Europe

The total number of pest species recorded from the three countries in the region was 44 (Figure 5).

Insect pests represented 86 percent of all the forest pests (Table 6). Diseases and other pests represented almost 7 percent each. The mammalian pests reported were from Moldova and included Sika deer (*Cervus nippon*), the fallow deer (*Dama dama*), and the raccoon dog (*Nyctereutes procyonoides*).

Indigenous pests were the most commonly reported, representing 89 percent of all pest species, while the remaining were introduced. All were recorded in naturally regenerated forests.

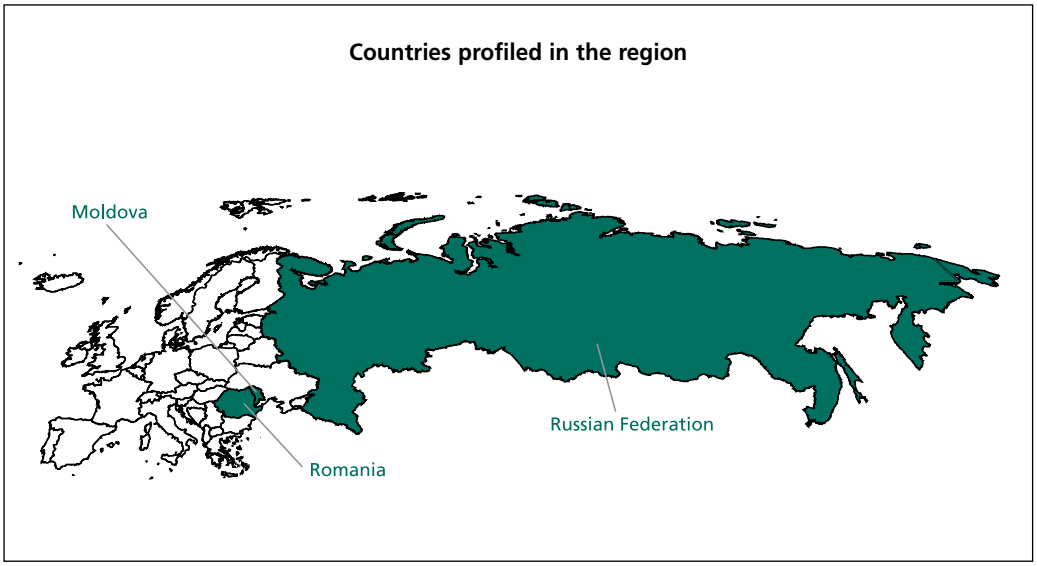
The majority of pest species were recorded in naturally regenerated forests (almost 62 percent) while almost 5 percent were found in planted forests. Moldova and Romania reported more pests in naturally regenerated forests while pests in the Russian Federation were found equally in both forest types. These findings are different than those in most other regions where more pests were recorded in planted forests.

About 50 percent of the pests were recorded on broadleaf tree species, and 43 percent on conifers. Moldova and Romania reported more pests on broadleaf trees while the Russian Federation reported more on conifers.

Lepidopteran species were the most frequently reported insect pests (Figure 6). Romania and the Russian Federation also reported a high number of coleopterans. Significant pests of pines, spruce and other conifers, *Ips acuminatus* and *I. amitinus,* were recorded in Romania's naturally regenerated forests. The large larch bark beetle, *I. cembrae*, was recorded in the naturally regenerated and planted forests of the Russian Federation. All pathogens reported were species from the phylum Ascomycota.

SPECIES FOUND IN MORE THAN ONE COUNTRY

Eleven pest species were recorded in more than one country in the region: ten insect pests and one disease (Table 7). Five of the transboundary pests were recorded in naturally regenerated forests and six in both planted and naturally regenerated forests. Six were recorded on broadleaf tree species, three on conifers and two on both host types.



Sixty percent of the transboundary insect pests were lepidopteran species. Two *Lymantria* species were reported from the region, both of which occurred in more than one country. The gypsy moth, *Lymantria dispar**, was reported to be found on both broadleaf and conifer trees in naturally regenerated forests in Moldova (European strain). Romania (European strain) and the Russian Federation (Asian strain) reported this pest in both forest types and both host types. *Lymantria monacha**, the nun moth, was reported on broadleaf and conifer trees in Romania's naturally regenerated forests and from the Russian Federation in both forest and host types.

FIGURE 5
Number of forest pest species reported, Europe

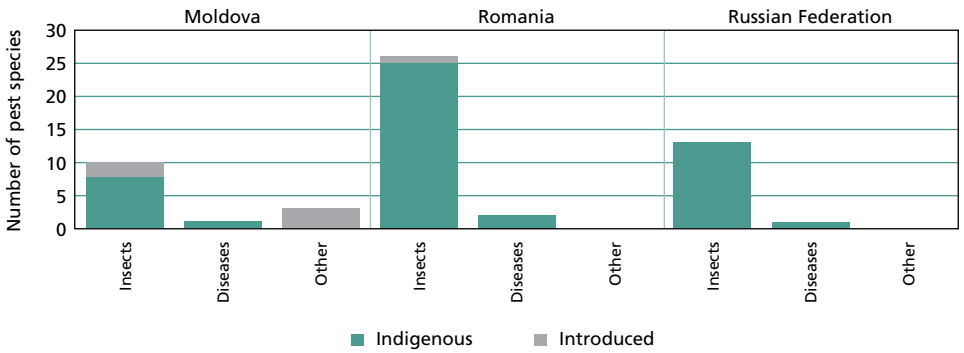
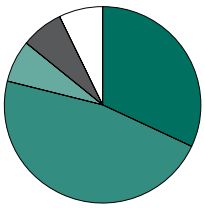


FIGURE 6
Most prevalent pests, Europe



Insects
Coleoptera 32%
Lepidoptera 47%
Hymenoptera 7%

Diseases
Ascomycota 7%

Other
Other pests 7%

TABLE 6
Summary of the data on forest pest species reported, Europe

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	36	21	2	13	15	18	3
Diseases	3	1	0	2	2	1	0
Other	0	0	0	0	0	0	0
Introduced species							
Insects	2	2	0	0	2	0	0
Diseases	0	0	0	0	3	0	0
Other	3	3	0	0	0	0	0
Total	**44**	**27**	**2**	**15**	**22**	**19**	**3**

Other lepidopterans included *Erannis defoliaria*, *Operophtera brumata*, *Tortrix viridana* and *Hyphantria cunea*. The mottled umber moth, *Erannis defoliaria*, the winter moth, *Operophtera brumata*, and the green oak tortix, *Tortrix viridana*, were all reported as indigenous pests of oak (*Quercus* spp.) in naturally regenerated forests in Moldova and Romania. The fall webworm, *Hyphantria cunea*, introduced from its native North America into Moldova and Romania where it attacks naturally regenerated broadleaf forests, is a tent-making defoliator of broadleaf trees and shrubs including *Betula*, *Salix*, *Prunus* and *Populus* spp.

The remaining transboundary insect pests were indigenous coleopteran species. The six-toothed bark beetle, *Ips sexdentatus**, and the European spruce bark beetle, *I. typographus**, are significant pests of conifers throughout the region, particularly pines and spruce respectively. They were reported in naturally regenerated forests in Romania and in both naturally regenerated and planted forests in the Russian Federation. Two indigenous *Tomicus* spp. (the lesser pine shoot beetle, *T. minor*, and the common pine shoot beetle, *T. piniperda)* are pests of conifers in Romania's naturally regenerated forests. The latter species was also recorded in both forest types in the Russian Federation. The weevil, *Stereonychus fraxini*, is a significant pest of ash (*Fraxinus excelsa*) in the region, reported from Moldova and Romania where it attacks naturally regenerated broadleaf forests.

One pathogen, *Microsphaera abbreviata*, was reported as a transboundary pest, recorded in naturally regenerated and planted broadleaf forests in Moldova and Romania.

TABLE 7
Species found in more than one country, Europe

Pest species	Order/phylum: family	Countries of occurrence	Type of forest	Host type
Insects				
Erannis defoliaria	Lepidoptera: Geometridae	Moldova, Romania	Naturally regenerated	Broadleaf
Hyphantria cunea	Lepidoptera: Arctiidae	Moldova, Romania	Naturally regenerated	Broadleaf
*Ips sexdentatus**	Coleoptera: Scolytidae	Romania, Russian Federation	Naturally regenerated, planted	Conifer
*Ips typographus**	Coleoptera: Scolytidae	Romania, Russian Federation	Naturally regenerated, planted	Conifer
*Lymantria dispar**	Lepidoptera: Lymantriidae	Moldova (European strain), Romania (European strain), Russian Federation (Asian strain)	Naturally regenerated, planted	Broadleaf, conifer
*Lymantria monacha**	Lepidoptera: Lymantriidae	Romania, Russian Federation	Naturally regenerated, planted	Broadleaf, conifer
Operophtera brumata	Lepidoptera: Geometridae	Moldova, Romania	Naturally regenerated	Broadleaf
Stereonychus fraxini	Coleoptera: Curculionidae	Moldova, Romania	Naturally regenerated	Broadleaf
Tomicus piniperda	Coleoptera: Scolytidae	Romania, Russian Federation	Naturally regenerated, planted	Conifer
Tortrix viridana	Lepidoptera: Tortricidae	Moldova, Romania	Naturally regenerated	Broadleaf
Diseases				
Microsphaera abbreviata	Ascomycota: Erysiphaceae	Moldova, Romania	Naturally regenerated, planted	Broadleaf

CAPACITY FOR FOREST HEALTH PROTECTION

Monitoring and detection

In Moldova and Romania, forest health conditions are regularly monitored and pests of special concern are monitored annually. Romania monitors specific pests such as nun moth, oak leaf roller, gypsy moth and bark beetles with pheromone traps. They also use sampling systems developed to predict damage by defoliators. In the Russian Federation, monitoring activities are typically carried out in areas of large outbreaks or those areas made susceptible to pests through abiotic factors such as pollution. Monitoring programmes have been carried out to target specific pests such as the defoliators *Lymantria dispar**, *L. mathura* and *L. monacha**.

Data management

Tools for data management in Moldova and Romania are available and apparently advanced, particularly in Romania. No information was provided on the capacity for data management in the Russian Federation.

Moldova and the Russian Federation provided data on the area affected by insects and/or diseases for FRA 2005 for both reporting periods: 1990 (annual average from 1988 to 1992) and 2000 (1998 to 2002). Moldova reported that 61 200 ha of forests were damaged by insects for the 1990 reporting period and 96 000 ha for 2000. The Russian Federation reported that insects affected over 1.7 million hectares for the 1990 reporting period and almost 5 million hectares for 2000, and that diseases impacted almost 125 000 ha (1990) and over 950 000 ha (2000).

Pest management

Typically pest management techniques such as ground and aerial application of biological or chemical insecticides are carried out in the face of major outbreaks of damaging forest pests. Romania, however, carries out preventative measures including encouragement of mixed species stands, maintenance of proper stocking levels, establishment of nesting sites for insectivorous birds and protection of predaceous ant nests.

Ownership

All lands are public in Moldova and the Russian Federation. In Romania, the independent autonomous forestry agency, RomSilva, conducts forest pest management activities on all forest lands. Private landowners are expected to cover costs associated with forest health activities.

ADDITIONAL INFORMATION

Compared to other regions, Europe has a great deal of information available on the impact of forest insect pests and diseases. For the 2000 reporting period for FRA 2005, Europe provided data on insect pests and diseases for over 90 percent of the region's forest area (FAO, 2006a). The annual average of forest area affected by insects for this period was 6.4 million hectares or 0.7 percent, while diseases affected 3.1 million hectares or 0.3 percent (FAO, 2007a). This marks a notable increase over the average area of forest impacted by insects and diseases in the 1990 period (FAO, 2006a), perhaps due to the increased susceptibility of forests and subsequent pest attacks following major storms in the region in December 1999.

Some of the pests recorded in selected countries are also found elsewhere in Europe. The oak processionary caterpillar, *Thaumetopoea processionea**, recorded as a pest in Romania, is a major pest of oak throughout Europe. Native to central and southern Europe where it is widely distributed, it has been expanding northwards, presumably in response to climate change, and is now firmly established in northern France and the Netherlands and has even been reported in southern Sweden. A related species, the

pine processionary caterpillar, *Thaumetopoea pityocampa**, is considered one of the most important forest pests in the Mediterranean region and is commonly found in pine forests (EPPO/CABI, 1997). A marked change in distribution is also occurring related to climate shift and the insect pest is steadily moving north.

*Ips sexdentatus** occurs in *Pinus* forests throughout Europe and although it is considered a secondary pest by attacking stressed trees, it can kill trees of commercial importance (EPPO/CABI, 1997). *Ips typographus** is considered the most destructive species of the genus and probably the most serious pest of spruce in Europe (EPPO/CABI, 1997). It is common throughout the entire natural range of *Picea abies* in Europe and also occurs in plantations in Western Europe, outside the natural range of the host. Outbreaks have occurred in the Czech Republic, Germany, Italy, Norway, Poland and Sweden. In the mid to late 1990s, spruce stands in Slovakia also experienced a serious infestation of bark beetles (particularly *Ips typographus** and *Pityogenes chalcographus* but also *I. duplicatus*, *I. amitinus* and *Polygraphus polygraphus*) and fungal diseases (primarily *Armillaria* sp.) which caused the death of many trees, loss of timber and deterioration of the environment through poor management of infested trees.

Cyclical outbreaks of the gypsy moth, *Lymantria dispar**, occur in many countries in the region and cause considerable damage. FAO has provided emergency assistance to Bulgaria, Moldova and Romania to deal with outbreaks of this pest.

While not reported from the selected countries, *Phytophthora ramorum**, associated with sudden oak death and other diseases on broadleaf and conifer trees, is a major concern in the region. It has been found in Belgium, the Czech Republic, Denmark, France, Germany, Italy, the Netherlands, Norway, Ireland, Slovenia, Spain, Sweden and the United Kingdom (Kliejunas, 2005; DEFRA, 2005a). *P. ramorum* has mainly affected ornamental plant species in nurseries although it has been found on a few trees and in some established plantings of shrub hosts (mainly rhododendron) in some countries (DEFRA, 2005b). *P. kernovieae* is a new and potentially serious pathogen of woodland environments recently found in the UK, causing extensive leaf blight and dieback of rhododendron and large nectrotic cankers on beech trees. Symptoms progress rapidly, increasing the degree of risk (UK Forestry Commission, 2008; EPPO, 2008).

Another problem is the significant impact that many mammal species, such as squirrels, rabbits, deer and moose, have on European forests through browsing, overgrazing and stripping of bark. Heavy grazing can result in severe damage to trees in both naturally regenerated and planted forests and woodlands and can also prevent natural tree regeneration and reduce populations of ground cover and understorey species. Large herbivores also cause physical damage to trees by scraping tree trunks and destroying smaller saplings with their antlers. In Sweden, for example, dense populations of moose and roe deer are known to cause severe damage, particularly in pine and hardwood plantations and young forests, although the level of damage varies considerably (Swedish Forest Agency, 2007).

Severe storms, particularly those in 1990, 1999/2000, 2004/05 and January 2007, have had catastrophic impacts on forests in the region (UNECE Timber Committee, n.d.). Impacts can be observed for years after the storm has occurred. In addition to damaging considerable areas of forest, such storms have also made them more susceptible to forest pest outbreaks. Windblown wood presents ideal conditions for massive fires and insect outbreaks, threatening forests not directly damaged by the storms themselves. Not only are the fallen trees at risk, but the adjacent trees can serve as hosts for the pests as well.

The 1999/2000 storms were centred on Denmark, France, Germany, Sweden and Switzerland but countries across Europe sustained damage to their forests. Denmark, Sweden and Slovakia suffered much damage in the 2004/05 storms and the 2007 storms

impacted Belgium, the Czech Republic, Denmark, France, Germany, Sweden and the United Kingdom. In Sweden much of the storm-felled trees are within areas already at high risk of large-scale outbreaks of the European spruce bark beetle, *Ips typographus** (Swedish Forest Agency, 2007). Newly storm- and wind-felled trees in Finland have also been a prime target for *I. typographus* which reproduces in such damaged trees (Erikssona, Pouttub and Roininena, 2005).

Forest pests newly introduced to the region include the citrus longhorned beetle, *Anoplophora chinensis* (Coleoptera: Cerambycidae), the blue gum chalcid, *Leptocybe invasa**, the Asian longhorned beetle, *Anoplophora glabripennis**, the oriental chestnut gall wasp, *Dryocosmus kuriphilus* (Hymenoptera: Cynipidae), and chestnut blight, *Cryphonectria parasitica* (Ascomycota: Cryphonectriaceae).

Originating in Japan and Korea where it is a serious pest of deciduous tree species and citrus, *A. chinensis* was added to the EPPO A1 List in 1994 (listed as *A. malasiaca*). The beetle was first discovered in Europe in 2000 at Parabiago, Italy. Despite the application of control techniques, this pest has since spread into nearby villages. Single occurrences were recorded in 2003 in the Netherlands and France but the pest was officially declared eradicated in 2006. It was found in Switzerland in 2006 but the two infested *Acer* spp. trees were destroyed. European interceptions have included infested bonsai trees from Japan and potted plants (*Acer* spp.) from China, both of which are critical pathways (EPPO, personal communication, 2008). The potential impact on the region has not yet been determined.

Believed native to Australia, the blue gum chalcid, *Leptocybe invasa**, is currently spreading through Africa, Europe and the Near East. A serious pest of young eucalypt trees and seedlings, it has been reported in Mediterranean countries, including France, Italy, Portugal and Spain, where eucalypts are widely grown for forestry and ornamental purposes (EPPO, 2008).

*Anoplophora glabripennis** was added to the EPPO A1 list after a pest risk assessment by the Panel on Phytosanitary Regulations in 1999 considered the risk of its establishment in Europe to be high. It has been recorded in Austria (2001), France (2003), Germany and Poland (2004) and Italy (2007). To date there has been no establishment recorded in Europe.

The oriental chestnut gall wasp, *Dryocosmus kuriphilus*, was added to the EPPO A2 list after being discovered in the southern part of the Piemonte region of Italy, where management attempts include classical biological control. This wasp is a serious pest of chestnut worldwide with a high potential for spread throughout the region through female flight and movement of infested chestnut plants and plant materials.

Native to Asia, chestnut blight, *Cryphonectria parasitica*, was first discovered in 1938 in Europe in northern Italy. Since then the fungus has spread rapidly throughout much of southern and Central Europe where chestnuts are cultivated and has been recorded in Austria, Belgium, Bosnia and Herzegovina, Croatia, France, Germany, Greece, Hungary, Montenegro, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain, Switzerland, the former Yugoslav Republic of Macedonia, Turkey and Ukraine (EPPO, 1997).

The emerald ash borer, *Agrilus planipennis**, has recently been reported in the Russian Federation, both European and Asiatic (Y. Baranchikov, personal communication). Native to eastern Asia, this pest is a major threat to ash trees and poses a potential threat to European forests.

Recent introductions of the pine wilt nematode, *Bursaphelenchus xylophilus**, the causal agent of pine wilt disease, has resulted in severe losses to *Pinus pinaster* in Portugal. The nematode and vector *M. galloprovincialis* now co-exist, and other susceptible pines are now at risk in areas above 20 °C. If this pest spreads to the rest of Europe, it could pose a threat to European forestry and trade.

REGIONAL PEST MANAGEMENT EFFORTS

A number of organizations exist at the regional level to aid in the monitoring and detection of plant and forest pests. The European and Mediterranean Plant Protection Organization (EPPO) is an intergovernmental organization responsible for European cooperation in plant health. Founded in 1951 by 15 European countries, EPPO now has 48 members, covering almost all countries of the European and Mediterranean region. Its objectives are to protect plants, to develop international strategies against the introduction and spread of dangerous pests and to promote safe and effective control methods. As a Regional Plant Protection Organization (RPPO) under the IPPC, EPPO participates in global discussions on plant health organized by the FAO and the IPPC Secretariat.

Since the 1970s, EPPO has maintained a list of A1 (absent from region) and A2 (present in region) quarantine pests, based on technical justification and a meticulous approval procedure. The purpose of the lists is to recommend that organisms of serious phytosanitary concern be regulated as quarantine pests. In 2004 a list of invasive plants was created to draw attention to plant species that pose a threat to plant health, environment and biodiversity in the region. An Action List was added in 2005 to draw attention to recently added pests recommended for regulation or those that present an urgent phytosanitary concern. EPPO also produces a large number of standards and publications on plant pests (including many which impact forests), phytosanitary regulations, and plant protection products.

Long-term monitoring and data collection is fairly well-established in the region as a whole. The International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was created in 1985 under the United Nations Economic Commission for Europe (UNECE) Convention on Long Range Transboundary Air Pollution (LRTAP) in response to growing public awareness of the possible adverse effects of air pollution on forests. In cooperation with the European Union, ICP Forests monitors forest conditions in Europe using two different monitoring intensity levels. Annual transnational surveys of forest conditions have been conducted by means of large-scale monitoring of tree vitality of 6 000 observation plots with about 130 000 sample trees on a systematic transnational grid of 16 x 16 km throughout the region. The intensive monitoring level involves the assessment of crown condition, increment, chemical composition of foliage and soils and other variables on approximately 800 permanent observation plots established across Europe.

The Ministerial Conference for the Protection of Forests in Europe (MCPFE) is a high-level cooperation of 46 European countries and the European Community that addresses the most important issues on forests and forestry and makes recommendations related to the protection and sustainable management of forests in Europe. The MCPFE has adopted the Pan-European Criteria and Indicators for Sustainable Forest Management to help define and monitor the region's forests. The quantitative indicators of forest health and vitality include changes in defoliation and serious damage caused by biotic or abiotic agents, including insects and diseases.