The mountain pine beetle is the most damaging biotic disturbance agent in mature lodgepole pine in western Canada. The current beetle outbreak in British Columbia is unprecedented in scale and will have unavoidable ecological and economic impacts. Unfortunately, this beetle outbreak may be a harbinger to an increased pest threat to Canadian forests. The abundance of mature age class timber in the inventory and a trend to warmer, drier summers and infrequent cold winter weather can combine to alter the balance between pest and host in forest ecosystems.

Major economic and non-market values accrue from forests. Sustainability of these forest values will be challenged by an increase in forest pest disturbances. The extensive character of Canadian forestry does not remove the risks of pest outbreaks. Maintaining forest resource values will benefit from a renewed commitment to reducing the impacts of forest pest disturbances. The key elements of this commitment are forest health monitoring, identification of high threat stands and pathways, prompt direct control activity, and landscape level reduction of stand susceptibility through preventive forestry practices. Forests are too valuable to not effectively respond to pest disturbances.
The Mountain Pine Beetle
A Synthesis of Biology, Management, and Impacts on Lodgepole Pine

edited by Les Safranyik and Bill Wilson

Sponsored by the Government of Canada through the Mountain Pine Beetle Initiative, a program administered by Natural Resources Canada, Canadian Forest Service.

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SB945.M78S33 2006  634.9'7516768  C2006-980019-7
This book presents a synthesis of published information on mountain pine beetle (*Dendroctonus ponderosae* Hopkins [Coleoptera: Scolytidae]) biology and management with an emphasis on lodgepole pine (*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm.) forests of western Canada. Intended as a reference for researchers as well as forest managers, the book covers three main subject areas: mountain pine beetle biology, management, and socioeconomic concerns. The chapters on biology cover taxonomy, life history and habits, distribution, insect-host tree interactions, development and survival, epidemiology, and outbreak history. The management section covers management strategy, survey and detection, proactive and preventive management, and decision support tools. The chapters on socioeconomic aspects include an economic examination of management programs and the utilization of post-beetle salvage timber in solid wood, panelboard, pulp and paper products.

Le présent ouvrage offre une synthèse de l’information publiée concernant le dendroctone du pin ponderosa (*Dendroctonus ponderosae* Hopkins [Coleoptera: Scolytidae]), sa biologie ainsi que la lutte qu’on lui fait. L’accent porte sur les forêts de pins tordus latifoliés (*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm.) de l’Ouest du Canada. Préparé à l’intention des chercheurs et des aménagistes des forêts comme ouvrage de référence, ce dernier traite de trois sujets principaux : la biologie du dendroctone du pin ponderosa, la lutte qu’on lui fait et les questions socioéconomiques qui y sont liées. Les chapitres sur la biologie comprennent la taxonomie, le cycle de vie et les mœurs, la répartition, l’interaction entre l’insecte et l’arbre hôte, son développement et sa survie ainsi que l’épidémiologie et l’historique des infestations. La section sur la lutte et la gestion traite de stratégies de lutte, de détection et de relevés, de lutte préventive et proactive ainsi que d’outils d’aide à la décision. Les chapitres sur les aspects socioéconomiques examinent, d’un point de vue économique, les programmes d’aménagement et l’utilisation du bois récupéré après le passage du dendroctone dans la fabrication de produits en bois massif, de panneaux ainsi que des pâtes et papiers.

**Disclaimer:**

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Preface

Les Safranyik, Bill Wilson, and Allan L. Carroll

Our main objective in producing this book is to provide a comprehensive review and synthesis of the biology and management of the mountain pine beetle (Dendroctonus ponderosae Hopkins [Coleoptera: Scolytidae]) in lodgepole pine (Pinus contorta Dougl. ex. Loud. var. latifolia Engelm.) with a special emphasis on western Canada. In addition, the synthesis is intended to assist in identifying the incremental research necessary to effectively respond to the major beetle epidemic in British Columbia and to provide a benchmark to measure the research contribution of Natural Resources Canada’s Mountain Pine Beetle Initiative.

The extensive lodgepole pine forests in western North America provide a wide range of values, including scenic and recreational areas, watersheds, habitat for wildlife, grazing for livestock, and raw materials for wood and wood fibre products. However, lodgepole pines are relatively transient successional pioneers subject to frequent natural disturbances, particularly from wildfires and from insects such as the mountain pine beetle. This creates significant challenges for forest managers. These challenges are further complicated by the apparent dependence of lodgepole pine upon disturbances related to fire and the mountain pine beetle. In the absence of disturbance, lodgepole pine is normally replaced by late-successional species such as spruce and fir. The mountain pine beetle’s preference for mature pine and the consequent increased fuel loading and wildfire potential, in combination with the serotinous cone character of lodgepole pine, assist in the perpetuation of lodgepole pine forests (Raffa and Berryman 1987). The combination of these factors tends to produce mixed-age, pine-dominated landscapes.

The mountain pine beetle is an indigenous insect in pine ecosystems throughout western North America. Beetle populations are prone to periodic landscape-level outbreaks where larger diameter trees of mature stands may be heavily depleted in a few years over large areas. During large outbreaks some younger stands may also suffer considerable mortality. The extensive tree mortality that occurs during these outbreaks has important economic and ecological impacts. Consequently, the biology and habits of the beetle, as well as the nature and effects of its interaction with its pine hosts, have been studied and foresters have attempted to manage the problem over the past century or so, both in Canada and the United States.

Despite the large inventory of pine, the increased vulnerability of these pine forests and the scale of outbreak impacts, little of the beetle research is recent. The last comprehensive publications on mountain pine beetle biology and management in lodgepole pine were published over two decades ago (Safranyik et al. 1974, 1975; Amman et al. 1977; Berryman et al. 1978; McGregor and Cole 1985; Amman and Cole 1983). Some of these publications are out of print and others are not readily available to forest managers. Furthermore, even though these past publications were generally comprehensive for their time, there have been
importantly advances since then. Accordingly, this book presents a synthesis of published information on mountain pine beetle biology and management with an emphasis on lodgepole pine forests. The goal is to interpret the diverse and often complex literature within the context of operational mountain pine beetle management. Where possible, sections have been augmented with new, unpublished information, especially on aspects of beetle population biology and epidemiology. As deemed appropriate, information sources relating to host species other than lodgepole pine (e.g., ponderosa pine, *Pinus ponderosa* and jack pine, *P. banksiana*) and other geographic regions (i.e., the western United States) were also included.

The book covers three main subject areas: mountain pine beetle biology, management, and socioeconomic concerns. As such, it is intended to be the most comprehensive treatment of mountain pine beetle to date. The chapters on biology cover taxonomy, life history and habits, area distribution, insect-host tree interactions, development and survival, epidemiology, and outbreak history. The management section covers management strategy, survey and detection, proactive and preventive management, and decision support tools. The chapters on socioeconomic aspects include an economic examination of management programs and the utilization of post-beetle salvage timber in solid wood, panelboard, pulp and paper products.

Our synthesis of mountain pine beetle biology highlights the importance of climate and the evolved interaction between the beetle with its associated blue stain fungi and lodgepole pine in determining the onset and course of beetle epidemics. Significant new information is presented on factors affecting change from endemic to incipient population phase, possible effects of climate change on range expansion, and the structure, growth and development of residual stands following epidemics.

In the management section, new information includes an assessment of remote sensing tools in beetle survey and detection, the role of decision aids in management programs, and the potential of preventive forestry practices to reduce losses from the mountain pine beetle.

The synthesis of the economic aspects of management points out the relatively minor role economic theory has played in beetle management and suggests ways to increase this vital component of decision making. The chapter on the characteristics of post-beetle salvage timber for manufacturing wood products reveals that in spite of considerable published information and local experience with the utilization of salvage timber, there are important gaps in knowledge, especially in relation to changes in the manufacturing qualities of trees as a function of time since death.

The material presented necessarily includes complex technical information, but the book should be a valuable reference for forest managers as well as researchers. As much as it was practicable, each chapter is self-contained and the need for the reader to refer to other chapters for additional information is kept to a minimum. Indeed, for readers with specific topics of interest, electronic copies of individual chapters are available for downloading from the Canadian Forest Service’s electronic bookstore at bookstore.cfs.nrcan.gc.ca.
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The mountain pine beetle is the most damaging biotic disturbance agent in mature lodgepole pine in western Canada. The current beetle outbreak in British Columbia is unprecedented in scale and will have unavoidable ecological and economic impacts. Unfortunately, this beetle outbreak may be a harbinger to an increased pest threat to Canadian forests. The abundance of mature age class timber in the inventory and a trend to warmer, drier summers and infrequent cold winter weather can combine to alter the balance between pest and host in forest ecosystems.

Major economic and non-market values accrue from forests. Sustainability of these forest values will be challenged by an increase in forest pest disturbances. The extensive character of Canadian forestry does not remove the risks of pest outbreaks. Maintaining forest resource values will benefit from a renewed commitment to reducing the impacts of forest pest disturbances. The key elements of this commitment are forest health monitoring, identification of high threat stands and pathways, prompt direct control activity, and landscape level reduction of stand susceptibility through preventive forestry practices. Forests are too valuable to not effectively respond to pest disturbances.