

Conclusions

Given the vast benefits that forests and other wooded lands provide to the world, it is vital to protect these resources. This publication and many others on forest health illustrate that insect pests and diseases have had, and will continue to have, significant impacts on the world's forests and forest sector. In terms of sustainable forest management, minimizing the impacts of insects and diseases is no less important to a viable and strong forest sector than improving silvicultural and traditional forest management techniques.

Forest pests and diseases are a global problem and, consequently, it is necessary to look beyond national borders to develop effective solutions. The problem of intercontinental spread of insect pests and pathogens has raised serious concerns for some time now. In the past five years, the importance of invasive species and their impact on the environment has been increasingly recognized. More and more forest pest species appear to have been intentionally or accidentally introduced into areas beyond their natural ranges, resulting in a more extensive list of transboundary pests threatening forests and the forest sector worldwide. While this may seem to indicate that our ability to address the problem is progressively worsening, it is more likely that new introductions have increased as a result of the speed, volume and improved efficiency of the global trade market and that, fortunately, capacity to monitor and detect new pests and their impacts has improved.

Awareness of the need to gather and share information on forest pests at national, regional and global levels is increasing. Countries need to obtain reliable, quantitative information on the impacts of forest insect pests and diseases on a regular basis. At present, however, data are often collected only after significant damage has been caused and for most countries little information is available on pest impacts in naturally regenerated forests. Agreement is needed on the parameters by which to gather data and, in particular, on common definitions on what constitutes a disturbance and how the data are to be collected (FAO, 2007a).

Although many countries are adopting more pest management strategies to contain forest pests, greater recognition is still needed of the importance of pest management for effective forest management. Improving forest pest management involves increased research into the pests themselves and their control, increased taxonomic and diagnostic expertise to improve pest identifications, better monitoring and detection including the development of detection methodologies and diagnostic tools, research into new control technologies, and an overall increase in the capacity of all countries in forest health protection.

Over the past few decades, there has been a notable shift in requests to FAO: from requests for technical assistance for emergency control of pests to requests for help in increasing national or regional capacities in monitoring and prevention techniques for forest health and protection. Pest outbreaks are cyclical, occurring every 7 to 10 years, and the fact that there are fewer requests for emergency assistance for pests that were dealt with within the last decade suggests that countries have increased their capacity to deal with forest pest problems themselves. The progression of emphasis from dealing solely with pest emergencies towards more holistic approaches of prevention and improving national capacities needs to be continued.

The development and dissemination of effective control measures is vital to the protection of forest health. An evolution has been observed over the past few decades in terms of techniques and attitudes towards pest control. In the early 1960s a variety

of methods were used to control forest insect pests and diseases including mechanical, silvicultural, chemical and biological methods, with chemical control the most commonly used. By the 1970s environmental concerns were being increasingly raised about the use of chemicals. As a result, research into the use of biological control agents in conjunction with silvicultural methods or pheromones began in earnest.

There is also a growing recognition of the importance of environmental policies and pesticide legislation. The Forest Stewardship Council (FSC), a non-governmental organization established to promote the responsible management of the world's forests, prohibits the use of highly hazardous pesticides and promotes the development and adoption of environmentally friendly non-chemical methods around the world. The FSC maintains a list of prohibited highly hazardous pesticides which includes chlorinated hydrocarbon pesticides, pesticides banned by international agreement, and pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use (FSC, 1996). Today, integrated pest management involving a combination of control measures is considered the most effective way to deal with forest pests. Applications of biological control agents and microbial insecticides have become major components of pest management programmes and considerable emphasis is placed on prevention and early detection as a means to avoid future pest problems.

Breeding trees for pest resistance is another technique that has grown in importance over the past few decades. Currently, there are many programmes on breeding for resistance of forest trees, and resistant hosts have been developed against a variety of forest pests. For example, strains of black poplar (*Populus nigra*) resistant to attack by the Asian longhorned beetle (*Anoplophora glabripennis**) have been developed in China (Hu *et al.*, 2001), monterey pine (*Pinus radiata*) resistant to *Mycosphaerella pini** have been developed in New Zealand (Carson, 1990) and western white pine (*Pinus monticola*) have been bred for resistance to white pine blister rust (*Cronartium ribicola*) in Canada and the United States (Sniezko, 2006).

Cooperation and coordination of pest management activities between countries and regions is imperative, as are international activities, particularly those geared to developing international standards on pests and global trade. There is a need for increased pest reporting to National Plant Protection Organizations (NPPOs) and stronger links between the forest sector and the International Plant Protection Convention (IPPC). This has been improving: the IPPC has given greater recognition to forest pests and has adopted International Standards for Phytosanitary Measures (ISPMs) directly relevant to the forest sector. Recent focus is on better implementation of these complex international standards by translating them into more understandable and relevant terms for the use of all forest personnel dealing with phytosanitary issues.

The forest sector needs to be able to adapt to new situations and scenarios and this requires research, policies and practices that will enable it to plan and manage healthy forests to meet future needs. The impacts of a changing climate on forests and the possibility of increased susceptibility to forest insects and pathogens are of global significance in forest health today. Climate change is influencing not only trees and forests but also the way in which forestry is practiced. For example, climate change can stress forest ecosystems and may be a key factor in forest health decline. This has serious implications for forests in terms of altering pest distributions, population dynamics and behaviours. In response to such global concern, FAO, IUFRO, the Swedish University of Agricultural Sciences (SLU), USDA Forest Service, Seoul National University, and the Royal Swedish Academy of Agriculture and Forestry sponsored an international conference on Adaptation of Forests and Forest Management to Changing Climate with Emphasis on Forest Health, held in Sweden in August 2008.