

# 69<sup>th</sup> Annual Western Forest Insect Work Conference Proceedings



ANCHORAGE MARRIOTT DOWNTOWN  
ANCHORAGE ALASKA  
APRIL 22-25, 2019



# Western Forest Insect Work Conference

69<sup>th</sup> WESTERN FOREST INSECT WORK CONFERENCE  
ANCHORAGE MARRIOTT DOWNTOWN  
820 W 7TH AVE, ANCHORAGE ALASKA  
APRIL 22-25, 2019

FINAL AGENDA (All times AKT, presenters in italics)

## MONDAY, 22 APRIL

1500-2000 Registration Open

1600-1700 Executive Meeting

*Kodiak Rm*

1800-2000 **MEET AND GREET SOCIAL**

## TUESDAY, 23 APRIL

0700-1000 Registration Open

0700-0800 Coffee and Tea

0800-0815 **WELCOME TO ANCHORAGE/HOTEL DETAILS/HOUSEKEEPING**  
*Elizabeth Graham, USDA Forest Service Forest Health Protection*  
*Jason Moan, Alaska Division of Forestry*

*Anchorage Rm*

0815-0915 **DISTINGUISHED SPEAKER**

*Anchorage Rm*

### **Entomology in Alaska: A dozen years of discovery**

*Dr. Derek Sikes, Professor of Entomology and Curator of Insects, University of Alaska Museum, Institute of Arctic Biology, Department of Biology and Wildlife, University of Alaska Fairbanks*

0915-0945 **MEMORIAL SCHOLARSHIP (2018) PRESENTATION**

*Anchorage Rm*

### **Spatiotemporal dynamics of forest insects in an era of global change**

*Mr. Sam Ward, University of Minnesota*

0945-1015 BREAK

1015-1145 CONCURRENT SESSION 1

**1) ECOLOGY AND MANAGEMENT OF SPRUCE BEETLE IN WESTERN NORTH AMERICA**

*Anchorage Rm*

*Chris Fettig, USDA Forest Service Pacific Southwest Research Station*

**Here we go again: The scale and impact of the current spruce beetle outbreak in Alaska**

*Jason Moan, Alaska Division of Forestry*

**Update on the current spruce beetle outbreak in British Columbia**

*Jeanne Robert, Ministry of Forests, Lands, and Natural Resource Operations*

**New research on spruce beetle adult overwintering, flight ability and reproductive development**

*Kathy Bleiker, Telsa Willsey and Brian Van Hezewijk, Canadian Forest Service, Natural Resources Canada*

**Interactions among spruce beetle, Engelmann spruce phloem chemistry, and fungal symbionts**

*Thomas Seth Davis and Jane Stewart, Colorado State University*

**Lessons learned from battles on the front lines**

*Roger Burnside, Alaska Division of Forestry (retired)*

**2) OPEN SESSION**

*Juneau Rm*

*Sky Stephens, USDA Forest Service Forest Health Protection*

**Assessing forest health in Alaska**

*Stephen Burr, USDA Forest Service Forest Health Protection*

**Impact of the aspen leaf miner on plant physiology and performance**

*Diane Wagner, University of Alaska Fairbanks*

**Impact of defoliators on subsistence life style (title pending)**

*Nathan Lojewski, Chugachmiut Inc.*

**Current recommendations for applying MCH to prevent Douglas-fir beetle infestations**

*Darrell Ross, Oregon State University*

1145-1315 LUNCH (on your own)

**3) ECOLOGY AND MANAGEMENT OF SPRUCE BEETLE IN WESTERN NORTH AMERICA (PART 2)**

*Anchorage Rm*

*Chris Fettig, USDA Forest Service Pacific Southwest Research Station*

**Mycoinsecticides for forestry: Spruce beetles as a model system**

*Cliff Bradley* Montana Microbial Products LLC, *Rich Hofstetter* Northern Arizona University, *Danielle Malesky* and *Amanda Grady* USDA Forest Service, and *Thomas Seth Davis* Colorado State University

**Recent advances in semiochemical-based tools for management of spruce beetle**

*Chris Fettig*, *Matt Hansen*, *Darren Blackford* USDA Forest Service, *Agenor Mafra-Neto* ISCA Technologies Inc., *Jason Moan* Alaska Division of Forestry, *Steve Munson* USDA Forest Service (retired), and *Dave Wakarchuk* Synergy Semiochemicals

**Systemic injectables for tree protection from spruce beetle and its associated fungi**

*Don Grosman* Arborjet Inc., *Chris Fettig*, *Darren Blackford* and *Steve Munson* USDA Forest Service

**Landscape scale silvicultural considerations for resistance and resilience to spruce beetle outbreaks**

*Justin DeRose* USDA Forest Service Rocky Mountain Research Station, *Marcella Windmuller-Campione* and *John Long* Utah State University

**Extension and outreach to communities impacted by spruce beetle in Alaska**

*Jessie Moan*, Cooperative Extension Service, University of Alaska Fairbanks

**4) CLIMATE IMPACTS ON FOREST DISTURBANCE IN ALASKA**

*Juneau Rm*

*Jeremy Littell*, DOI USGS Alaska Climate Adaptation Science Center

**Climate and wildfire: global-to-local interactions of climate, weather and fuels**

*Jeremy Littell*, DOI USGS Alaska Climate Adaptation Science Center

**Future boreal forest fire in Alaska: results from the Alaska Integrated Ecosystem Model**

*Amy Breen*, University of Alaska Fairbanks

**Contrasting climatic and biotic drivers of tree growth in Interior Alaska**

*Sean Cahoon*, USDA Forest Service Pacific Northwest Research Station

**Climate-beetle interactions in forests of southwest Alaska**

*Amy Miller*, National Park Service-Denali

1445-1500 BREAK

1500-1630 **GRADUATE STUDENT SESSION I**

*Anchorage Rm*

*Andrea Hefty*, USDA Forest Service Forest Health Protection

**Fidelity and fitness effects of the fungal symbionts of invasive *Euwallacea* ambrosia beetles in Southern California**

*Christine Dodge* and Joseph Carrillo University of California Riverside, Akif Eskalen University of California Davis, Richard Stouthamer University of California Riverside

**How are conifer constitutive and induced defenses related? A multiscale approach to testing for tradeoffs**

*Michael Howe*, Claudio Gratton, Ken Keefover-Ring, Jun Zhu, and Kenneth Raffa, University of Wisconsin Madison, Charles J Mason Pennsylvania State University, Kimberly Wallin, University of Vermont, Alvin Yanchuk Ministry of Forests, Lands, Natural Resource Operations & Rural Development, British Columbia

**A study of the landing behavior of pioneer colonizing walnut twig beetles, *Pityophthorus juglandis*, in the context of host and non-host volatile profiles in a riparian forest in northern California**

*Jackson P. Audley*, Crystal S. Homicz and Richard M. Bostock University of California Davis, and Steven J. Seybold USDA Forest Service

**Arthropod communities in restoration of slash pile burn scars**

*Christine Mott* and Rich Hofstetter, Northern Arizona University

1630-1700 **INITIAL BUSINESS MEETING**

*Anchorage Rm*

1730-1830 SHERYL COSTELLO MEMORIAL FUN RUN

*Darren Blackford*, USDA Forest Service Forest Health Protection

1900-2100 **POSTER SESSION/SILENT AUCTION FOR MEMORIAL SCHOLARSHIP**

*Haines Rm*

*Monica Gaylord*, USDA Forest Service Forest Health Protection

**WEDNESDAY, 24 APRIL**

0700-1000 Registration Open

0700-0800 Coffee and Tea

0800-0845 **DISTINGUISHED SPEAKER** *Anchorage Rm*

**History of Alaska Forest Entomology and other "Stuff"**

*Dr. Ed Holsten* USDA Forest Service Forest Health Protection (retired)

0845-1030 **GRADUATE STUDENT SESSION II** *Anchorage Rm*

*Andrea Hefty*, USDA Forest Service Forest Health Protection

**Effects of invasive grasses and grazing on plant and pollinator diversity and abundance in the Colorado Front Range**

*Khum Thapa-Magar* and Thomas Seth Davis, Colorado State University

**The entomological and commercial impacts of bundling in thinning operations of northern Arizona.**

*Marcos Riquelme*, Richard Hofstetter and David Auty Northern Arizona University, and Monica Gaylord USDA Forest Service

**Phenology and infection rates of pine wilt disease vectors in ponderosa pine**

*David Atkins* and Thomas Seth Davis, Colorado State University

**Biological control agents of larch casebearer (*Coleophora laricella*) in eastern larch (*Larix laricina*) in Minnesota**

*Spencer Stout*, University of Minnesota

**Field responses of mountain pine beetle and *Ips grandicollis* to pheromone baits in a novel sympatric range**

*Zach Smith*, University of Minnesota

1045-1700 **FIELD TRIP COMBINED WITH ALASKA CHAPTER OF THE SOCIETY OF AMERICAN FORESTERS**

*Jason Moan* Alaska Division of Forestry, *Jessie Moan* and *Gino Graziano* Cooperative Extension Service, *Tom Crockett* Chugach State Parks

Depart hotel, drive down Turnagain Arm with forest health stops in Anchorage, Bird Creek Campground, and Girdwood Ranger District

1800-2200 **2018 FOUNDERS AWARD BANQUET**

**It seemed like a good idea at the time (or what could possibly go wrong?)**  
*Dr. Staffan Lindgren, University of Northern British Columbia*

**THURSDAY, 25 APRIL**

0700-0800 Coffee and Tea

0800-0845 **DISTINGUISHED SPEAKER**

*Anchorage Rm*

**British Columbia's forest landscape: managing in a different ecological state.  
Insect outbreaks and everything else.**

*Dr. Lorraine Maclauchlan, Ministry of Forests, Lands, Natural Resource  
Operations & Rural Development, British Columbia*

0845-1015 CONCURRENT SESSION 3

**5) FOREST POLLINATORS**

*Anchorage Rm*

*Thomas Seth Davis, Colorado State University*

**The challenges and pitfalls of sampling forest pollinators: common  
problems and how to avoid them**

*Justin B. Runyon USDA Forest Service Rocky Mountain Research Station, and  
Casey M. Delphia Montana State University*

**Impacts of a forest disturbance on pollinator abundance and diversity: An  
example from interior Douglas-fir**

*Gabriel Foote and Darrell W. Ross Oregon State University, Christopher J.  
Fettig and Justin B. Runyon USDA Forest Service*

**Insect-plant pollination networks of central Alaskan boreal forest in the  
presence of invasive white sweetclover**

*Laura Schneller Alaska Center for Conservation Science, University of Alaska  
Anchorage, Katie V. Spellman and Christa P. H. Mulder Biology and Wildlife  
Department, University of Alaska Fairbanks, and Matthew L. Carlson  
University of Alaska Anchorage*

**Patterns of pollinator diversity along elevation gradients in Denali National  
Park**

*Jessica Rykken National Park Service, Derek Sikes and Adam Haberski  
University of Alaska Fairbanks*

**6) REACH OUT! ENGAGING WITH THE PUBLIC ON FOREST HEALTH ISSUES USING SEVERAL DIFFERENT APPROACHES**

*Juneau Rm*

*Jessie Moan, Cooperative Extension Service*

**Montana's outreach efforts to discourage firewood from out of state**

*Amy Gannon, Montana Department of Natural Resources and Conservation - Forestry Division*

**Forest health: putting knowledge to work**

*Glenn Kohler, Washington Department of Natural Resources*

**Working with limitations; how to use social media and improve websites as a federal employee**

*Elizabeth Graham and TJ Holley, USDA Forest Service Forest Health Protection*

**Tweet! Post! Like! Incorporating social media into a forest health extension program**

*David Coyle, Clemson University*

1015-1045 BREAK

1045-1200 CONCURRENT SESSION 4

**7) FOREST POLLINATORS (PART 2)**

*Anchorage Rm*

*Thomas Seth Davis, Colorado State University*

**Native bees, riparian restoration and ungulate herbivory at the US Forest Service Starkey Experimental Forest and Range**

*Sandra DeBano, Samantha M. Roof, Lauren A. Smith DiCarlo, and Scott Mitchell Oregon State University, Mary Rowland USDA Forest Service, Skyler Burrows Utah State University*

**Seasonal pollinator diversity of rangeland grasslands and neighboring forested habitats in eastern interior Alaska**

*Justin Fulkerson, Paul Schuette and Matt Carlson, University of Alaska Anchorage*

**Bark beetle outbreak enhances pollinator habitat and site occupancy in high elevation forests by reducing stand densities**

*Thomas Seth Davis Colorado State University and Paul R. Rhoades Idaho Department of Natural Resources*



## Discussion

- 1200-1330 LUNCH (on your own)
- 1330-1400 FINAL BUSINESS MEETING
- 1400-1530 CONCURRENT SESSION 5

### 8) NEW DEVELOPMENTS IN INVASIVE FOREST INSECTS IN THE WEST

*Anchorage Rm*

Steve Seybold USDA Forest Service Pacific Southwest Research Station

#### **Assessing the risk of two hardwood pests in southern California (polyphagous shot hole borer and goldspotted oak borer)**

*Andrea Hefty, USDA Forest Service Forest Health Protection*

#### **Updates on invasive forest insects in Oregon and Washington and on the overseas Asian gypsy moth program**

*Robbie Flowers, USDA Forest Service Forest Health Protection and Glenn  
Kohler, Washington Department of Natural Resources*

#### **Detection survey and impact of the Mediterranean pine engraver in urban forests of the American Southwest.**

*Steve Seybold, USDA Forest Service Pacific Southwest Research Station*

#### **Update on invasive forest insect issues in Alaska**

*Jason Moan Alaska Division of Forestry*

### 9) Forest Health Management Tools

*Juneau Rm*

Open discussion lead by *Darren Blackford* and *Carl Jorgensen*, USDA Forest  
Service Forest Health Protection

- 1530-1600 BREAK

- 1600-1700 GROUP DISCUSSION AND CLOSEOUT

*Anchorage Rm*

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Local arrangements: Jason Moan ([jason.moan@alaska.gov](mailto:jason.moan@alaska.gov))

Program: Elizabeth Graham ([elizabeth.e.graham@usda.gov](mailto:elizabeth.e.graham@usda.gov)), Kathy Bleiker, Thomas Seth Davis,  
Chris Fettig, Monica Gaylord, Jason Moan

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## Poster Titles and Authors

- 1. The Fourth National (U.S.) Climate Assessment – Forests.** *Christopher J. Fettig, James M. Vose, David L. Peterson, Grant M. Domke, Linda A. Joyce, Robert E. Keane, Charles H. Luce, Jeffrey P. Prestemon, Lawrence E. Band, James S. Clark, Nicolette E. Cooley, Anthony D’Amato, and Jessica E. Halofsky.*
- 2. Drought, Beetles and Tree Mortality.** *Christopher J. Fettig, and Leif A. Mortenson*
- 3. Western Forest Insect Work Conference Founder’s Award: An Amazing Legacy.** *Founder’s Award Committee (Joel McMillin, Chair, Bill Riel, Lorraine Maclauchlan, Steve Seybold, Steve Cook, and Jackson Audley).*
- 4. Seasonal Effects of Systemic Insecticides on Spotted Lanternfly Life Stages and Associated Sooty Mold Production.** *Don Grosman and Brian Walsh.*
- 5. Evaluation of Systemic Insecticide and Fungicide for Protection of Sycamore from Polyphagous Shot Hole Borer / Fusarium Dieback.** *Don Grosman, Akif Askalen and Cavell Brownie.*
- 6. Effects of Warmer Temperature on Reproductive Development of Spruce Bark Beetles.** *Marianne E. Davenport, Gregory J. Ragland, Barbara J. Bentz.*
- 7. Potential native natural enemies of invasive species *Vachellia nilotica* in Baluran National Park, Indonesia.** *Shafia Zahra, Richard W Hofstetter, Balqis Arche Nofinska, Fadly Muhammad and Edwar Josen.*
- 8. Northwestern range expansion of European gypsy moth despite low predicted climatic suitability.** *Brian Aukema, Patrick Tobin, Aubree Kees, and Marissa Streifel.*
- 9. Population genetic structure of western North American spruces.** *Monia SH Haselhorst and Ann M. Lynch.*
- 10. A partnership between NASA and the Forest Service to improve aerial detection surveys with remote sensing applications.** *Ryan P. Hanavan; Bruce Cook, Lawrence A. Corp, Mary Verry, Brent W. Oblinger, Robbie W. Flowers, Tom W. Coleman, and Andrew D. Graves.*
- 11. Evaluating methodologies for converting legacy trees per acre measurements to percent mortality measurements.** *Benjamin C. Bright, Andrew T. Hudak, Arjan J.H. Meddens, Joel M. Egan, Carl L. Jorgensen, and Franciel E. Rex*

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## **New research on spruce beetle adult overwintering, flight ability and reproductive development**

Kathy Bleiker, Telsa Willsey and Brian Van Hezewijk  
Canadian Forest Service, Victoria, British Columbia

A two year life cycle is common for spruce beetle (*Dendroctonus rufipennis*) throughout most of its range. Diapause is induced to survive winter conditions, first as larvae and again as teneral adults. Larval diapause is facultative, but adult diapause is widely considered essential for reproductive maturity and flight. We used flight mills, as well as flight muscle and ovariole dissections, and introduced pairs to bolts, to assess the flight capacity and reproductive maturity of fully darkened brood adults that had no cold diapause or a cold period. Only beetles that emerged after a cold period could fly; these beetles were also reproductively mature when they emerged. A proportion of the beetles that did not receive a cold period eventually emerged, but could not fly and were not reproductively mature; however, these beetles were able to infest new host material and some laid viable eggs. Flight muscles initially degenerated and then started to thicken again following introduction to new host material, but development was insufficient for flight on mills. The average distance flown for female beetles that did fly in a 23 hour period was 11 km and the longest uninterrupted flight distance for was 36 km. Our results indicate that an adult cold diapause is essential for dispersal, and important, although not mandatory, for reproduction.

## **Mycoinsecticides for forestry: Spruce beetles as a model system**

Cliff Bradley (Montana Microbial Products LLC), Rich Hofstetter (Northern Arizona University), Danielle Malesky (USDA Forest Service), Amanda Grady (USDA Forest Service), Seth Davis, and Andrew Mann (Colorado State University).

Fungal bioinsecticides, “mycoinsecticides”, offer potential as safe effective bioinsecticides for native bark beetles and invasive insects in forestry. Mycoinsecticides are widely used in agricultural crops but have not been developed for control of forest insects. Work in developing mycoinsecticides for spruce beetle provides insights into the opportunity and issues in developing forestry mycoinsecticides. Isolation of 30 strains of the insect pathogen *Beauveria bassiana* from Rocky Mountain forest habitats suggests this fungus occurs widely and may play a role in bark beetle population cycles. Field trials of selected isolates showed 85% adult mortality in year 1 and 58% in year 2. However larval mortality was much less, indicating adults reproduced before succumbing to infection. Larval mortality was not sufficient to limit population. In field sampling, *B. bassiana* was isolated from infected 3<sup>rd</sup> and 4<sup>th</sup> instar spruce beetle larvae in untreated controls. This demonstrates that strains of *B. bassiana* can grow in spruce beetle galleries and infect larvae distal from adult entry. In screening studies, the isolates of *B. bassiana* showed wide variation in tolerance to conifer monoterpene defense compounds and in ability to compete with the fungal symbiont of spruce beetle, *Leptographium abietinum*. In addition to bark beetle infectivity, habitat adaptation is important in selecting effective fungal pathogen strains for developing bark beetle mycoinsecticides. The team plans to investigate methods for applying *B. bassiana* to establish as an endophyte in beetle galleries as a means to control larvae and limit populations.

## Landscape scale silvicultural considerations for resistance and resilience to bark beetle outbreaks

R. Justin DeRose<sup>1</sup>, Marcella Windmuller-Campione<sup>2</sup>, and James N. Long<sup>3</sup>

<sup>1</sup>USDA Forest Service, Rocky Mountain Research Station, Forest Inventory and Analysis, Ogden, Utah

<sup>2</sup>Forest Science Department, University of Minnesota, Saint Paul, Minnesota

<sup>3</sup>Department of Wildland Resources and Ecology Center, Utah State University, Logan, Utah

Bark beetle (*Dendroctonus* spp.) outbreaks cause large amounts of mortality outstripping wildfire by an order of magnitude. Temperatures play a role in the direct control of ectothermic beetles, but the structure and composition of the host plays an indirect role. Host-specific, and forest type-specific bark beetle hazard indices characterize the attributes that make shifts in beetle populations from endemic to epidemic more likely, but represent ‘resistance thinking’ because they apply to the stand level. At the landscape-level outbreaking beetle populations can overwhelm host defenses. However, the utility of hazard indices is not lost when scaled up to the landscape. Virtually all the hazard indices share in common three key variables—stand structure, stand density, and species composition—each of which have a strong ecological basis. First, bark beetles prefer larger hosts and stand structure characterizes mean tree size. Second, bark beetles prefer host trees which are more susceptible, i.e., stressed, which increases with stand density. Third, bark beetles prefer stands with more host trees and composition characterizes stand-level species diversity. We provide a conceptual model to apply these three characteristics more generally to entire landscapes of forests (i.e., stands). Quantitative or qualitative (e.g., low, medium, high risk) thresholds can be used to calculate the proportion of the landscape at various hazard levels with respect to each of the three variables. Plotting all three on the conceptual model will help indicate landscape-level hazard. As an example, we used one full cycle of Forest Inventory and Analysis data (2006-2015) for the state of Colorado, where we quantified for each stand (regardless of forest type): stand structure as quadratic mean diameter; stand density as relative stand density index, and; species composition as the Shannon Diversity Index based on species-specific basal area. Frequency distributions of each of these three variables were then individually assessed for the relative proportion of the ‘landscape’ considered susceptible to outbreaking beetle populations. Well over half of the landscape had a mean diameter > 10 cm, and an even larger portion of the landscape had high Shannon Diversity—both indicating high hazard. Only about 20% of the landscape had relative stand density index > 0.6, which indicates self-thinning stands. In conclusion, the conceptual model is an important way for silviculturists to think about their stand in relation the larger landscape, and can quickly and efficiently indicate what elements of structure and composition need to be managed to lower hazard overall.

## **Tweet! Post! Like! Incorporating social media into a forest health extension program.**

Dr. David R. Coyle, Clemson University Department of Forestry and Environmental Conservation, [dcoyle@clemson.edu](mailto:dcoyle@clemson.edu)

### Abstract:

Forestry is a major economic driver in many parts of North America – in the southeastern U.S., it has a multi-billion dollar impact on the region’s economy. In developing a regionally-relevant forest health and invasive species extension program, social media was incorporated into the educational platform. This approach allowed a greater reach – particularly important to access and assist the 13-state region. Social media can be an effective tool for science communication (#scicomm) if used appropriately – it can also result in a great deal of wasted time and effort. Different demographics of society tend to use different social media platforms, and to get the most “bang for your buck” in social media communication it is crucial to know who’s using what platform. It is important to tailor your extension products to the desired audience, and to not discount or ignore more traditional extension materials (e.g. fact sheets, radio, emails).

## **Montana's outreach efforts to discourage firewood from out of state**

Amy Gannon, Montana Department of Natural Resources and Conservation - Forestry  
Division

Invasive tree pests threaten a diversity of Montana forest resources including wildlife habitat, forest products, urban canopy cover, water quality, shelterbelts, recreation and tourism. A variety of known and potential pests can be transported from out-of-state on firewood therefore, the Montana Department of Natural Resources and Conservation collaborated with various agencies to deter the importation of firewood. The Nature Conservancy's "Don't Move Firewood" campaign was a key partner in offering a unified message across the country and provided support in graphics, advertising and diverse outreach activities. The USDA Forest Service provided a multi-state "Competitive Redesign Grant" to fund outreach efforts across neighboring states. The formation of the Montana Invasive Species Council further solidified Montana's efforts to identify and mitigate invasive pest pathways.



## **Evaluating methodologies for converting legacy trees per acre measurements to percent mortality measurements**

Benjamin C. Bright<sup>1</sup>, Andrew T. Hudak<sup>1</sup>, Arjan J.H. Meddens<sup>2</sup>, Joel M. Egan<sup>3</sup>, Carl L. Jorgensen<sup>4</sup>, Franciel E. Rex<sup>5</sup>

<sup>1</sup>USDA Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory, Moscow, ID

<sup>2</sup>University of Idaho, Department of Natural Resources and Society, Moscow, ID

<sup>3</sup>USDA Forest Service, Northern and Intermountain Regions, Forest Health Protection, Missoula, MT

<sup>4</sup>USDA Forest Service, Intermountain Region, Forest Health Protection, Boise, ID

<sup>5</sup>Federal University of Paraná, Curitiba, Brazil

The Forest Health Assessment and Applied Sciences Team (FHAASST) has updated their methodology for reporting damage intensity in Insect and Disease Survey (IDS) data. Since 2016, damage intensity, formerly reported as dead trees per acre (TPA), is now reported in five classes of percent tree canopy mortality (1-3%, 4-10%, 11-29%, 30-50%, and >50%). Several methodologies exist for converting legacy TPA measurements to percent mortality cover measurements: 1) the remote sensing-based method of Meddens et al. (2012), 2) the categorization of TPA measurements via the histogram-matching method of FHAASST, and 3) the categorization of TPA measurements into broad classes (1-10%, 11-30%, >30% mortality cover) via the method of Egan et al. We evaluated these methods using field observations of tree mortality and WorldView 2 (WV2) remote sensing data in an area of recent elevated insect activity in the Nez Perce National Forest in central Idaho. We found moderate agreement (40-59%) between cumulative IDS and WV2 tree mortality severity when comparing three classes of mortality severity (1-10%, 11-30%, and >30%). Overall accuracies were greater when three classes of mortality, as opposed to five, were compared. The Egan et al. and Meddens et al. (2012) methods outperformed the histogram-matching method.

## Variability in Adult Reproductive Diapause of the Spruce Beetle from Colorado and Wyoming Populations

- Marianne E. Davenport, University of Colorado Denver
- Manaal K. Dalwadi, University of Colorado Denver
- Barbara J. Bentz, USDA Forest Service Rocky Mountain Research Station
- Gregory J. Ragland, University of Colorado Denver

Life cycle synchronization is a key adaptation to seasonally variable environments. Many insects synchronize by entering dormancy, or diapause, during unfavorable conditions while growing and reproducing during favorable conditions. Timing of diapause is particularly critical in determining voltinism, the number of generations per year. Because diapause induction is often environmentally sensitive, small changes, e.g., in temperature, may change voltinism. Spruce beetle (*Dendroctonus rufipennis*), an eruptive forest pest, is often semivoltine (1gen/2yrs), but univoltinism (1gen/yr) has been observed in warm years and geographic regions, increasing population growth. There is a facultative, prepupal diapause that may flexibly produce univoltine or semivoltine life cycles, depending on temperature. Spruce beetles also enter an adult reproductive diapause that is typically assumed to be obligate. However, if aversion of adult diapause is possible, warming temperatures could produce more complex population dynamics.

We tested whether beetles reared under atypically warm conditions could be flexibly induced to avert adult diapause. In summer of 2018, we cut infested spruce trees from Colorado and Wyoming that were brought to lab and held at 22°C. Emerging beetles were collected and either inserted into bolts with a mate to test for reproductive success, or frozen then later scored for reproductive maturity. We found that indeed, a small but statistically significant proportion of beetles can avert adult diapause and produce viable eggs without chilling, a trait that could potentially evolve and cause more rapid population growth in response to warming temperatures.

## **The Fourth National (U.S.) Climate Assessment – Forests**

Christopher J. Fettig<sup>1</sup>, James M. Vose<sup>1</sup>, David L. Peterson<sup>1</sup>, Grant M. Domke<sup>1</sup>, Linda A. Joyce<sup>1</sup>, Robert E. Keane<sup>1</sup>, Charles H. Luce<sup>1</sup>, Jeffrey P. Prestemon<sup>1</sup>, Lawrence E. Band<sup>2</sup>, James S. Clark<sup>3</sup>, Nicolette E. Cooley<sup>4</sup>, Anthony D'Amato<sup>5</sup>, and Jessica E. Halofsky<sup>6</sup>

<sup>1</sup>Research & Development, USDA Forest Service, <sup>2</sup>University of Virginia, <sup>3</sup>Duke University, <sup>4</sup>Northern Arizona University, <sup>5</sup>University of Vermont, and <sup>6</sup>University of Washington

Public and private forests in the U.S. provide many essential ecological goods and services, however their ability to continue to provide these goods and services is threatened by climate change. Volume II of the Fourth National Climate Assessment (NCA4) was released in November 2018 and is regarded as the most authoritative assessment of climate change impacts, risks, and adaptation across the U.S. It builds upon the physical science assessment presented in Volume I released in November 2017. The Forests chapter of NCA4 ([https://nca2018.globalchange.gov/downloads/NCA4\\_Ch06\\_Forests\\_Full.pdf](https://nca2018.globalchange.gov/downloads/NCA4_Ch06_Forests_Full.pdf)) describes the potential effects of climate change on forest composition, structure, disturbance regimes and ecological goods and services, as well as climate change adaptation options.

## **Drought, Beetles and Tree Mortality**

Christopher J. Fettig and Leif A. Mortenson

Pacific Southwest Research Station, USDA Forest Service, Davis, California

Evidence from global climate models suggests that future droughts in the western U.S. will have severe and widespread impacts. For example, the Fourth National Climate Assessment concluded that in forests “more frequent extreme weather events will increase the frequency and magnitude of severe ecological disturbances, driving rapid (months to years) and often persistent changes in forest structure and function across large landscapes” (Vose et al. 2018). In particular, increases in the frequency and intensity of droughts may alter forest insect populations and impacts through both direct and indirect effects, the latter mediated primarily through changes in host tree nutrition, vigor and susceptibility to colonization. To that end, evidence suggests a non-linear relationship between drought intensity and outbreaks of aggressive bark beetle species (i.e., those capable of causing extensive levels of tree mortality) in the western U.S. where moderate drought reduces bark beetle population performance and subsequent tree mortality, whereas intense drought increases bark beetle performance and tree mortality. We describe the effects of drought on tree physiology and susceptibility to colonization by bark beetles, and short-term impacts to forest structure and composition following the most recent drought (2012–2015) in California.

## 2019 WFIWC Poster Submission

### Title:

Improved Detection of Forest Disturbances using Goddard's LiDAR, Hyperspectral and Thermal Airborne Imager (G-LiHT)

### Authors and Affiliations:

Ryan P. Hanavan<sup>1</sup>, Bruce Cook<sup>2</sup>, Lawrence A. Corp<sup>3</sup>, Mary Verry<sup>4</sup>, Brent W. Oblinger<sup>5</sup>, Robbie W. Flowers<sup>5</sup>, Tom W. Coleman<sup>6</sup> and Andrew D. Graves<sup>7</sup>

<sup>1</sup>USDA Forest Service, Forest Health Protection, Northeastern Area; <sup>2</sup>NASA Goddard Space Flight Center; <sup>3</sup>Science Systems and Applications, Inc.; <sup>4</sup>USDA Forest Service R6 Aviation; <sup>5</sup>USDA Forest Service, Forest Health Protection, R6; <sup>6</sup>USDA Forest Service, Forest Health Protection, R8, <sup>7</sup>USDA Forest Service, Forest Health Protection, R3

Since 2014, the USDA Forest Service Forest Health Protection and Aviation have partnered with the NASA Goddard Space Flight Center to integrate commercially available LiDAR, hyperspectral, and thermal detection components to produce a compact, lightweight and portable system that can be used on a wide range of airborne platforms. The result of this instrument fusion was G-LiHT, which is being used in support of NASA Earth Science research projects as well as being evaluated for detections and assessments of forest disturbances, including important insects and diseases. From 2014-2017, G-LiHT data acquisitions in the eastern U.S. were focused on emerald ash borer (Pontius et al. 2017), gypsy moth (Meng et al. 2018a), southern pine beetle (Hanavan et al., in prep) and white pine needle cast (Hanavan et al., in prep) as well as burn severity (Meng et al. 2018b). In 2018, data acquisitions were completed in the western U.S. and were focused on western bark beetles, Douglas-fir tussock moth, western spruce budworm and Armillaria root disease. G-LiHT data analyses are ongoing and we're continuing to work with NASA Goddard and the G-LiHT team on methods development, targeted forest health data acquisitions, streamlining data analyses and delivery and integration with annual forest health aerial surveys and other types of remote sensing.

### References:

Meng, Ran, Philip E. Dennison, Feng Zhao, Iurii Shendryk, Amanda Rickert, Ryan P. Hanavan, Shawn P. Serbin. 2018a. Mapping canopy defoliation by herbivorous insects at the individual tree level using bi-temporal airborne imaging spectroscopy and LiDAR measurements. *Remote Sensing of Environment*, Vol. 215, pp. 170-183. <https://doi.org/10.1016/j.rse.2018.06.008>

Meng, Ran, Jin Wu, Feng Zhao, Bruce D. Cook, Ryan P. Hanavan and Shawn P. Serbin. 2018b. Measuring short-term post-fire forest recovery across a burn severity gradient in a mixed pine-oak forest using multi-sensor remote sensing techniques. *Remote Sensing of Environment*, Vol. 210, pp. 282-296. <https://doi.org/10.1016/j.rse.2018.03.019>

Pontius, Jennifer, Ryan P. Hanavan, Richard Hallett, Bruce D. Cook and Lawrence A. Corp. 2017. High spatial resolution spectral unmixing for mapping ash species across a complex urban environment. *Remote Sensing of Environment*, Vol. 199, pp. 360-369.

## **Population genetic structure of western North American spruces**

M.S.H. Haselhorst and A.M. Lynch

Haselhorst et al. (2013, 2019) estimated key population genetic parameters from a comprehensive sample of western North American spruce. The six known western North American spruce species are indeed distinguishable based on their genetic composition. There is no evidence of hybridization between any species except between white spruce (PIGL) and Engelmann spruce (PIEN). PIGL x PIEN hybrids occur in the central Rocky Mountains, and the admixture is equivalent to that which exists in “interior spruce” in British Columbia. PIGL and PIEN potentially occupied the same region some time ago, and secondary contact likely occurred during periods of glaciation, however pure PIGL and PIEN trees rarely occur in the same areas today. In all, three genetically distinct PIEN forms were identified, corresponding to geographic location: the western (northern Rocky Mountains and Cascades), central (admixed populations in Wyoming and adjacent states), and southern). Comprehensive sampling was critical to detecting interspecific variation in PIEN, assessing hybridization between PIEN and PIGL, and providing high levels of confidence in conclusions - thank you to the entomologists who contributed so many samples! Haselhorst et al. (2013 *Tree Genetics & Genomes* 9: 669-681; 2019 *Molecular Ecology* DOI: 10.1111/mec.15056, 2019).

## **Western Forest Insect Work Conference Founder's Award: An Amazing Legacy**

**Founder's Award Committee (Joel McMillin, Chair, Bill Riel, Lorraine Maclauchlan, Steve Seybold, Steve Cook & Jackson Audley)**

The Founder's Award is bestowed to an individual who has significantly advanced forest entomology in western North America. The award recognizes contributions in the areas of pest management, extension-consultation, research, and teaching. We highlight the amazing legacy of the award and include pictures of prior recipients. From 1991 to 2019, there have been 26 recipients who embody the evolution of western forest entomology. For more information concerning Founder's Award recipients and how to submit a nomination please visit the WFIWC website (<http://www.wfiwc.org/awards/founders-award>). We acknowledge and appreciate the assistance of the Technology Committee in recording and uploading recent Founder's Award presentations.

## Northwestern range expansion of European gypsy moth despite low predicted climatic suitability

Brian Aukema<sup>1</sup>, Patrick Tobin<sup>2</sup>, Aubree Kees<sup>1</sup>, and Marissa Streifel<sup>1,3</sup>

<sup>1</sup>University of Minnesota

<sup>2</sup>University of Washington

<sup>3</sup>Minnesota Department of Agriculture

The European gypsy moth, *Lymantria dispar dispar* (L.), (Lepidoptera: Erebididae) continues to expand its range in North America following its introduction in 1869. We investigated recent range expansion into a region previously predicted to be climatically unsuitable. We examined whether winter severity is correlated with summer trap captures of male moths at the landscape scale. Several winter severity metrics were defined using daily temperature data from 17 weather stations across northwestern Minnesota. These metrics were used to explore associations with male gypsy moth monitoring data (2004–2014). Reductions in summer male moth captures were associated with several metrics of winter severity, such as minimum temperatures. We also quantified overwintering egg survivorship along the northern boundary of the invasion edge. Laboratory-reared egg masses were deployed to field locations each fall for 2 years in a 2 × 2 factorial design (north/south aspect × below/above snow line) to reflect microclimate variation. Rates of successful egg hatch were assessed the following springs. Most egg masses suffered >95% mortality each winter. However, hatching success reached up to 80% in egg masses that had overwintered below the snow line (e.g., <30 cm from the ground). Our findings that cold winter temperatures are associated with reduced summer trap captures of European gypsy moth, likely due to increased overwintering mortality of exposed egg masses, are consistent with previous predictions of thermal range boundaries for this species. However, high survival in egg masses deposited close to the ground are consistent with thermal escape in subnivean environs (i.e., below snow cover), and suggest that further northward range expansion will be likely in areas that receive measurable annual snowfall.



# THE POTENCY OF INSECT AND FUNGI IN BALURAN NATIONAL PARK AS BIOCONTROL OF INVASIVE *VACHELLIA NILOTICA*.

ZAHRA, S., NOFINSKA, B.A., JOSEN, E., MUHAMMAD, F., AND HOFSTETTER, R.W.

## ABSTRACT

The prickly acacia *Vachellia nilotica* first invaded Baluran National Park (BNP), Indonesia in 1969. The tree now covers more than 50% of the national park and has directly or indirectly resulted in a decrease in biodiversity in BNP. Physical and chemical methods have been unsuccessful in reducing the spread and reproduction of the plant in the park. The use of native natural enemies of the plant could provide a solution which would also be more environmentally friendly. Our objective was to inventory potential natural enemies (insects and fungi) on *V. nilotica* in BNP and scrutinize the factor that affect their presence. We hope our inventory will resulted in finding potential biological control agents for the tree. We found 20 taxa of herbivorous insects feeding on *V. nilotica* but not all the specimens could be identified to species. The presence of herbivor is associated with ecosystem type and forest densities with the highest frequency in savannah. We also found a white cottony-fungus that attacked the seeds and stem of the plant, and a dark stain fungus under bark of dead or the weakened trees. The white fungus on the seed significantly reduced seed germination rates. In addition to these fungi, we recommend the following insects for potential control agents: *Bruchidius* sp., *Caryedon* sp., *Aeolesthes* sp., *Rhynchaenus* sp., *Sinoxylon anale*, *Ambrosiodmus minor*, Psyllidae, Cosmopterigidae, and Apionidae. Further tests are needed to determine the diet specificity of these natural enemies, if they are to be used for future biocontrol and augmentation projects.

**Western Forest Insect Work  
Conference Treasurer's Report –**

**Karen Ripley (503  
808-2674)**

[karen.ripley@USDA.gov](mailto:karen.ripley@USDA.gov)

**April 2019**

<u>Account balances:</u>	<u>Checking:</u>	<u>Savings:</u>	<u>Total:</u>
January 1, 2017	\$ 5,328.77	\$ 19,837.03	\$ 90,054.54
January 1, 2018	\$ 4,429.17	\$ 87,276.10	\$ 91,705.27
January 1, 2019	\$ 3,718.20	\$ 84,260.76	\$ 87,978.96
March 31, 2019	\$ 3,560.20	\$ 84,271.15	\$ 87,831.35 early '19 meeting expenses

	<u>Operating Funds:</u>	<u>Memorial Scholarship Funds:</u>	<u>ratio OF/MSF:</u>
January 1, 2017	\$ 25,165.80	\$ 64,888.74	28/72
January 1, 2018	\$ 25,591.18	\$ 66,114.09	28/72
January 1, 2019	\$ 21,262.15	\$ 66,716.81	24/76
Change in 2018:	\$ -4,329.03	\$ + 602.72	

The Western Forest Insect Work Conference has sound financial status. Although interest rates are very low (.05% on a Savings account) and account balances decreased about 4% in 2018, we are in a reasonable position to sustain the Memorial Scholarship Fund and have sufficient operating funds to buffer annual meeting expenses.

Some details follow:

1. It is important to track which assets are Operating Funds vs. Memorial Scholarship Funds, so WFIWC can preserve the resources that were specifically donated for Scholarship purposes. In addition to tracking specific expenses and revenue, the 2018 Savings account interest was divided between Operating and Scholarship Funds based on the ratio (28/72) of those assets January 1, 2018, crediting \$11.94 to Operating and \$30.71 to Scholarship in 2018.
2. The 2018 WFIWC Denver meeting expenses had a net cost of \$4,340.97. This was within the target parameters guiding meeting organizers. Sky Stephens deserves special commendation for vigilant attention to evolving Forest Service meetings management policies that had the potential to disastrously limit Forest Service attendance and for developing an innovative meeting sponsorship system that provided revenue to offset meeting expenses and support the Memorial Scholarship Fund.
3. In 2018, the Memorial Scholarship fund had a net increase of \$602.72. WFIWC awarded a \$1,000 scholarship to Samuel Fahrner Ward. Earnings included: \$30.71 in interest; \$5 from the Amazon Smile program; \$942.01 from the Denver silent auction; \$525 from the Denver meeting sponsorships and vendor booths; and \$100 donated in memory of Sheryl Costello.
4. A \$1,000 Memorial Scholarship will be awarded in 2019.
5. The meeting sponsorship system developed in Denver is being implemented for Anchorage. Other fund raising events such as a Silent Auction are planned.
6. WFIWC is enrolled in the "Amazon Smile" program, which allows Amazon customers to easily contribute to charities when making other purchases. If someone is interested enhancing and publicizing this direct donation option, please contact Karen Ripley.
7. The 2010 and 2011 Tax Returns are posted on the WFIWC website. The 2012 Tax Return is also available but has not been posted on the website. Filing requirements for small Tax Exempt Organizations (less than \$50,000 in gross receipts) changed in 2013. Since then, WFIWC has filed the electronic notification Form 990-N, due each year on May 15. The 2018 Tax notification form has been filed.
8. Contact Karen Ripley if you have questions about WFIWC finances. The recent banking records, check registers and US Tax information will be reviewed by the Councilors during this meeting.



Dr. Steve Seybold awarded the 2018 Memorial Scholarship to Sam Ward, University of Minnesota.

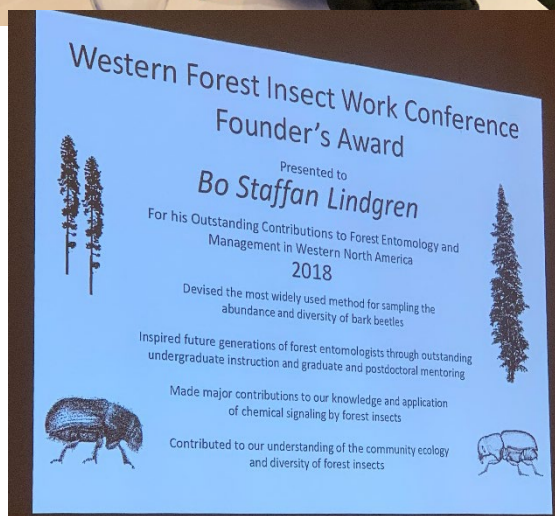
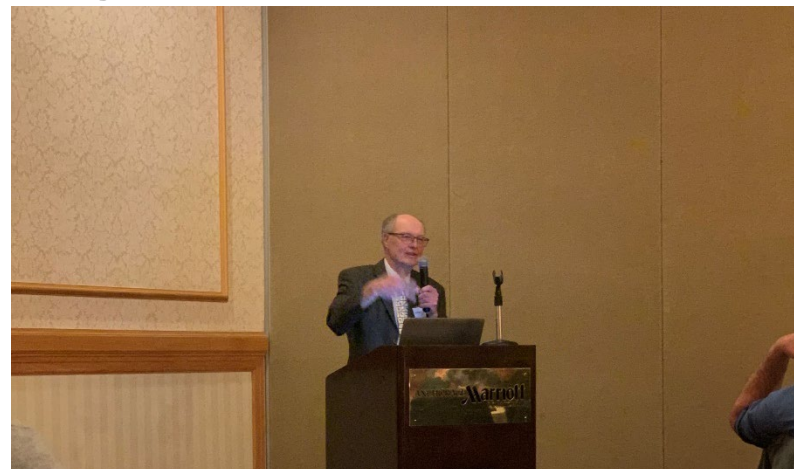


Distinguished Speaker Dr. Ed Holsten presented on a history of Alaska Forest Entomology and other “stuff”

# Field trip to Earthquake Park, Bird Creek Campground, and Begich Boggs Visitor Center



# Founders Award Banquet, Dr. Staffan Lindgren honoree





Standing Left to Right: Bob Rabaglia, Mike Johnson, Marianne Davenport, Richard Hofstetter, Steve Swenson, Carl Jorgensen

Sitting Left to Right: Sky Stephens, Steve Seybold, Lorraine Maclauchlan, Brian Aukema, Bill Riel



Standing Left to Right: Jake Bodart, Jackson Audley, Darrel Ross, Garret Dubois, Colleen Keyes, John Fornsbly, Khum Thapa-magar, Christina Dodge

Sitting Left to Right: Babita Bains, Glenn Kohler, Mike Howe, Iral Ragenovich, Seth Davis



Standing Left to Right: Martin Schoofs, Chrissy Mott, David Atkins, Marcos Riquelme, Clifford Bradly, Khum Thapa-magar

Sitting Left to Right; Amy Gannon, Jessie Moan, Erika Eidson, Melissa Fischer, Roberta Fitzgibbons





Standing Left to Right: Andrea Hefty, Brett Andrews, Javier Heredia

Sitting Left to Right: Don Grosman, Elizabeth Graham, Ann Lynch, Justin Runyon, Stephen Burr



Standing Left to Right: Jason Moan, Monica Gaylord, Marnie Duthie-Holt, Kathy Bliker

Sitting Left to Right: Darren Blackford, Chris Fettig, Christopher Secary