Global analysis

PEST TYPE

Almost 77 percent of the forest pests reported from the overview countries were insect pest species (Table 11). All regions reported significantly more insect pests than other pest types (Figure 11; Table 12). Sixteen percent of the pest species were pathogens and the remaining 7 percent were other pests.

Insects tend to be easier to trap than other pests and easier to identify as the cause of tree damage, although identification still requires specialized training and expertise. The impacts of pathogenic diseases on forest trees, such as destruction of internal wood, reductions in growth, or delayed regeneration, are often subtle and difficult to detect. It can be difficult to determine the causative agent of these impacts. Likewise, the impacts of other pests such as nematodes, mites, mammals and parasitic plants on forest trees are not easy to detect.

INDIGENOUS VERSUS INTRODUCED PESTS

A large majority of the forest pests reported from the overview countries are indigenous species (Table 11). All regions reported more indigenous pest species than introduced species (Figure 11). Latin America and the Caribbean, however, reported almost equal numbers of indigenous and introduced species.

Eleven of the pest species were reported as both indigenous and introduced – the fungal pathogens *Armillaria mellea**, *Botryosphaeria dothidea**, *Nattrassia mangiferae* and *Subramanianospora vesiculosa* and the insect pests *Brontispa longissima*, *Coptotermes gestroi*, *Hylurgus ligniperda*, *Hypsipyla grandella**, *Hypsipyla robusta**, *Pineus pini* and *Xylosandrus morigerus*.

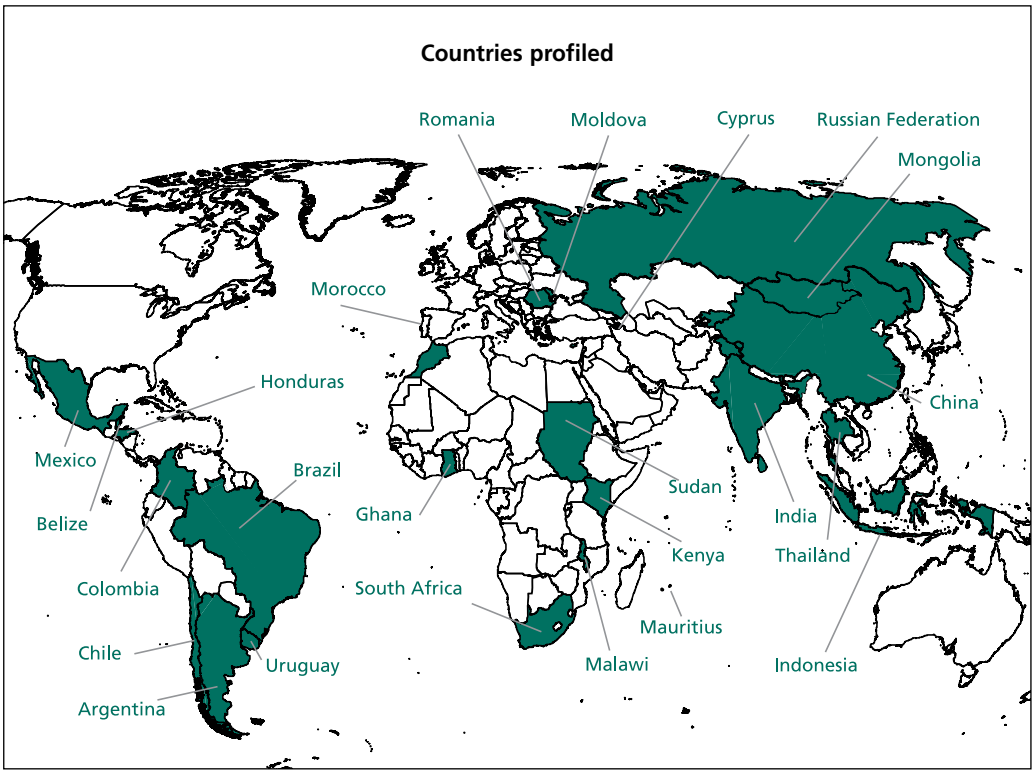


FIGURE 11
Number of pest species by region as reported from the selected 25 countries

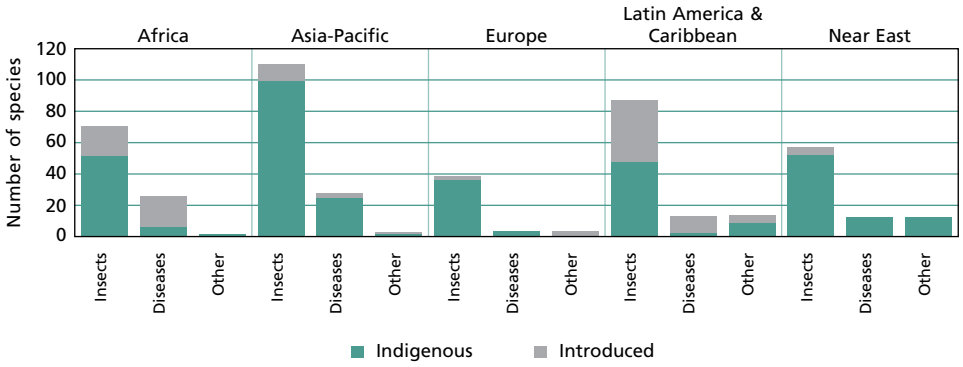


TABLE 11
Summary of the data on forest pest species from the 25 countries

Pest type	Number of pest species						
	Total	In naturally regenerated forests	In planted forests	In both types of forest	On broadleaf	On conifer	On both host types
Indigenous species							
Insects	277	102	135	39	178	80	18
Diseases	46	7	30	9	34	8	4
Other	22	14	7	1	14	5	3
Total	344	123	172	49	226	93	25
Introduced species							
Insects	64	3	49	12	28	34	2
Diseases	28	2	22	4	17	6	5
Other	9	7	1	1	5	1	3
Total	101	12	72	17	50	41	10
Total all regions [a]	**434**	**135**	**235**	**64**	**268**	**132**	**34**

[a] Eleven pest species (*Armillaria mellea**, *Botryosphaeria dothidea**, *Brontispa longissima*, *Coptotermes gestroi*, *Hylurgus ligniperda*, *Hypsipyla grandella**, *Hypsipyla robusta**, *Nattrassia mangiferae*, *Pineus pini*, *Subramanianospora vesiculosa and Xylosandrus morigerus*) were reported as both indigenous and introduced pests. These species were included in each section but were counted only once in the total.

TABLE 12
Prevalent characteristics of pest problems by region (from the 25 forest pest overviews)

Region	Pest type	Indigenous/ introduced	Planted/ naturally regenerated	Host type	Insect pest order	Disease order	Other pest order
Africa	Insect	Indigenous	Planted	Broadleaf	Coleoptera, Lepidoptera	Ascomycota	Primata
Asia and the Pacific	Insect	Indigenous	Planted	Broadleaf	Coleoptera, Lepidoptera	Ascomycota	Tylenchida, Rodentia
Europe	Insect	Indigenous	Naturally regenerated	Broadleaf	Lepidoptera	Ascomycota	Artiodactyla
Latin America and the Caribbean	Insect	Indigenous	Planted	Broadleaf	Coleoptera	Ascomycota	Santalales
Near East	Insect	Indigenous	Naturally regenerated	Broadleaf	Coleoptera	Basidiomycota	Acarina

Indigenous pests and signs of their infestation are often well-known to foresters and forest workers in the region. Previous experience with the pests leads to better and faster identification. Introduced pest species are usually more difficult to identify and detect owing to lack of knowledge of their biology and associated symptoms and lack of monitoring for such species.

TYPE OF FOREST

Over 54 percent of pests in the overview countries were recorded in planted forests, 31 percent in naturally regenerated forests and almost 15 percent in both forest types (Table 11). Planted forests are growing in importance but represent just 6.9 percent of the global forest total (271 million hectares) (FAO, 2006b). Nearly half of the world's planted forests are in Asia, almost 30 percent in Europe, 11 percent in North and Central America, 6 percent in Africa, 5 percent in South America and just over 1 percent in Oceania (FAO, 2006b). The pest data are likely to be skewed positively towards planted forests. Because of their commercial and economic importance, more attention is often paid to their health and monitoring, and pests in these forests are more often detected, identified, dealt with and reported.

Forest plantations of single tree species may have higher risk of major insect or disease infestation. In more diverse forest ecosystems, the risk of major infestations is not considered to be as high.

Three of the regions reported more species impacting planted forests than naturally regenerated forests: Asia and the Pacific (77 percent); Latin America and the Caribbean (65 percent); and Africa (59 percent) (Table 12). A number of countries with the largest planted forest area in Asia and the Pacific and in Latin America and the Caribbean were included in this analysis. Therefore, it is not surprising that more pests were reported from planted forests in these regions. A similar result was noted for Africa, where two countries with particularly large planted forest area, the Sudan and South Africa, were included in the overview.

Europe and the Near East, regions with the lowest sample sizes, reported more pest species in naturally regenerated forests, almost 62 percent and 51 percent respectively. Although planted forests are an important category in Europe, many of the countries that contribute to the large area, such as Sweden, Finland and France, were not part of the review. The Near East is represented by only two countries, Cyprus and Kyrgyzstan, and Kyrgyzstan provided more information on the naturally regenerated forests than on the remote and less accessible planted forests in the country.

Belize, Honduras, Kyrgyzstan, Malawi, Moldova and Romania reported more pests in naturally regenerated forests, while Mongolia, Russian Federation and Cyprus reported pests in equal numbers in both forest types.

Over 73 percent of pests in planted forests and 91 percent in naturally regenerated forests were indigenous species (Table 11). Introduced pests were found more prevalently in planted forests than naturally regenerated forests. This is notable since many planted forest trees are comprised of exotic species that were introduced for particular purposes. These may be more susceptible to introduced pests which, in the absence of natural enemies, can build up into large numbers (FAO, 2001). In addition, introduced pests are often difficult for foresters and forest workers to detect and identify due to lack of knowledge about the pest and its biology.

HOST TYPE

Almost 62 percent of forest pests were recorded on broadleaf tree species, over 30 percent on conifers and almost 8 percent on both host types (Table 11). In all regions, pests were recorded more often on broadleaf trees than conifers.

In 16 of the 25 overview countries, broadleaf tree species were the most commonly affected host species. Argentina, Belize, Cyprus, Honduras, Mexico, Mongolia, Morocco and the Russian Federation reported more pests on conifers. Kenya, reported equal numbers on both host types.

Broadleaf trees in planted forests were more affected by forest pests than those in naturally regenerated forests. The proportion of conifer pests in each forest type also exhibited the same pattern.

FIGURE 12
Insect pests reported from the 25 countries

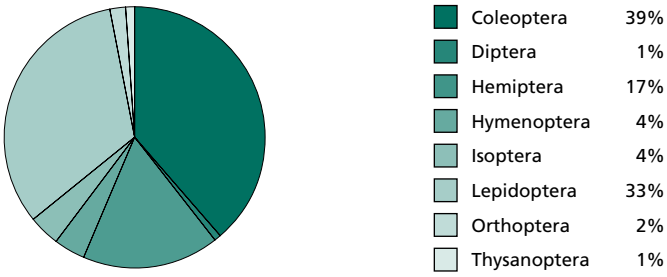


FIGURE 13
Disease-causing pathogens reported from the 25 countries

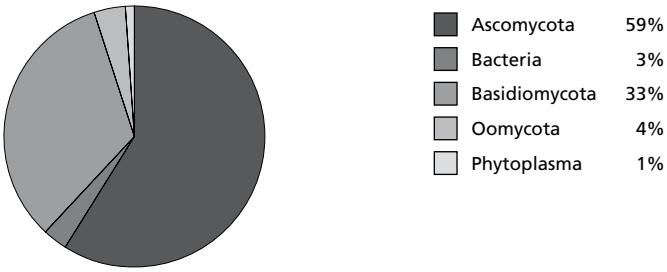
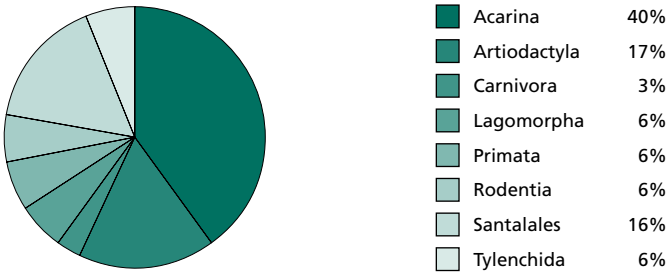


FIGURE 14
Other pests reported from the 25 countries



PREVALENT PEST SPECIES

For insect pests, the most commonly reported pest species belong to the orders Coleoptera and Lepidoptera which together made up over 70 percent of all insect pest species reported (Figure 12). Hemipteran species were the third most important insect order at 16 percent. In Africa and Asia and the Pacific, both Coleoptera and Lepidoptera made up the majority of pest species reported. Europe reported more lepidopterans and Latin America and the Caribbean reported more coleopterans.

For diseases, the majority of species were members of the phylum Ascomycota which represented almost 60 percent of all pathogens reported (Figure 13). Basidiomycota species were the next major group at 33 percent. Four of the regions reported more Ascomycota species while the Near East reported more Basidiomycota species.

For the category other pests (Figure 14), Acarina species were the most common followed by Artiodactyla species (even-toed ungulates) and Santalales (mistletoes and parasitic plants). Nematodes, rodents and primates were also classified as important pests. Africa reported more primate species, Europe more Artiodactyla, Latin America and the Caribbean more mistletoes and parasitic plants, and the Near East more Acarina species. In the Asia and Pacific region, nematodes and rodents were equally reported.

TRANSBOUNDARY PESTS

Twenty-five insect pest species were recorded in more than one region (Table 13). In order of importance are coleopterans (9), lepidopterans (7), hemipterans (6), hymenopterans (2) and isopterans (1). Bark beetles (Curculionidae, Scolytinae) were the most prevalent order.

Eleven of the above are introduced species, eight are indigenous and six are both indigenous and introduced depending on the country from which the species was reported. Twelve of the pests were recorded in planted forests, one in naturally regenerated forests and 12 in both forest types. Conifers were the host species for 12 of the transboundary pests, broadleaf trees for 12, and one pest was reported on both host types.

Nine disease-causing pathogens were reported from more than one region (Table 14). The majority of these were species of the phylum Ascomycota; the remainder were Basidiomycota species. Five of the pathogens are introduced species and four are both indigenous and introduced depending on the country from which they were reported. Seven of the pests were recorded in planted forests and two in both forest types. Broadleaf trees were the hosts for six of the transboundary pests, conifers for two species, and one pathogen was recorded on both host types.

In the category other pests, genera but not species were repeated for more than one continent, e.g. *Arceuthobium* was reported on conifers in Latin America and the Caribbean (*Arceuthobium* spp. in Mexico) and the Near East (*A. oxycedri*, Kyrgyzstan); and deer (*Cervus* spp.) were reported as pests of naturally regenerated forests in Latin America and the Caribbean (*Cervus elaphus*, Chile) and Europe (*Cervus nippon*, Moldova).

CAPACITY FOR FOREST HEALTH PROTECTION

Countries are increasingly recognizing the importance of environmental and biodiversity issues, including health and protection, to effective forest management. Many countries have national centres dedicated to forest research and in some countries there are also centres for forest health and protection. A number of constraints have been noted from the regions, including outdated equipment and lack of financial resources and specialized training.

TABLE 13
Insect pest species reported across regional borders from the 25 countries

Insect pest species	Order: family	Countries of occurrence	Indigenous/ introduced	Type of forest	Host type
*Cinara cupressivora**	Hemiptera: Aphididae	Africa: Kenya, Malawi, Mauritius Latin America and Caribbean: Chile, Colombia	Introduced	Naturally regenerated, planted	Conifer
*Cinara pinivora**	Hemiptera: Aphididae	Africa: Kenya Latin America and Caribbean: Argentina, Brazil	Introduced	Planted	Conifer
Coptotermes gestroi	Isoptera: Rhinotermitidae	Asia and Pacific: Thailand Latin America and Caribbean: Mexico	Indigenous, introduced	Planted	Broadleaf
*Dendrolimus sibiricus**	Lepidoptera: Lasiocampidae	Asia and Pacific: China, Mongolia Europe: Russian Federation	Indigenous	Naturally regenerated, planted	Conifer
Erannis defoliaria	Lepidoptera: Geometridae	Europe: Moldova, Romania Near East: Kyrgyzstan	Indigenous	Naturally regenerated	Broadleaf
Eulachnus rileyi	Hemiptera: Aphididae	Africa: Kenya, Malawi Latin America and Caribbean: Argentina, Chile, Colombia	Introduced	Naturally regenerated, planted	Conifer
*Gonipterus scutellatus**	Coleoptera: Curculionidae	Africa: Kenya, Mauritius, South Africa Latin America and Caribbean: Chile	Introduced	Planted	Broadleaf
*Heteropsylla cubana**	Hemiptera: Psyllidae	Africa: Kenya, Malawi, Mauritius, Sudan Asia and Pacific: India, Indonesia, Thailand	Introduced	Planted	Broadleaf
Hylurgus ligniperda	Coleoptera: Scolytidae	Africa: South Africa Latin America and Caribbean: Chile	Indigenous, introduced	Naturally regenerated, planted	Conifer
Hyphantria cunea	Lepidoptera: Arctiidae	Asia and Pacific: China Europe: Moldova, Romania Near East: Kyrgyzstan	Introduced	Naturally regenerated, planted	Broadleaf
*Hypsipyla grandella**	Lepidoptera: Pyralidae	Africa: Mauritius Latin America and Caribbean: Argentina, Belize, Brazil, Colombia, Mexico, Uruguay	Indigenous, introduced	Planted	Broadleaf
*Hypsipyla robusta**	Lepidoptera: Pyralidae	Africa: Ghana, Mauritius Asia and Pacific: India, Indonesia, Thailand	Indigenous, introduced	Planted	Broadleaf
*Ips sexdentatus**	Coleoptera: Scolytidae	Asia and Pacific: Mongolia, Thailand Europe: Romania, Russian Federation	Indigenous	Naturally regenerated, planted	Conifer

Insect pest species	Order: family	Countries of occurrence	Indigenous/ introduced	Type of forest	Host type
*Leptocybe invasa**	Hymenoptera: Eulophidae	Africa: Kenya, Morocco, South Africa Asia and Pacific: India	Introduced	Planted	Broadleaf
*Lymantria dispar**	Lepidoptera: Lymantriidae	Africa: Morocco (European strain) Asia and Pacific: China and Mongolia (Asian) Europe: Moldova and Romania (European), Russian Federation (Asian) Near East: Cyprus (European), Kyrgyzstan (Asian)	Indigenous	Naturally regenerated, planted	Broadleaf, Conifer
*Orthotomicus erosus**	Coleoptera: Scolytidae	Africa: Morocco Near East: Cyprus	Indigenous	Naturally regenerated, planted	Conifer
*Phoracantha recurva**	Coleoptera: Cerambycidae	Africa: Malawi, Morocco, South Africa Latin America and Caribbean: Chile, Uruguay	Introduced	Planted	Broadleaf
*Phoracantha semipunctata**	Coleoptera: Cerambycidae	Africa: Malawi, Morocco, South Africa Latin America and Caribbean: Chile	Introduced	Planted	Broadleaf
Pineus pini	Hemiptera: Adelgidae	Africa: Kenya, Malawi, South Africa Asia and Pacific: India Near East: Kyrgyzstan	Indigenous, introduced	Planted	Conifer
Quadraspidiotus perniciosus	Hemiptera: Coccidae	Asia and the Pacific: India Near East: Kyrgyzstan	Introduced	Naturally regenerated, planted	Broadleaf
*Sirex noctilio**	Hymenoptera: Siricidae	Africa: South Africa Latin America and Caribbean: Argentina, Brazil, Chile, Uruguay	Introduced	Planted	Conifer
*Thaumetopoea pityocampa**	Lepidoptera: Thaumetopoeidae	Africa: Morocco Near East: Cyprus (*Thaumetopoea wilkinsoni*)	Indigenous	Naturally regenerated, planted	Conifer
Tomicus minor	Coleoptera: Scolytidae	Asia and Pacific: Mongolia Europe: Romania Near East: Cyprus	Indigenous	Naturally regenerated, planted	Conifer
Tomicus piniperda	Coleoptera: Scolytidae	Asia and Pacific: Mongolia Europe: Romania, Russian Federation Near East: Cyprus	Indigenous	Naturally regenerated, planted	Conifer
Xylosandrus morigerus	Coleoptera: Scolytidae	Asia and Pacific: Indonesia Latin America and Caribbean: Mexico	Indigenous, introduced	Planted	Broadleaf

TABLE 14
Disease pest species reported across regional borders from the 25 countries

Disease species	Phylum: family	Countries of occurrence	Indigenous/ introduced	Type of forest	Host type
*Armillaria mellea**	Basidiomycota: Marasmiaceae	Africa: Kenya, Malawi, Sudan Near East: Kyrgyzstan	Indigenous, introduced	Naturally regenerated, planted	Broadleaf, Conifer
*Botryosphaeria dothidea**	Ascomycota: Botryosphaeriaceae	Africa: South Africa Asia and Pacific: Thailand Latin America and Caribbean: Uruguay	Indigenous, introduced	Planted	Broadleaf
*Chrysoporthe cubensis**	Ascomycota: Incertae sedis	Asia and Pacific: Thailand Latin America and Caribbean: Brazil, Colombia	Introduced	Planted	Broadleaf
Coniothyrium zuluense	Ascomycota: Leptosphaeriaceae	Asia and Pacific: Thailand Latin America and Caribbean: Uruguay	Introduced	Planted	Broadleaf
*Mycosphaerella pini**	Ascomycota: Mycosphaerellaceae	Africa: Kenya, South Africa Latin America and Caribbean: Chile	Introduced	Planted	Conifer
Nattrassia mangiferae	Ascomycota: Incertae sedis	Africa: Sudan Asia and Pacific: Thailand	Indigenous, introduced	Planted	Broadleaf
Phanerochaete salmonicolor	Basidiomycota: Phanerochaetaceae	Africa: South Africa Latin America and Caribbean: Brazil	Introduced	Naturally regenerated, planted	Broadleaf
Sphaeropsis sapinea	Ascomycota: Incertae sedis	Africa: Kenya, South Africa Latin America and Caribbean: Chile	Introduced	Planted	Conifer
Subramanianospora vesiculosa	Ascomycota: Incertae sedis	Africa: Mauritius Asia and Pacific: India, Thailand	Indigenous, introduced	Planted	Broadleaf

Monitoring and detection

In most of the regions, monitoring and detection activities are informal, involving field surveillance by foresters and forest workers, and many are targeted to specific pests. Some activities include aerial and ground surveys, mapping of winter nests and placement of pheromone traps. More activities are carried out in commercially valuable planted forests than in naturally regenerated forests.

Data management

In some areas advanced tools for data management are available, often developed as part of programmes to address specific forest pests. In most regions, however, data management capacity is lacking.

Most information on forest health is qualitative in nature. Very little quantitative data exist for many regions, and existing data are often not available in an easily accessible format. Data are often collected only after significant damage has been caused. Consistent data on the impacts of forest pests and diseases over time are not available for most regions.

Only 13 of the 25 overview countries provided quantitative data on forest health as part of the FRA 2005 process, and the information is still incomplete for many of these countries (Table 15). For these countries, the area affected by insects, diseases and other

TABLE 15
Total forest area and forest area affected by disturbances for the selected countries that provided quantitative information for the Global Forest Resources Assessment 2005

Country	Total forest area (*1 000 ha*)	Average forest area affected annually (*1 000 ha*)							
		Insects		Diseases		Other		Total	
		1990	2000	1990	2000	1990	2000	1990	2000
Brazil	477 698	50	30	–	20	–	–	50	50
Chile	16 121	866	531	13	810	–	–	879	1 341
China	197 290	7 879	6 191	1 820	883	755	820	10 454	7 894
Honduras	4 648	–	1	–	–	–	–	–	1
India	67 701	–	1	–	8	–	–	–	9
Indonesia	88 495	3	–	–	–	–	–	3	–
Kyrgyzstan	869	70	60	16	10	–	–	86	70
Mexico	64 238	8	8	11	2	–	–	19	10
Moldova	329	61[a]	96	–	–	–	–	61	96
Mongolia	10 252	28	2 798	–	–	–	–	28	2 798
Morocco	4 364	16	37	–	–	–	3	16	40
Russian Federation	808 790	1 718	4 953	124	957	–	–	1 842	5 910
South Africa[b]	9 203	2	1	–	–	–	–	2	1
Total	**1 749 998**	**10 701**	**14 707**	**1 984**	**2 690**	**755**	**823**	**13 440**	**18 220**

Source: FAO, 2006a

[a] The estimate for damage by insects for 1990 in Moldova may include some areas damaged by disease.

[b] Data for South Africa are from one source for planted forests only and refer to disturbances by weather, diseases, insects, animals and rodents.

pests and disturbances increased for the 2000 reporting period from the 1990 period by over 36 percent. For the 2000 reporting period, a total of over 18 million hectares were affected by forest pests; 14.7 million hectares damaged by insects, 2.7 million hectares by diseases and over 800 000 ha by other pests and disturbances. The total area affected was just over one percent of the total forest area of the countries reporting.

Pest management

Few comprehensive forest pest management plans exist for most regions and emphasis on preventative measures is for the most part lacking. A variety of pest management activities (biological, chemical, silvicultural) have been carried out in each region for specific pests. Such activities include the physical removal of infested trees and other silvicultural procedures, ground and aerial application of chemical and microbial pesticides, the use of biocontrol agents, and the planting of pest tolerant tree species.

Ownership

While forests are publicly owned in many of the regions, there is a trend from public to private ownership (FAO, 2007a). Little information is available on the capacity of private landowners in the area of forest health protection although it was noted that in many cases, they work collaboratively with national agencies, institutes and universities on such issues.

SUMMARY

Forest insect pests, diseases and other pests are having significant impacts on forests worldwide. While the devastating impacts of indigenous forest pests are already recognized, those of introduced species are increasingly being recognized as well. Rapid transport, ease of travel, and free trade have facilitated the spread of pests, as evidenced by the list of transboundary species (Tables 13 and 14).

There is a growing trend towards adopting more sustainable forest management strategies to contain forest pests, particularly in developed countries (FAO, 2007a). This movement is related to changes in the perception and role of forests, which are increasingly valued not just for economic reasons but also for their ecological and social functions.

Insect pests are the main problem reported. Disease-causing pathogens are more difficult to detect and identify and are reported less frequently. Training and expertise in pest identification and in detection of the first signs and symptoms are needed in many countries as a first line of defence against pest introductions.

Monitoring and surveillance of forest pests are needed, as well as agreement on parameters by which to gather data, in particular common definitions on what constitutes a disturbance and how the data are to be collected (FAO, 2007a).

Most countries do not have reliable information on the area of forest affected by insect pests and diseases because they do not systematically monitor these variables (FAO, 2007a). Data are often collected only after significant damage has been caused. More information is available on pests in commercially valuable planted forests than naturally regenerated forests. Awareness of the need to gather and share information on forest pests at national, regional and global levels is increasing.

Many strides have been made on forest health issues at regional and international levels by a variety of working groups, regional plant protection organizations, international organizations, research organizations and networks (Box 2). There have been concerted efforts to increase the free flow of information through networking and the Internet (Box 3) and to encourage compliance with international phytosanitary standards, especially those with direct relevance to forestry.

BOX 2

Regional and international groups and initiatives addressing forest health

- The International Union of Forest Research Organizations (IUFRO) has a number of divisions and units dedicated to research on a variety of forest health issues including entomology, pathology, invasive alien species and the impacts of air pollution and climate change on forest ecosystems.
- The International Plant Protection Convention (IPPC) targets the spread and introduction of pests of plants and plant products and promotes appropriate measures for their control (see Box 1).
- The working group for forest insects and disease of the North American Forest Commission (NAFC) was established over 40 years ago and was recently amended to include invasive plant species.
- Regional networks dealing with forest pests, primarily forest invasive species, include the Asia-Pacific Forest Invasive Species Network (APFISN), the Forest Invasive Species Network for Africa (FISNA), the Near East Network on Forest Health and Invasive Species (NENFHIS) and Red de Países de Cono Sur sobre Especias Exoticas Invasoras a Ambientes Forestales.
- In 1993, Near Eastern countries agreed to create the Near East Plant Protection Organization (NEPPO). This agreement has been ratified by eight countries (most recently the Syrian Arab Republic in July 2005), but two more ratifications are required for it to enter into force.
- A number of international instruments and organizations concentrate on the issue of invasive alien species such as the Global Invasive Species Programme (GISP), International Union for the Conservation of Nature (IUCN)/SSC Invasive Species Specialist Group (ISSG), Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention).

BOX 3

Sources of information on forest pests and invasive species

- FAO's forest health Web site: www.fao.org/forestry/pests
- FAO's invasive species Web site: www.fao.org/forestry/aliens
- FAO's forest biosecurity Web site: www.fao.org/forestry/biosecurity
- Forest Invasive Species Network for Africa (FISNA): www.fao.org/forestry/27679
- Asia-Pacific Forest Invasive Species Network (APFISN): www.fao.org/forestry/35067
- Center for Invasive Species and Ecosystem Health (Bugwood Network): www.forestpests.org
- Delivering Alien Invasive Species Inventories for Europe (DAISIE): www.europe-aliens.org
- Ecoport: www.ecoport.org
- European and Mediterranean Plant Protection Organization (EPPO) pest lists: www.eppo.org/QUARANTINE/quarantine.htm
- Exotic Forest Pest Information System for North America: spfnic.fs.fed.us/exfor
- Global Invasive Species Database (GISD), Invasive Species Specialist Group (ISSG), IUCN: www.issg.org/database
- Global Invasive Species Information Network (GISIN), list of invasive alien species (IAS) online information systems: www.gisinetwork.org/Documents/draftiasdbs.htm
- Near East Network on Forest Health and Invasive Species (NENFHIS): www.fao.org/forestry/51295
- Pacific Island Ecosystems at Risk (PIER): www.hear.org/pier/index.html
- Phytosanitary Alert System, North American Plant Protection Organization (NAPPO): www.pestalert.org
- Red de Países del Cono Sur sobre Especies Exoticas Invasoras a Ambientes Forestales: www.fao.org/forestry/52502
- Tree Protection Co-operative Programme (TCPC) pamphlets: www.fabinet.up.ac.za/tpcp/pamphlets