2013, 2014 – apply to trees, bait them, 30 trees/treat and control, LPP and PP sites. Checked attack level, survival and beetle larval effects. Commercial application equipment for chemical too high volume coverage varied too much off ran off a lot, 1 year later still find spores on tree. Found some effects inside infested trees- shorter galleries, fewer eggs, infected larvae- lots of variation. 2014 – 2-3 liters/8"-12" tree; SOLO company low volume backpack sprayer 300 psi holds ~10 gallons hits up to 35 ft. Had 2 spp. Ips, WPB, RTB and MPB in ponderosa. Find lots of native pathogens, usu. Beauvaria (selective agar sorts them to 8 spp.) Some D-F, too. Found some strains more effective than current commercial formulation. Idea: get 1 or 2 strains cover several spp. of Dendroctonus and a multiple Ips part. Another selection criterion is non-targets.
  Clerids are susceptible; Oatomids NOT (can't kill!)
  Strategy: tree protection maybe not best, maybe yes; trap tree (with Eckberg); spruce beetle (Munson, Blackford); Dendroctonus sp.; Ips pini (NAU, Hofstetter).MPB? SB- hot spot treat down trees. Ips- slash plie treatment. Spring V.S. Fall applications also possible [cbradley@montana.com]- Company and = 4 staff incl. Cliff
  Self-perpetuating? Seasonal variation in native fungal spp. presence, prob. will recede into background with others. Will it displace natives? Don't know. In agriculture, pretty sterile scene; rangeland trials go back DNA fingerprinting didn't seem to displace, could find their stuff, too.
  Field searches for new strains: in 1 pt. baggie of duff a base of tree, always multiple pathogens. IDEAL- work with isolate and put back where collected in use, minimize "exotic" issue. Ambrosia beetle chews. Takes several days for infected tree to die.

- Steve Clarke- [Handout] R8 BBTL Projects [red bay ambrosia beetle in sassafras and red bay not fungus but tree dies]
  Mississippi, Southern Pine, MS- One Hotspot, moved north from Homochitto NF red bay got most spots. In some 1-2" pine, seen usually when host depletion in outbreak, odd deal. Scattered VA, GA and? scattered stuff NJ and Long Island are hot spots recent outbreak in Honduras; will go down with Ron Billings.

Projects

1) Transect. Anything west of MI River? Still haven't gone west; nothing last 15 years; use traps into Louisiana. Also what is population needed to get spread? Had some localized dispersal with traps, nothing long distance. Also checking genetic differences in SPB from MS, LA and TX (John Reeve SIU), looking (Harold T.) what climatic conditions would loft SPB west or cause increased dispersal. Traps at ~5 mi interval; can fly 2 – 3 mi on own.
2) Natural enemy and competitor project. Looked at other stuff they caught (competitors' enemies) 2 traps/site: for SPB and monochamus. No analysis yet but reject the hypothesis that competitors and enemies would increase during outbreak. Why? Only 1 year outbreak (↑ 7 generations of SPB/year), Ips ↑ in LA than MS, trap timing ideal for SPB not as good timing for clerids and borers, climatic factors. Maybe? Maybe enemies and competitors keep outbreaks from starting. Last 15 years the 7-8 year cycle of SPB outbreaks NOT seen! It all collapsed in many states in 1990; usually had at least one state with SPB even when others collapse.



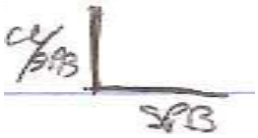
This triangle leaves out forest management component! (Has MS on this) also species composition changes! Used to plant 1,000 trees/acre loblolly from wherever, now try better.
3) Data Portal- States and feds enter all bark beetle infestation, prevention and survey data into portal; maintains consistency and accountability in bark beetle record keeping and analysis. COOP with FHTET, good relationship (Tony at FHTET) past few years- also SPBIS being converted/streamlined.
R-3 could put their SPB data into it!
4) Ips monitoring (long term probably kills more than SPB) COOP with U of AK better methods need to estimate mortality so far roadside surveys best.
5) Botanigard, test effectiveness against SPB doesn't prevent, may kill brood/prevent emergence.
6) Other:
    - Develop degree day model for the SPB spring and fall surveys- missed some spring outbreaks.
    - Revise SPB prediction (Brian Sullivan) - add endo-brevicomin ↑ 4m away ↑ catch, incorporate.
    - SPLAT for suppression of SPB (will try in Honduras)
    - Plans fell thru to test trap trees

- Beth- "Flight response of *Ips paraconfusus* in the Columbia River Gorge, WA to 3 lure formulations"

- scenic site, lots of attention
- CFI not found in WA before and their lure ~$59/each due to ipsdienol: Limits monitoring and suppliers
- Dave W. new economical process, wanted testing standard trap test- 8 blocks, 24 traps, moved traps each week when collecting, 7 weeks: standard, enhanced, standard and myrtenol. Problems- wind blew off the cups; some lures disintegrated. Enhanced lure preferred over pure Myrtenol also beat standard lure [47, 792 caught] "enhanced' is less pure product.
- Enhanced lure at ~50% less cost
- Myrtenol promising; add to enhanced?
- Explore effectiveness of "trap out" treatments in infested log decks.
- Killing really big trees 30" without WPB; moves down top and branches and woodborers in base.

- Tom Eager- Situations NW of Cortez, Dolores RD southern Colorado: Round headed pine beetle, Ips and WPB- heavily hit trees, RPB alone (usually expect a mixed brood). RPB flies late in year, in September, 2013 rain driven floods of CO severe condition. Saw lots of pitchouts, unsuccessful attacks prediction it'll go away is wrong, has intensified but not spread.
  SB- On continental divide, 5 years so far SB moves into area, field says MPB co-occurs, prominent attacks on LPP not always successful, large number attacks. Pulled in Javier M. into this; did a training thing because SB hit under bark flakes no pitch tubes; 100s of LPP without brood development; huge number SB hits. Hard to get good specimens – gone or resin encrusted and tough to extract dead beetles at base of the tree. In some places saw LPP die. SB was outside LPP cover type and moved into it.
  D. muryannae usually attacks lower on bole. Sibling species with SB. Darre/Liz see brood develop in LPP and death. Darren/Liz send Javier SB and ? beetles. [LPP? D. muryanna?]
  Note: Don Wood didn't have specimens. Spray LPP and Spruce instead. Saw some bluestain in attacked LPP.
  Routt – Jeff W. saw D. muryannae in base of spruce, perhaps because weakened by SB. Are other beetles just coming into the party?

- Joel Egan- [Bill's comment "Missed a lot here"] - <u>BEETLE PRESSURE</u>
  % suitable host/year killed, next season ADS will use severity classes- this is inherently, how often do people count beetles? – Yes, with SPB…SPB/day + clerid/SPB ratio



  SPB- 1 spot/1,000acres susceptible=outbreak. How fast trap fills? Across years how varies? Need a temporal component. John Withrow and Jose with DFB a few years ago.

- Average distance between infestations increased a lot as indicator of epidemic pressure. Gaussian surfaces, ∑ between pixel distances using ADS. (Withrow et al publication). Has some problems with were acknowledged.
- Counts successfully colonized trees % suitable host/year killed differs by beetle and by region/area within beetle- ADD other veg, climate, other factors to help understand pattern esp. for studies, how to equate between measure the BBTL/pressure
- Reading literature, hard to interpret.
- Push for people to report pressure however you can. Small group look into it? Sky and Joel E. and Progar and Jose and Hansen- How to demonstrate efficacy?! Usually we don't, but FHP should do that! If knew beetle pressure could help a lot. In AK, long term plots monitored gives background info (Ips perturbatus), Skeeter Werner's legacy. How do they know what is elevated? Use 2 component lure traps (less hot to avoid killing enemies). Peer review process should take care of this, perhaps. If it was important, wouldn't reviewers request beetle pressure info be included?
- Literature is rife with silence and inconsistent use of terms.
- Explain what you mean by your metric estimating beetle pressure.
- Publish a good paper, cite it and have others do that, too (e.g. Munson and Bentz on SB)

- Conditions Reporting

[Note: Some annotation lost during conditions reports.]
R1/4 – 3 handouts
Dave Beckman's Last year (as aerial surveyor contractor); Stephanie Sandoval took over, Root collar weevil in SAF, significantly girdles trees, dig in soil around stem…larvae bigger than RTB larvae, huge numbers. [Root weevils in DF fire up after drought in R6]. Gregarious feeding under the bark. Have a chip cocoon. Steve Munson said on their transect (1990s) saw some weevil, no ID in high value ski area. TELL Liz with any citings. R2 no hand out.

R2 CO: SB in southern CO, increasing rapidly (most dramatic) ~500,000 acres in 2014. Since 2000, WY and CO >$1x10^6$acres. New blowdown in Sangre and MT. Evans and along I-70. Expect more and more trouble including ski corridor and Front Range and Monarch Pass. Pinyon Ips gone down; Fir engraver dropped from last year. WY: MPB really down on Shoshone, Med Bow-Routt and Bighorn – lots of dead spruce in northern Wind River – range. Wind River and BLKH still really heavy, Medicine Bow successful regeneration. SD: No ADS, all photo interpreted…no data until end of year. State/USFS paying a lot to get "more precise"data much later. Rosebud NE /S and PF – high Ips levels continuing, Ips grandicollis mostly (projects on Rosebud and central SD) Move wood, concentrate and trap there. 2014 – Wettest year in CO in a long time! NE and SD not so much.

R-3 (handout) – NM lots of Ips knausi and Ips calligraphus, makes old surveyor's rule of using I-40 to separate BB and Ls doesn't work. AZ -DFB around Wallow Fire increasing a lot, hot spot of all sorts (Ppine – across landscape) and spruce with I. hunter. Dry winter. Why not

MPB in Ppine in NM – too warm? Competition? Dendroctonus adjunctus 1/year but SPB and WPB – 2 generations/year.

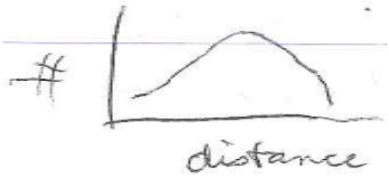
R5 – 2014 3rd driest year recorded. 2 handouts, only 1 copy I have. Cyndi is trying to…

R6 Hand out. At or below 10 year average in WA. 5 needle and LPP mostly has gone down in OR. –LPP intense hot spots, bleeds into others. 2012 winter damage in Gorge → pockets.

R10 Had a really wet year in AK. SB and Ips perturbatus are at relatively low levels (last few years) little SAF mortality, limited range, probably WBBB.

- Darrell Ross (Oregon State University)

1) MCH work concentrating bubble caps 4-5x release concentrated in same area
   a) Less walking, lower deployment/cleanup cost
   b) Same number/acre and amount AI/acre
   c) Will manufacturer make bigger bubble caps or just change label or what? Student on it, due to publish/finish soon – Brian.
2) Dan Ott– MS at Univ NBC with MPB in LPP. Spruce beetle with Fettig, Munson and Ogden folks.
   a) Permanent plots outside management array of timelines of epidemic, measuring lots of things, ecosystem response to SB mortality.
   b) Blue spruce less often killed by SB V.S. Engelmann. Why? Baited both spp., Blue way less hit.
3) With Brian Sullivan
   a) "Multifunctional" pheromone work (near Stanley, ID)
   b) Rudinsky said MCH multi-functional, Pitman said no.
   c) Single release, traps at distance downwind should see a switch from repellent to attractant to none makes ecological sense – MCH in air means successful infestation somewhere, attract at LOW concentration and as beetle gets close will repel.



4) Hercon – Biodegradable release test MCH burned up last time Mr. Ketchum; this time Mr. Haley (can't say). Laura Lagarus and Phil M. have helped.

- Iral on behalf of Harold Thistle (FHTET – Motown, WV). He has money set aside to fund work on:
  - Meteorology, pheromone, spray application
  - Not a lot of money, might add to ongoing (~$15,000) to collect the meteorology or a small study (e.g. Steve's SPB trap transect)

- Last year no one put in for money! First time!
- Relies on Iral (and ?) to recommend/evaluate. Has $30-60,000 usually.
- Would like recommendation by February.
- There are criteria (can send) and a call letter

- Update on FINIT=Brytten
- Send out/put in drop box for folks to use
- Tony C. started, got STDP money but Frank S. sees it and new National Director fits her vision (other bells, whistles), R ¼ says that's nice but we need it now.
- Mark Zwifler with Drew McMann got it running with Pivot Tables and EXCEL…took rest of money to follow Frank's vision. There is a wish list.
- Ongoing

- FIDLs, Rob Flowers, R6-FHP-RO, Will contact those authors needing update. New work. DFTM – Lee Pederson; GSOB – Tom Coleman, "508 compliance" is a big deal. Update, Daniel Reboletti waiting for action, western Bark beetle, revised DFB [done]. Contact Rob Flowers if want to do a new one. Old FIDLS = should these be scanned? Grey Literature? YES!

- Western Forest Insects Update – Iral. Lots of folks said they'll produce – she's still waiting. Still needs help with Hemiptera, Passalidae, cleridae [Javier's hobby, he says]/ Ostomids and biggest need (18 pgs in old) weevils;

  Lepidoptera and Scolytidae done. Mites done. (Alex Mangini). Some APHIS folks. ↑80% revised if everyone produces. Got 18 GB photos from Ciesla last night, more photos from Mal Furniss. Hasn't started matching pictures yet. Mike Harvey did structural pests. Waiting for list of needed photos)

- Website (Robbie Flowers) - R6 to keep what they're doing for now. Maybe mimic what Joel E did with WFIWC.org to get up separate sites.

- March 30th – April 3rd for WFIWC. FS employees, tell Andy info he needs it we need the chief's approval. Action for those USFS folks intending to attend.

Next BBTWG meeting: Ogden, Utah (October 20th is Steve's Birthday)

- Project Ideas - Please get info on WPB-MPB-IPS interaction, especially WPB-MPB.

<u>MPB</u>

1) In sugar pine – odd different behavior is it MPB? Sinuous egg gallery, top kill and 1 sample with Celia Boone's work with Brent Murray didn't sort well. He's willing to look at samples. Need cooperators. Cyndi and Iral will help (Bill made comment.)

2) Darren – (handout with many projects) see R4 special projects. Bristlecone pine lacks b-carotene; Justin Runyan and Mike Jenkins working on it; more on way.
3) SDTP proposal (Brytten and Fettig and Runyan) crowns of trees fading fall rates of needles, fall rates of trees. R1, 2, 4, and 5.Chris' EM plots. Russ Parsons. Request tagged LPP and known year of hit, tell them. Opportunity: Across R1, 2, and 3, seek post-doc. Sharon Hood – funded age class diversity of Interior Mountain West will set stage for "Beetlegeddon."
4) Jose - data on the fall rates requested. Known death year! (Like Brytten in LPP)

R-3 Walnut twig beetle

Corwin Parker. Walnut twig beetle project trapping study. Eastward expansion in SW New Mexico, will it go across TX?

Also old school host range study – hanging branches to see what it is. Submitting proposal to get host range walnut better defined, locate stands, redefine host layer, do genetics, improve risk map. Also R4 putting in project (#11 in Darren's list).

Farthest: Spokane, WA, NE-MD, San Diego CO. Colorado → 126 counties, see Seybold's latest info on WTB distribution.

SB projects: R4 list #4, #6, and snowpack with post-doc in Mike Jenkins Lab how does SB mortality affect snowpack?

Beth: wish list – even aged wish list does DFB come into a girdled snag? Which is better for wildlife? Trees girdled in crown – get DFB. Trees girdled at base – less DFB. Baits don't kill DF on west side. Liz has some info on this?

ADJOURN

Note: The above was transcribed by Bob Cain and Isaac Dell (R2) from meeting notes taken by Bill Schaupp (R6)