The Western Bark Beetle Research Group: A Unique Collaboration With Forest Health Protection

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J.L. Hayes and J.E. Lundquist, compilers

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Bark Beetle Conditions in Western Forests and Formation of the Western Bark Beetle Research Group[1]

Robert J. Cain and Jane L. Hayes[2]

Abstract

The recent dramatic impacts of bark beetle outbreaks across conifer forests of the West have been mapped and reported by entomology and pathology professionals with Forest Health Protection (FHP), a component of USDA Forest Service's State and Private Forestry, and their state counterparts. These forest conditions set the stage for the formation of the Western Bark Beetle Research Group (WBBRG), comprised of research scientists within the three western research stations of the USDA Forest Service Research and Development. Facing the increasing bark beetles impacts, the newly formed WBBRG, in concert with FHP professionals from the western Regions, developed research priorities. Building on a strong foundation of past and present research, WBBRG scientists in conjunction with their varied partners will investigate the complex interactions of bark beetles and their hosts. Interactions to be explored include those within vegetation management scenarios at the individual tree to landscape scale, those between wildland fire and bark beetles, the long-term impacts of bark beetle outbreaks on ecological and socioeconomic values, and importantly the response of bark beetle systems (i.e., bark beetles, their hosts and common associates) to climate change. This increased understanding of bark beetle behavior and population dynamics at multiple scales and with other agents of change will lead to the development and improvement of management tools. As in the past, WBBRG scientists will work closely with FHP entomologists to implement practical research products to prevent, retard, or suppress unwanted effects of native and nonnative invasive bark and woodboring beetles in the West.

Keywords: Aerial survey, Forest Health Protection, Western Bark Beetle Research Group.

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[1] The genesis of this manuscript was a presentation by the authors at the Western Bark Beetle Research Group—A Unique Collaboration with Forest Health Protection Symposium, Society of American Foresters Conference, 23-28 October 2007, Portland, OR.

[2] **Robert J. Cain** is an Entomologist, USDA Forest Service, R-2 Forest Health Protection, 740 Simms Street, Golden, CO 80401; email: rcain@fs.fed.us. **Jane L. Hayes** is a Research Biological Scientist, USDA Forest Service, Pacific Northwest Research Station, Forestry and Range Sciences Laboratory, 1401 Gekeler Lane, La Grande, OR 97850; email: jlhayes@fs.fed.us.

Introduction

As background for the presentations given at the 2007 SAF Conference Symposium, Western Bark Beetle Research Group—A Unique Collaboration with Forest Health Protection and the collection of papers in this Proceedings of that session, we describe the current trends in bark beetle-caused tree mortality in western forests. The many research challenges presented by these conditions provided compelling motivation for establishing a new west-wide Forest Service research group focusing on this situation. We outline the priority research topics defined by the group at their inaugural meeting with consensus by Regional partners. Past and present research experience and accomplishments that helped shape these priorities are briefly described.

Bark Beetle Conditions in Western Forests

Bark beetles have been causing dramatic tree mortality and making headlines across the West in recent years. Entomologists and pathologists with Forest Health Protection (FHP), a component of the USDA Forest Service State and Private Forestry (S&PF) and their state counterparts annually report insect and disease conditions. Acres affected by bark beetles across western forests are assessed through the creation of aerial survey sketchmaps. From fixed wing aircraft such as a Cessna 206, sketchmappers record polygons of insect activity in forest stands on USGS maps or on computer touch screens while the plane is flown along contours or predetermined flight lines. The tree species impacted, the damaging agent and the intensity are indicated for each polygon. When the damaging agent is a bark beetle, the intensity is determined by estimating the number of trees per acre that are currently fading. This becomes more difficult in large outbreaks with multiple years of damage and often multiple damaging agents active in the same area.

In recent years there have been widespread outbreaks of bark beetles across western North America. Outbreaks of native bark beetles have occurred across forest types from the low elevation pinyon-juniper woodlands to high elevation Engelmann spruce and subalpine fir forests (USDA 2005). Table 1 lists many of the bark beetles that have caused mortality over thousands of acres of their respective hosts. Native bark beetle populations are most influenced by stand conditions and weather conditions. Generally, older denser stands with larger trees and warmer, drier conditions are more favorable to bark beetles. Figure 1 shows the majority of the major forest cover types in the Rocky Mountain Region are over 100 years old and this is representative of conditions across the West.

Table 1—Western bark beetle species that have caused significant tree mortality in the last 10 years

Bark Beetle(s)	Host(s)
Spruce beetles, *Dendroctonus rufipennis* (Kirby)	Engelmann spruce (*Picea engelmannii* Parry ex Engelm.), white spruce (*P. glauca* [Moench] Voss), Sitka spruce (*P. sitchensis* [Bong.] Carr.)
Pinyon ips, *Ips confusus* (LeConte)	Pinyon pine (*Pinus edulis* Engelm. and *P. monophylla* Torr. & Frem.) and others
Pine engraver, *Ips pini* (Say), Arizona five spined ips, *Ips lecontei* Swaine	Ponderosa pine (*Pinus ponderosa* C. Lawson)
Western pine beetle, *Dendroctonus brevicomis* LeConte	Ponderosa pine, Coulter pine (*Pinus coulteri* D. Don)
Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopkins	Jeffrey pine (*Pinus jeffreyi* Balf.)
Mountain pine beetle, *Dendroctonus ponderosae* Hopkins	Ponderosa pine, lodgepole pine (*P. contorta* Douglas ex Louden), white pines and others (*Pinus* spp.)
Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins	Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco)
Fir engraver beetle, *Scolytus ventralis* LeConte	True firs (*Abies* spp.)
Western balsam bark beetle, *Dryocoetes confusus*, Swaine	Subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.)

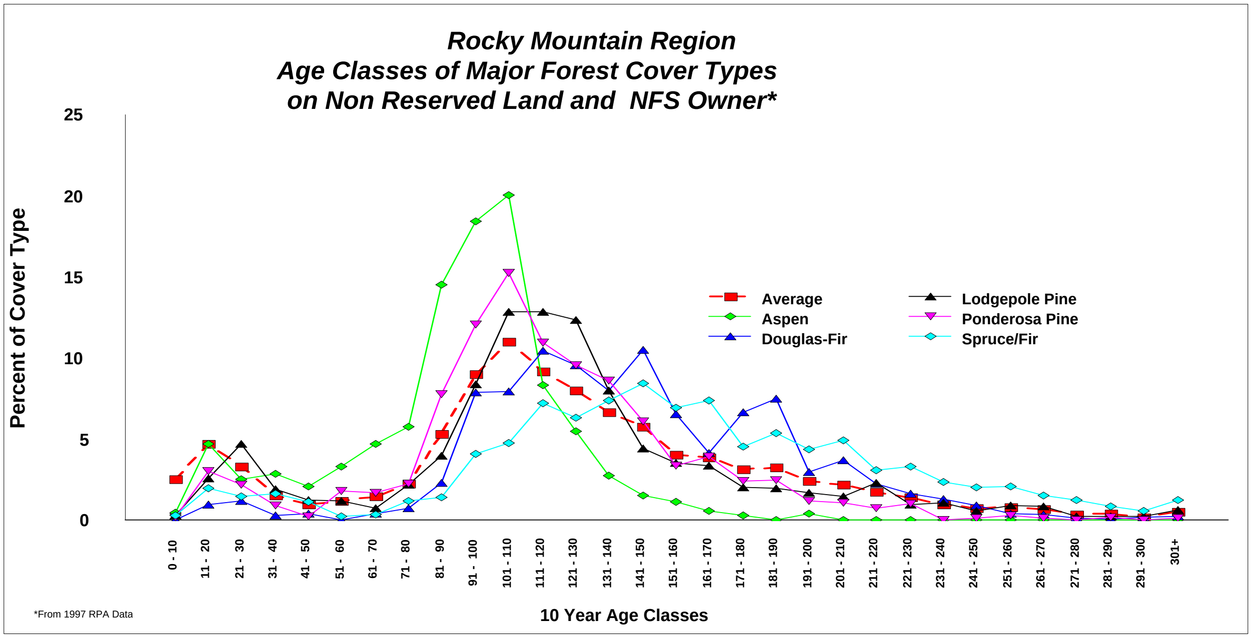

Figure 1—Age class distributions of forest types in the Rocky Mountain region based on 1990 FIA data.

Spruce beetle—Through the 1990s the largest spruce beetle epidemic ever recorded in North America eventually impacted to varying degrees over 3.2 million acres in Alaska including 1.4 million acres on the populated and extensively visited Kenai Peninsula (figure 2). This epidemic triggered some of the early widespread speculation in the media about the ecological impacts of warmer global temperatures (Juday 1998). Research has subsequently confirmed the connection between increased temperatures and spruce beetle population build-up (Hansen et al. 2001, Berg et al. 2006).

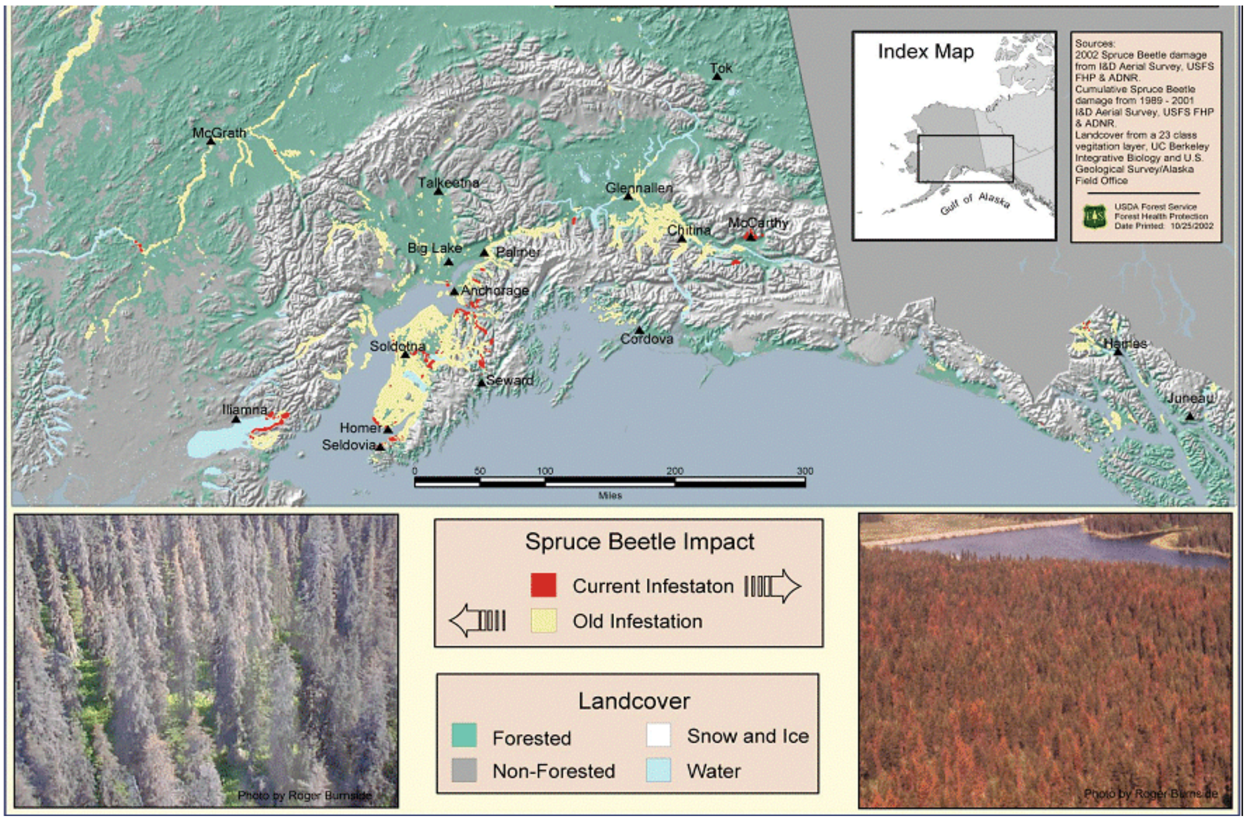

Figure 2—Spruce beetle outbreak in south-central Alaska 1989–2002 (1989–2001 in yellow, 2002 in red). Source: http://www.fs.fed.us/r10/spf/fhp/Condrpt03/2003%20Web%20Maps/slides/Spruce%20Beetle%20Outbreak%20-%202003.html.

Spruce beetle has been active in other western states as well. Strong winds that blew down high elevation stands of Engelmann spruce created suitable host material that favored the build-up of spruce beetle populations. Outbreaks were first noted throughout Utah, then Colorado and Wyoming in the 1990's and 2000's. Much of Utah's spruce forests have been killed and areas of tree mortality continue to increase in Colorado and Wyoming.

Pinyon ips and other bark beetles in southwestern pines—The late 1990's and early 2000's brought extreme drought to the Southwest combined with warmer than average temperatures. Pinyon pines, although adapted to irregular moisture regimes and shallow soils, began to die in record numbers from pinyon ips and associated twig beetles (Breshears et al. 2005). Although scattered references exist to another large die off in the 1950s, there were many areas of large pinyons that had survived the 1950s drought that succumbed in the 2000s. The impact was felt over six states and over 650,000 acres were affected. Improved moisture conditions by 2004 helped to end the pinyon ips epidemic.

During that same drought period in the Southwest, large areas of ponderosa pine forests in central Arizona were killed by the Arizona five-spined ips and associated bark beetles. Also, southern California's Angeles, San Bernardino and Cleveland National Forests and adjacent land experienced extremely high levels of tree mortality due to a complex of native bark beetles, dense stand conditions and severe drought. During 2003–2004, western pine beetles, Jeffrey pine beetles and mountain pine beetles all contributed to the dying trees that appeared on the landscape in and around resort communities like Arrowhead Lake. In 2003, massive wildfires driven by Santa Ana winds burned through chaparral, homes, and forested areas in which bark beetle killed trees were prevalent. Moisture conditions throughout the southwestern United States improved in many areas and bark beetle activity decreased.

Mountain pine beetle—Mountain pine beetle is currently making the most dramatic widespread changes on the landscape across the West. These beetles were first described at the turn of the last century in the Black Hills of South Dakota. A large outbreak was occurring at that time and the following unattributed quote was found on an archived slide at the USFS's Forest Health Office in Lakewood, CO. "At the time of their flight, they settled on cabins like swarms of locusts". Today, just over 100 years later the ponderosa pine forests of the Black Hills are again experiencing an intensifying mountain pine outbreak that is making dramatic landscape changes.

In recent years, mountain pine beetle has impacted millions of acres of lodgepole pine forests across the West at levels not previously recorded. If you look at the range of lodgepole pine in North American and the cumulative map of acres impacted from 2002–2006 you can see that most of the lodgepole pine cover type has been impacted (figure 3).

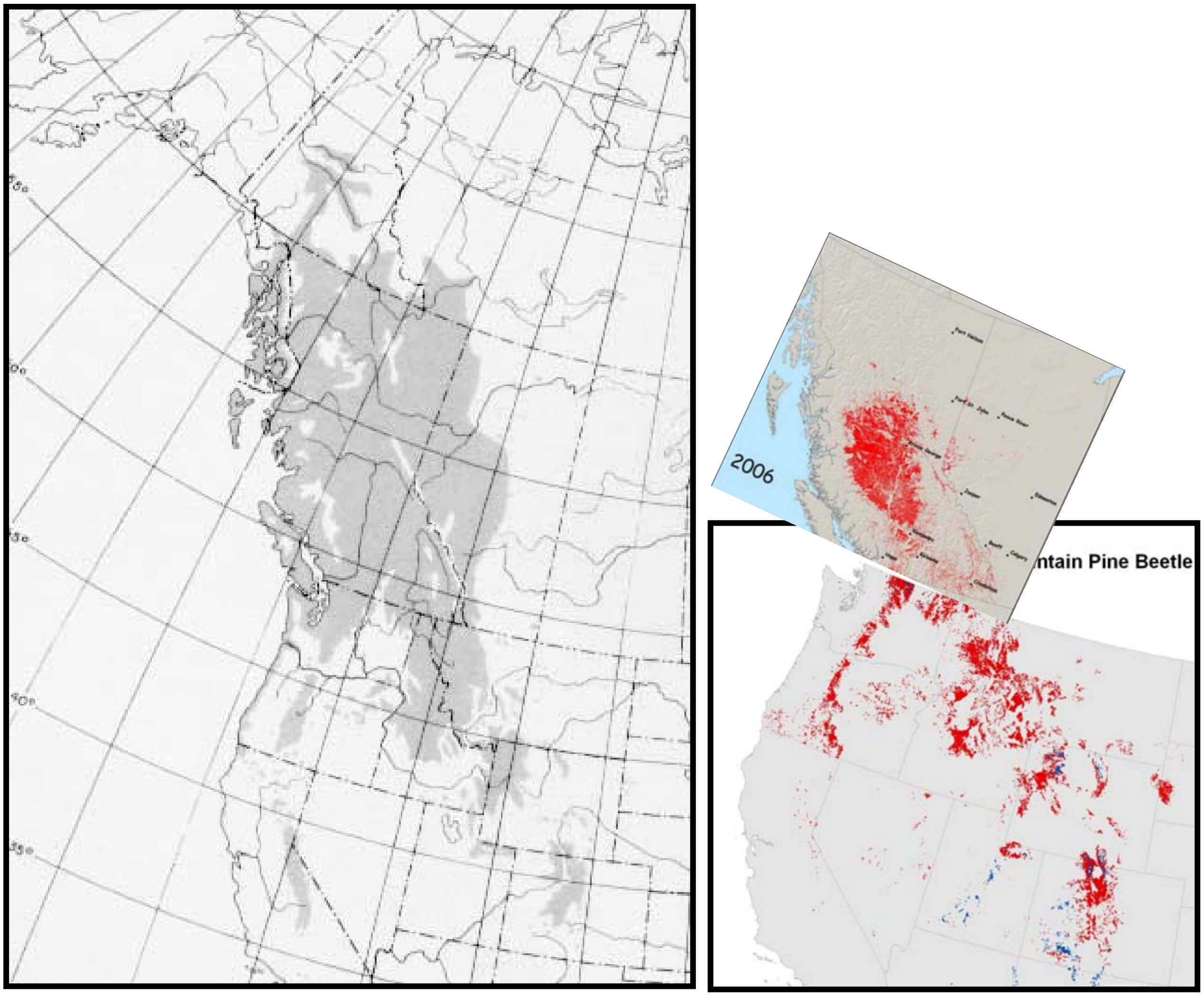

Figure 3—Range map of lodgepole pine in North America and mountain pine beetle impacted areas detected in aerial surveys. Canadian map is from the Canadian Forest Service website, http://mpb.cfs.nrcan.gc.ca/map_e.html, areas impacted by mountain pine beetle in 2006. The western U.S. map shows areas impacted by mountain pine beetle from 2004–2006.

The current epidemic has impacted stands at higher elevations and latitudes than have been previously recorded. In the Yellowstone corner of Montana, Wyoming and Idaho, high elevation white bark pines stands are being killed on sites previously considered to be too cold for serious mountain pine beetle epidemics (figure 4). Younger stands in old clearcuts, burns and avalanche runs remain green, but trees that are over five or six inches in diameter at the base are being killed by beetles attacking low on the trunk (figure 5). Twig beetles are also found attacking these smaller trees in regenerating stands in Colorado. Their populations may be building in the smaller diameter portions of trees attacked and killed by mountain pine beetle.


Figure 4—High elevation white bark pine killed in Idaho. Photo provided by Carl Jorgensen.

Figure 5—Mature lodgepole pine killed by mountain pine beetle in north central Colorado. Most of the trees regenerating in the old clearcut are too small for the beetles, however, many trees reaching five to six inches in diameter at the base are being killed by mountain pine beetles and twig beetles. Photo by Sheryl Costello.

The mountain pine beetle epidemic in northern Colorado illustrates how quickly beetle populations can increase and impact extensive areas. The first signs of a building beetle population occurred in 1997. By 1999, clearly defined epicenters were mapped during aerial surveys. These rapidly expanded and merged and by 2006 most of the cover type west of the Continental Divide had some level of mountain pine beetle activity. Cole and Amman (1980) reported that over the course of an outbreak, most of the large diameter trees will be killed by the time the outbreak subsides. They also reported that an outbreak averages six years to run its course in a given stand, but emphasized that once infestations build up, a large amount of dispersal may occur. This leads to more rapid tree losses in adjacent stands with beetle populations reaching outbreak levels and subsiding in a shorter time. Some newly infested areas are now being depleted of suitable host trees in only one or two years. Through 2006, the cumulative area of lodgepole pine forests in Colorado where mountain pine beetle activity was detected in aerial surveys was about 1 million acres. In 2007, that number increased to 1.5 million acres. The epidemic in British Columbia, where lodgepole forests are more contiguous than in the western U.S., is even more staggering. The B.C. Ministry of Forests and

Range reported over 24 million acres of lodgepole pine affected by mountain pine beetle in 2007 (Buxton unpublished).

Douglas-fir beetle—Visitors to Yellowstone National Park will notice old Douglas-fir trees killed by Douglas-fir beetle along the road from Cody, Wyoming to the east entrance of the park. Douglas-fir beetle outbreaks followed forest fires and drought and peaked in 2005 when over 670,000 acres were affected across the West. Acres of Douglas-fir tree mortality have been declining, but in 2007, increases in Douglas-fir beetle activity were recorded in the central and southern Rockies, intermountain west and the Pacific Northwest**.**

Western balsam bark beetle and fir engraver beetle—Western balsam bark beetle primarily attacks the high elevation subalpine firs and fir engraver beetles are most common on the other western true firs. Notable outbreaks have occurred in recent years across the West and are closely tied to local drought conditions. Outbreaks tend to subside when soil moisture improves.

There are also many areas in the West where more than one bark beetle species is active at the same time. On the Shoshone National Forest in northern Wyoming, uniquely pure stands of Rocky Mountain Douglas-fir are being killed by Douglas-fir beetle next to stands of Engelmann spruce killed by spruce beetle and limber and lodgepole pine being killed by mountain pine beetle. This scenario is being repeated throughout the West, in different types of host stands and with different beetle species.

Given these recent trends and present level of beetle-caused tree mortality, it is not difficult to see how the view out the window of a plane or even a car may lead one to the conclusion that western conifer forests are under attack. Certainly, vast areas of the western landscape have been affected by western bark beetle infestations—outbreaks involving several stands to epidemics encompassing a host type across multipe forests. Millions of acres are considered at risk (Western Forestry Leadership Coalition 2007). Whether the levels we see today are historically unprecedented is subject to debate. We lack sufficient records to adequately address the issue, although we know there were large-scale bark beetle infestations at the turn of the twentieth century when forest entomologists first began studying the insects of western forests (e.g., Wickman 2005) and other epidemics since then are well documented. Nevetheless, given the relationship of recent losses to changing climatic conditions, there exists a threat of increasing tree losses with projected climate changes. The current western bark beetle situation presents many opportunities for research to better understand changing western forest ecosystems and the management implications of this large disturbance, its source and interactions with other agents of change.

Formation of the Western Bark Beetle Research Group

These conditions were a driving force in bringing together research entomologists of the three western Forest Service research stations to form the USDA FS R&D Western Bark Beetle Research Group (WBBRG). The leadership of the Pacific Northwest, Pacific

Southwest and Rocky Mountain Research Stations, which cover the 15 western states including Hawaii and Alaska, recognized the bark beetle situation in the West as a compelling problem that crosses station boundaries. The WBBRG is made up of 11 researchers located from Alaska to Arizona, whose work focuses on native and non-native insects of western forest and rangeland ecosystems. With many research challenges, the benefits of a tri-Station partnership include improved efficiency by leveraging resources and expertise, and enhanced communication and coordination.

The WBBRG serves as an ad hoc umbrella organization aimed at fostering communication, enhancing responsiveness and delivery of bark beetle research, and enriching scientific interactions among Forest Service bark beetle researchers in the western U.S. The objectives of this group include:

- Work with partners and stakeholders to identify western bark beetle priority research
- Pursue priority research and develop high impact products
- Promote the relevance of western bark beetle research for partners and stakeholders
- Increase overall quality, productivity and timeliness of research through cooperation and integration among stations
- Enhance communication and service to partners and stakeholders

To achieve the first of these objectives, the WBBRG invited forest entomologists from FHP representing the western Regions to participate in this endeavor (see also Negrón et al. 2008b). When the ideas were synthesized, the consensus was that among the numerous research topics raised, the following represent the highest ranked priorities:

- Describe, evaluate, and quantify long-term outcomes of bark beetle outbreaks on ecological, economic, and social services at various spatial scales.
- Evaluate bark beetle response to vegetation treatments at the tree, stand, and landscape levels.
- Determine the relationships between bark beetles and wildfire.
- Evaluate bark beetle, common associates, and host tree physiological responses to climate change.
- Develop new and improved chemical and semiochemical-based strategies for bark beetle management.
- Develop methods and strategies for detecting, monitoring, and eradicating or mitigating invasive bark beetles and woodboring insects.

Part of a Long History of Western Forest Entomology Research
To accomplish these goals, the WBBRG is continuing to build on past research successes. Often teamed with FHP entomologists or other partners, FS R&D entomologists of the three western stations have a long history of conducting research that is relevant to land managers and owners. Forest insect research, especially bark beetle research, has had a prominent role in FS R&D in the West over the years and made significant contributions. Since the turn of the last century professional forest entomologists have been conducting research and sharing their findings and knowledge

with colleagues, partners, and clients. In 1899, A.D. Hopkins (commonly known as the father of forest entomology in the U.S.) made a 2-month trip to the Pacific Northwest. The "Preliminary Report of the Insect Enemies of Forests in the Northwest" from that trip arguably marks the beginning of forest entomological research in the West (Burke 1946 in Wickman 2005). Soon after this trip Hopkins, a bark beetle expert, became the first Chief of the Division of Forest Insect Investigation established in 1902. He made subsequent trips (1902–1905) to the bark beetle outbreak in the Black Hills, to Colorado, to the southwest, and other parts of the Pacific Slope, and eventually a visit in 1911 to the Northeastern Oregon Project, the first large-scale bark beetle control project in the West (Wickman et al. 2002).

It was in large part the dominant role of bark beetles in forests of the West and elsewhere that led to the creation of the Division of Forest Insect Investigation within the USDA Bureau of Entomology to work with the Bureau of Forestry, headed at the time by Gifford Pinchot. The Division established stations throughout the West including the Pacific Slope (eventually settling at UC Berkeley and Portland, OR), Fort Collins, CO, Coeur'd Alene, ID, and Missoula, MT. The Division pursued bark beetle and other entomological research until 1953 when it officially became a part of the USDA Forest Service and its functions were transferred to Forest and Range Experiment Stations, which eventually became Research Stations. Early activities of the Division naturally focused on identifying the insects of greatest concern, including studies of taxonomy and biology, and developing methods for control. Scientists with the Division played significant roles in cooperative bark beetle control projects with other agencies (e.g., Forest and Park Services) and private landowners in the West, such as the Northeastern Oregon Project (1910–11) and others into the 1930s, particularly in California and Oregon (Wickman et al. 2002). In later years, as more permanent laboratory facilities were established, the focus of bark beetle research shifted to ecological investigations and control of bark beetles through forest management practices.

Bark beetles and vegetation management—Studies by early researchers laid groundwork for the research of today. When it had become clear that direct control methods used in large-scale control projects were having little long-term impacts on reducing levels of bark beetle-caused tree mortality, they shifted their attention to silvicultural and forest management strategies. For example, a tree susceptibility classification system was developed in 1942 (Keen 1943), leading the way for considerable future research and development of stand hazard- or risk-rating systems that help managers identify stand susceptibility and the probability of bark beetle infestation (e.g., Schmid and Frye 1976, Stevens et al.1980). Many of these systems, or updated successors, are still widely used at the project level to guide silvicultural and restoration treatments and some research work has continued in the area where gaps exist (Negrón 1997, 1998, Negrón and Popp 2004, Negrón et al. 2008a). Response of beetles to vegetation treatments has been a subject of past research (reviewed by Fettig et al. 2007); however, particularly in light of the current emphases on fuel reduction and forest restoration, sufficient knowledge gaps exist to be ranked as an area of high priority research by WBBRG. For a more detailed description of this topic, see McMillin and Fettig in this Proceedings.

Long-term consequences of bark beetles impacts on ecological and socioeconomic values—Previously comprehensive reviews or annotated bibliographies of research on some of the most significant bark beetles were published (western pine beetle, Miller and Keen 1960; Douglas-fir beetle, Furniss 1979; mountain pine beetle, Lessard et al. 1986; spruce beetle, Linton and Safranyik 1987). As forest management has shifted to multiple resource management, bark beetle research has also become broader. Researchers then began looking at integrated management strategies for bark beetle-host systems (McGregor and Cole 1985, Waters et al. 1985). Syntheses of the state of knowledge of the cause and effect role of bark beetles and bark beetle management in the interior northwest have been published (Gast et al. 1991, Filip et al.1996, Hayes and Daterman 2001). By the 1990s, ecosystem and landscape management demands called for different analytical systems that examined multiple resources and could handle greater complexity and scale. Landscape simulation models provide a means of projecting long-term and large scale changes from succession, management, and disturbance. Using many of the same attributes of the early classification systems, models such as the Douglas-fir beetle impact model (Marsden et al. 1997) and the Western Pine Beetle Model (Beukema et al. 1997) were developed as extensions to the Forest Vegetation Simulator, which when integrated with other submodels allows simulations of multiple processes (e.g., Ager et al. 2007, McMahan et al. 2008). At larger scales, coarser grain models, such as state and transition models, have been used to examine multiple resource variables along with bark beetles and other insects (Hessburg et al. 1999, Barbour et al. 2007, Hemstrom et al. 2007). Limited research has directly addressed societal reactions to bark beetle outbreaks (e.g., Flint 2006). Additional research and improvements in landscape simulation models that include socioeconomic components and permit robust analysis of tradeoffs for management options including no treatment alternatives are needed. This is an area of high priority research for the WBBRG. For a more detailed description of this topic, see Progar and others in this Proceedings.

Bark beetle and fire interactions—It is generally acknowledged that historically across western landscapes, particularly in dry interior forests, disturbance agents including wildland fire and insects influenced successional processes (Agee 2003). Fire suppression over the past 100 years has changed both the frequency and severity of wildfire and insect outbreaks (Hessburg et al. 1994). Stimulated in part by large fires at the beginning of this century, researchers have increasingly placed more emphasis on the apparent reciprocal and sometimes synergistic association between fire and bark beetles; previous research efforts are reviewed by McCullough et al. (1998) and more recently by Parker et al. (2006). Recent studies have begun to examine functional and numerical interactions between bark beetles and fire at the tree and stand level (e.g., Hood and Bentz 2007), and the relationship between beetle outbreak and fuel dynamics (e.g., Jenkins et al. 2008). Few quantitative studies have been carried out that consider the spatiotemporal dynamics of wildfire and bark beetle outbreaks at the landscape scale. Somewhat conflicting results to date are indications that the mechanisms are complex, particularly over time and at large spatial scales. Given the number of forested acres affected by insects and wildland fire each year, it's clear why the interactions between fire and bark beetles continues to be an area of high priority research for the WBBRG. For a more detailed description of this topic, see Gibson and Negrón in this Proceedings.

Responses of bark beetle systems to climate change—Investigations of the role of historical or natural range of variation of bark beetles are limited, but are important for understanding when and how they function as natural disturbance agents in forest ecosystems. Understanding how landscapes respond over time to perturbations including climate change is key to the development of effective forest management strategies for the future. The response of beetles, their common associates and hosts is an area of active investigation by the FS R&D researchers and one of WBBRG's priority areas. Research is ongoing at the individual and mechanistic level (e.g., Bentz and Mullen 1999, Hansen et al. 2002, Six and Bentz 2007), as well as at the population and landscape level (e.g., Logan and Powell 2001, Logan et al. 2003, Regniere and Bentz 2006). For a more detailed discussion of this topic, see Lundquist and Bentz in this Proceedings.

Chemical and semiochemical-based management tactics—Research in the area of direct control of bark beetles and use of pesticides began in the mid-1900s and continues today (e.g., Negrón et al. 2001, Fettig et al. 2006). Direct control measures often have limited but important applications, particularly in high value areas. For example, research on viable replacements for carbaryl (Hastings et al. 2001), one of the most effective treatments for individual trees against attack by many bark beetles (Fettig et al. 2006), is likely to continue. Others have determined the amount of drift that occurs during these treatments and used this information to determine the potential risk that drift poses to fish and other taxa in nearby aquatic systems, a primary concern when treating trees in campgrounds in the West (Fettig et al. 2008).

Behavior- or semiochemical research has been a strong component and focus of research in FS R&D in the West since the early studies in the late 60s and 70s. New technologies in both experimental exploration and application continue to make this a productive area of research and development for detection and suppression tactics. Using techniques that are crude by today's standards, early researchers succeeded in identifying the attractant or aggregant, and anti-aggregant pheromones, along with synergistic compounds, produced by many major bark beetles (e.g., Furniss et al. 1972). Attractants have long been used in trapping technology for detection and monitoring. The relationship between trap captures and population dynamics and more specifically, levels of bark beetle-caused tree mortality in a given area remains an area of active research (e.g., Bentz 2006, Hansen et al. 2006). The role of host tree physiology and host-produced volatiles is also an area of ongoing research (e.g., Joseph et al. 2001, Kelsey and Joseph 2001, 2003, Kelsey and Manter 2004, Manter and Kesley 2008).

Similarly, development of semiochemical-based suppression tactics has been an active and effective area of research for FS R&D in the West. Development of individual tree to area-wide protection from infestation for some bark beetles such as Douglas-fir beetle (e.g., Ross and Daterman 1994, 1995, 1997) and mountain pine beetle (e.g., Progar 2005, Gillette et al. 2006) represent important tools for managers. Further improvements and development of similar tools for protecting single-tree to large-scale areas from other bark beetle species are needed, particularly for high value resources. This area continues to be an area of high priority research for the WBBRG. For a more detailed discussion of this research topic see Gillette and Munson in this Proceedings.

Detection, monitoring, and management of bark and woodboring invasives—Many of the same technologies used for native species are being applied to the research and development of detection and mitigation tools for non-native invasive bark and woodboring beetles. Non-native insects are not new to the conifer forests of the western U.S., but represent an increasing threat as global trade and human traffic brings increased opportunities for importation and exchange. Between 1985 and 1998, approximately 90% of the non-native insects intercepted on wood materials were Coleoptera, and of those introduced beetles, over 50% belong to the bark and woodboring Scolytinae (Haack and Cavey 2000, Haack 2006). Many of the most noteworthy introductions have been in the eastern U.S. (e.g., pine shoot borer, Asian longhorn beetle, emerald ash borer); however, by direct importation or spread from elsewhere within North America, the number of invaders continues to grow in the West (e.g., Lee et al. 2007). Surveys conducted only a few years apart reveal new non-native woodborer records for the Pacific Northwest and North America (Mudge et al. 2001, LaBonte et al. 2005). In the past, western forest entomologists have studied a number of invaders, particularly defoliating Lepidoptera (Hayes and Ragenovich 2001). One with potential for changing forest composition was the larch casebearer which spread from the East. A classic biological control treatment was developed by an FS R&D research entomologist for this defoliator (Ryan 1997). It is a textbook example; there have been no documented non-target effects of the non-native parasitoids released to control this invader, the control has been maintained for over a decade, and it appears to be self-sustaining. Detection, monitoring, and management for invasive bark and woodboring beetles is an area of current research (e.g., Negrón et al. 2005, Johnson et al. 2008, Lee et al. 2008, Liu et al. 2008) and a high priority area for the WBBRG. For a more detailed discussion of this research topic see Seybold and Downing in this Proceedings.

Working with our FHP partners and others, the WBBRG seeks to continue this legacy of relevant research, delivery and partnership. Exemplying this spirit and representative of our mutual goals to work cooperatively and communicate with stakeholders, each of the informative papers in this Proceedings is a WBBRG and FHP collaboration.

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