FAO
FORESTRY
PAPER

156

ISSN 0258-6150

Global review of forest pests and diseases

Cover photographs:
Left: Pine moth (*Dendrolimus spectabilis*) caterpillar feeding on *Pinus densiflora*, Democratic People's Republic of Korea (G. Allard)
Centre: Dothistroma needle blight (*Mycosphaerella pini*) on *Pinus contorta*, United States (Bugwood.org/USDA Forest Service Archive/2251050)
Right: Damage by the introduced beaver *Castor canadensis* to *Nothofagus pumilio*, Tierra del Fuego, Chile (G. Allard)

Global review of forest pests and diseases

FAO
FORESTRY
PAPER

156

A thematic study prepared in the framework
of the Global Forest Resources Assessment 2005

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2009

ISBN 978-92-5-106208-1

Contents

[1] Pests profiled in Part II are noted by an asterisk (*) when mentioned throughout the text.

TABLES

FIGURES

BOXES

Foreword

Insect pests, diseases and other biotic agents have considerable impacts on forests and the forest sector. They can adversely affect tree growth and the yield of wood and non-wood products. Damage caused by forest pests can significantly reduce wildlife habitat thereby reducing local biodiversity and species richness. They can alter natural forest landscapes by decimating one or more tree species as has been observed in eastern American forests as a result of chestnut blight and throughout the Northern Hemisphere because of Dutch elm disease. Some pests have necessitated changes in management regimes often forcing forest managers to switch to alternative tree species in plantations; for example, the failed attempts in many parts of the world to establish mahogany plantations because of the presence of mahogany shoot borers (*Hypsipyla* spp.). Pathogens may also limit the sites on which species can be grown successfully outside their natural range as has been experienced with red band needle blight (*Mycosphaerella pini*) and western gall rust (*Endocronartium harknessii*) infecting *Pinus radiata.*

While abundant literature is produced on forest pests and diseases, a comprehensive consideration of the issues at regional and global levels has been lacking. The first major global meeting on forest insect pests and diseases was held in Oxford, UK in 1964: the FAO and International Union of Forest Research Organizations (IUFRO) Symposium on Internationally Dangerous Forest Diseases and Insects. A second meeting held in New Delhi, India in 1975 continued the process of cooperation. Since the reports of these meetings, little information has been available at the global level that is not pest specific.

Understanding the state of global forest health requires international cooperation and the gathering and dissemination of accurate and timely information. As part of the Global Forest Resources Assessment 2005 (FRA 2005), countries reported on area affected by insect pests, diseases and other disturbances. This information was supplemented by a thematic study reviewing forest pests in 25 countries. Part I of this publication summarizes the results of these data by region. Part II presents profiles of some globally important forest pest species and Part III discusses select forest trees species and their associated pests. The information provided in this publication will assist forest health specialists, forest managers and policy-makers worldwide to make informed decisions.

During the preparation of this document continuous updates were necessary due to the discovery of previously unrecorded pest problems in new locations, countries and regions. The report is not comprehensive as new information is continually becoming available.

J.A. Prado
Director, Forest Management Division
FAO Forestry Department

Acknowledgements

This publication was compiled by Beverly A. Moore under the supervision of Gillian Allard.

Many thanks are extended to those who assisted with the preparation or review of the country pest overview papers that formed the basis for the regional chapters in Part I, including: Paula Klasmer, Instituto Nacional de Tecnologia Agropecuaria, Argentina; Aida Baldini Urrutia, Angelo Sartori Ruilova and other staff members, National Phytosanitary Protection Programme, Corporacion Nacional Forestal (CONAF), Santiago, Chile; Yang Zhong-qi, Research Institute of Forest Protection, Chinese Academy of Forestry; Olga Patricia Pinzon F., Universidad Distrital Francisco Jose de Caldas, Bogota, Colombia; Staff of the Department of Forests of the Ministry of Agriculture, Natural Resources and Environment, Cyprus; Paul P. Bosu, Forestry Research Institute of Ghana; Eston Mutitu, Linus Mwangi and Beryl Otieno, Kenya Forestry Research Institute; Almaz Orozumbekov, Kyrgyz Agrarian University, Kyrgyzstan; Clement Chilima, Forestry Research Institute of Malawi (FRIM); entomologists of the National Research Institute (ICAS), Bucharest, Romania; Jolanda Roux, Brett Hurley and Ryan Nadel, DST/NRF Centre of Excellence in Tree Health Biotechnology, Tree Protection Cooperative Programme (TPCP), Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, South Africa; Surachai Choldumrongkul, Royal Forest Department, Bangkok, Thailand; Glynn Maynard, Australia; Claus Eckelmann, FAO Subregional Office for the Caribbean, Barbados; and William Ciesla, Forest Health Management International, United States.

Thanks are also extended to those who reviewed draft versions of the publication or portions thereof, including: Zvi Mendel and Alex Protosov, Department of Entomology, Agricultural Research Organization, Volcani Center, Israel; Eric Allen, Pacific Forestry Centre, Canadian Forest Service; Kerry Britton, Research and Development, United States Forest Service; Claus Eckelmann and Gene Pollard, FAO Subregional Office for the Caribbean, Barbados; and Jose Antonio Prado, James Carle, Mette Loyche Wilkie and Andrea Perlis, FAO Forestry Department, Rome.

Matthew Cock of CABI Europe, Switzerland, with assistance from J. Knight, prepared Part III of this publication; their efforts are acknowledged.

Acronyms

ACIAR	Australian Centre for International Agricultural Research
AFWC	African Forestry and Wildlife Commission
APFC	Asia-Pacific Forestry Commission
APFISN	Asia-Pacific Forest Invasive Species Network
APPPC	Asia and Pacific Plant Protection Commission
CA	Comunidad Andina
CBD	Convention on Biological Diversity
CIBC	Commonwealth Institute of Biological Control
CIE	Commonwealth Institute of Entomology
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLRV	Cherry leaf roll nepovirus
COSAVE	Comité de Sanidad Vegetal del Cono Sur
CPPC	Caribbean Plant Protection Commission
EPPO	European and Mediterranean Plant Protection Organization
EU	European Union
FISNA	Forest Invasive Species Network for Africa
FRA	Global Forest Resources Assessment
FSC	Forest Stewardship Council
GISP	Global Invasive Species Programme
IAPSC	Inter-African Phytosanitary Council
ICP Forests	International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
ICPM	Interim Commission on Phytosanitary Measures
IFQRG	International Forestry Quarantine Research Group
IOBC	International Organization for Biological Control of Noxious Animals and Plants
IPM	Integrated pest management
IPPC	International Plant Protection Convention
ISPMs	International Standards for Phytosanitary Measures
ISSG	Invasive Species Specialist Group
IUCN	International Union for the Conservation of Nature
IUFRO	International Union of Forest Research Organizations
LACFC	Latin American and Caribbean Forestry Commission
LRTAP	Convention on Long Range Transboundary Air Pollution
MCPFE	Ministerial Conference for the Protection of Forests in Europe
NAFC	North American Forest Commission
NAPPO	North American Plant Protection Organization
NEFC	Near East Forestry Commission
NENFHIS	Near East Network on Forest Health and Invasive Species
NEPPO	Near East Plant Protection Organization
NPPO	National Plant Protection Organization
NPV	Nuclear polyhedrosis virus
OIRSA	Organismo Internacional Regional de Sanidad Agropecuaria
RPPO	Regional Plant Protection Organization
SLU	Swedish University of Agricultural Sciences
UNECE	United Nations Economic Commission for Europe
WMO	World Meteorological Organization

Introduction

Forests are complex ecosystems that provide a variety of valuable products, such as timber, fuelwood, fibre and non-wood forest products, and contribute to the livelihoods of rural communities. They also provide vital ecosystem services, such as combating desertification, protecting watersheds, maintaining biodiversity, and enhancing carbon sequestration, and play an important role in preserving social and cultural values. It is critically important to protect these valuable resources from disturbances such as fire, pollution, invasive species, insects and diseases.

While they are integral components of forest ecosystems, insects and diseases have considerable influence on the health of forests, trees outside forests and other wooded lands. They can adversely effect tree growth, vigour and survival, the yield and quality of wood and non-wood products, wildlife habitat, recreation, aesthetics and cultural values. Forest insect pests and diseases may also result in the limitation of plantation programmes, the abandonment of a given tree species and the necessity to clearcut large areas dominated by infested trees.

Forests need to be managed so that the risks and impacts of unwanted disturbances are minimized. Measures to protect forests from insect pests and diseases are an integral part of sustainable forest management. The importance of considering the impacts of insect pests and diseases on forests and the forest sector has been recognized for some time. Effective pest management requires reliable information – information on the pests themselves, their biology, ecology, and distribution, their impacts on forest ecosystems and possible methods of control. While much qualitative information on insect pests and diseases exists at local, national and even regional scales, little comprehensive, quantitative information is available at the global level. Typically more information is available on pests of trees in industrialized rather than non-industrialized countries and also for pests of trees grown in commercially valuable planted forests (which include plantation forests and planted semi-natural forests) compared to pests in naturally regenerated forests. Virtually nothing is known of the pests associated with those trees harvested from naturally regenerated forests, at least in the tropics.

FAO ACTIVITIES IN FOREST HEALTH

FAO is the only international organization working on forest health and protection at the global scale. Activities in the FAO forest protection and health programme aim to assist, advise and support countries to protect the health and vitality of forests, forest ecosystems and trees outside forests, with special reference to insects, diseases and other harmful biotic and abiotic agents. FAO provides advice on preventive measures, pest management and recommended actions to minimize risks of transboundary transfer. It also offers assistance to countries not only in response to pest outbreaks and emergencies but also in establishing long-term prevention and forest protection strategies. FAO also hosts the Secretariat of the International Plant Protection Convention (IPPC) (Box 1).

COLLECTING GLOBAL FOREST HEALTH INFORMATION

FAO gathers information to obtain an ever more complete picture of global forest health. The following activities are some examples that have helped contribute to closing the information gap regarding forest health.

With the cooperation of experts from member countries, FAO compiled data for a global information system on the impact of insect pests and disease outbreaks on forests (www.fao.org/forestry/25350). The pilot system was designed to document,

BOX 1

The International Plant Protection Convention

The International Plant Protection Convention (IPPC) is an international treaty to secure action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control. The IPPC is governed by the Commission on Phytosanitary Measures (CPM) which adopts International Standards for Phytosanitary Measures (ISPMs). These standards are developed and approved through an international consultative process, and are recognized under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures.

ISPMs have direct relevance to the forest sector including guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms (ISPM No. 3), pest risk analysis (ISPM Nos. 2, 11, 21), pest eradication programmes (ISPM No. 9), pest status and reporting (ISPM Nos. 8, 17), and regulating wood packaging materials in international trade (ISPM No. 15). In addition, the International Forestry Quarantine Research Group (IFQRG) acts as an advisory body to the IPPC and addresses critical forestry quarantine issues through discussion and collaborative research.

Regional Plant Protection Organizations (RPPOs) are intergovernmental organizations that assist in the coordination of National Plant Protection Organizations (NPPO), gather and disseminate information and assist in developing international standards.

The RPPOs include:

- Asia and Pacific Plant Protection Commission (APPPC) (formerly the Plant Protection Commission for Southeast Asia and the Pacific Region) created in 1956;
- European and Mediterranean Plant Protection Organization (EPPO), 1951;
- Inter-African Phytosanitary Council (IAPSC), 1954;
- Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA), 1953;
- Caribbean Plant Protection Commission (CPPC), 1967;
- Comunidad Andina (CA), 1969;
- North American Plant Protection Organization (NAPPO), 1976;
- Comite de Sanidad Vegetal del Cono Sur (COSAVE), 1980;
- Pacific Plant Protection Organization (PPPO), 1994.

A tenth RPPO, the Near East Plant Protection Organization (NEPPO), has been agreed upon and ratified by eight countries in the region. However, two more ratifications are required for it to enter into force.

analyse and make current information about forest health available at the country level in order to increase awareness of the severe problems related to insect pests and diseases worldwide and to provide up to date information for policy and forest management planning. A database on the incidence and extent of insect pests and diseases affecting forests over time was created and subsequently tested and a critical economic review of its contents was then carried out. To date, qualitative information on forest health issues has been collected for 64 countries, mostly developing countries and countries in transition. The information was gathered through different sources including FAO field project reports, country reports and a test questionnaire sent out to selected technical experts.

To attempt to quantify the impacts of the many factors that affect the health and vitality of a forest, the Global Forest Resources Assessment 2005 (FRA 2005) asked countries to report on the area of forest adversely affected by disturbances, including forest fires, insects, diseases and other disturbances such as weather-related damage (FAO, 2006). Most countries, however, were not able to provide reliable quantitative information because they do not systematically monitor these variables for many

TABLE 1
Countries included in the forest pest overviews

Region	Countries
Africa	Ghana, Kenya, Malawi, Mauritius, Morocco, South Africa, Sudan
Asia and the Pacific	China, India, Indonesia, Mongolia, Thailand
Europe	Moldova, Romania, Russian Federation
Latin America and the Caribbean	Argentina, Belize, Brazil, Chile, Colombia, Honduras, Mexico[a], Uruguay
Near East	Cyprus, Kyrgyzstan

[a] For the purposes of this study, Mexico has been included in Latin America and the Caribbean

reasons. As a result, FAO has been investigating ways to adapt the forest health and vitality reporting tables for the 2010 assessment in order to improve the quality of data reported and encourage monitoring of forest health.

A review of forest pests in both naturally regenerated forests and planted forests was carried out from 2005 to 2008 in 25 countries, including a number of major forest countries (Brazil, China, Indonesia), in Africa, Asia and the Pacific, Europe, Latin America and the Caribbean and the Near East (Table 1). Information was collated from many sources including expert contacts in the countries, the Internet and literature searches; where possible all data have been evaluated in country. Specifically, information was gathered on insect pests, diseases and other pests (nematodes, mites, parasitic plants and mammals) impacting naturally regenerated and planted forests. A section was also devoted to national capacities for forest health protection and included information on government and private landowner activities as well as monitoring and detection, data management and pest management activities. This activity is a continuous process and FAO will continue to review forest pests in other countries.

ABOUT THIS BOOK

Part I analyses the information gathered in the country reports to help identify the key issues in each region regarding forest health and protection and help further discussions on regional forest pests and capacities for pest management. Quantitative forest health information gathered through FRA 2005 is also presented where available. Further information from the region that was not highlighted in the country papers is discussed to present a more inclusive picture of forest health in each region. A section on North America (Canada and the United States of America) is also included. Part I concludes with a global analysis of this information.

Part II provides detailed profiles of some globally important transboundary forest pest species. These profiles are also available online at www.fao.org/forestry/pests, where additional pests will be included over time.

Part III presents profiles of the pests associated with some select forest tree species. This section was prepared by M.J.W. Cock, with assistance from J. Knight, in 2002. The information was extracted and adapted from the CABI Forestry Compendium (www.cabi.org/compendia/fc) to illustrate the diversity of pest and disease problems in important forest trees. The species were chosen to represent important forest tree genera. For any given genus, only one or two representative species are discussed, although main genera such as *Pinus* and *Eucalyptus* obviously have dozens of important species.

Annexes provide the raw data collected from the countries, by region, and a table of the species mentioned in the publication.

Throughout this book, an asterisk (*) indicates species that are profiled in Part II.