

# Forest Health Status in Russia<sup>1</sup>

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## Abstract

About 886.5 Mha in Russia is occupied by forests, including 763.5 Mha of tree stands and 123 Mha of non-stocked lands. The Russian forests comprise about 22 percent of the earth's forest area or 43 percent of the earth's temperate and boreal forests. Main forest-forming species are *Larix sp.* (32 percent of the growing stock), *Pinus sylvestris* (20 percent), *Picea sp.* (15 percent), *Betula sp.* (13 percent), *Pinus sibirica* (10 percent), *Populus tremula* (5 percent), *Abies sp.* (3 percent), *Quercus sp.* (1 percent) and other species (1 percent). About one-third of tree stands and two-thirds of forest ecosystems in Russia are disturbed by natural and anthropogenic stresses. Most prevalent are natural causes of disturbance (climate, aging of stands, fires, pests) that affect 200-250 Mha of forest stands. About 45 Mha of forest stands (6 percent of stocked area) are under the impact of anthropogenic influence. Atmospheric pollution is the most dangerous form of anthropogenic stress in the Russian forests.

## Introduction

According to national inventory data from 1993, lands classified from the Forest Fund of Russia (1995) occupy 1,180.9 Mha. These lands include 294.4 Mha of non-forest land (mires, water, rocks, wastelands, etc.) and 886.5 Mha of forest land, including 763.5 Mha of tree stands and 123.0 Mha of non-stocked lands (woodlands, clear-cuttings, burned stands, etc.). These forest lands comprise about 22 percent of the Earth's forest area or 43 percent of the earth's temperate and boreal forests (United Nations 1992).

Forests are distributed in plain forest-tundra and subarctic mountains (14.1 percent), boreal plain and mountain regions (66.0 percent), zone of mixed forests (1.7 percent), zones of forest-steppes, steppes, and subboreal mountains (17.9 percent), and zone of semi-deserts and subarid mountains (0.3 percent). Natural forests comprise 98 percent and plantations 2 percent of the total forested area. About 350 Mha of forests are in permafrost territory, and about 340 Mha in mountains (mainly in subarctic and boreal regions). The average yield of the Russian forests is not high: the growing stock of mature and overmature forests is 136.7 m<sup>3</sup>/ha (table 1). Main forest-forming species are *Larix sp.* (32 percent of the total growing stock), *Pinus sylvestris* (20 percent), *Picea sp.* (15 percent), *Betula sp.* (13 percent), *Pinus sibirica* (10 percent), *Populus tremula* (5 percent), *Abies sp.* (3 percent), *Quercus sp.* (1 percent), and other species (1 percent). Forests are considerably damaged by natural and anthropogenic stresses.

This paper presents the current health status of the Russian forests and predicts possible trends caused by global climate change.

## Forest Health Status and Factors of Disturbance Climate

One of the primary disturbance factors of trees in the frontier forests of the forest-tundra and subarctic mountains on permafrost territories of Siberia and eastern Russian is severe climatic conditions (table 2). Trees in open, sparse unproductive forests and woodlands of these regions have crowns heavily damaged by frost and wind. Leaf area index (LAI) of trees is three to five times less than LAI of trees in more southern territories. Healthy stands and healthy trees in stands and

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woodlands of permafrost territory are a rare phenomenon. The area of such naturally disturbed forests is estimated to exceed 150-200 Mha.

Long-term monitoring of several Siberian stands showed no change for the worse of the health status of such forests. Moreover, data indicate improvement of health condition of these forests. However, the improved condition of forests has not yet been statistically proven.

As a result of global warming in the next 100 years, an improvement of forest health on the present permafrost territory and decrease of damaged area of stands can be expected.

**Table 1** — Age structure of area and growing stock in Russian forests (Forest Fund of Russia 1995).

Statistic data	Age classes of stands				Total
	Young	Middle-aged	Premature	Mature and overmature	
Area, million ha	134.4	201.6	74.8	352.7	763.5
percent	17.6	26.4	9.8	46.2	100
Growing stock, billion m <sup>3</sup>	3.7	20.2	10.5	46.3	80.7
percent	4.6	25.0	13.0	57.4	100

**Table 2** — Present and forecasted forest area of Russia disturbed by natural and anthropogenic factors.<sup>1</sup>

The primary reason of damage	Present status		Forecasted status in year 2100			
	Stands Mha	pct <sup>2</sup>	Ecosystems Mha	pct <sup>2</sup>	Stands	Ecosystems
<b>Natural factors</b>						
Climate	150-200	20-26	150-200	20-26	decrease	decrease
Fires	10	1	50	7	increase	increase
Pest	10	1	20	3	increase	increase
Aging of trees	100-150	13-20	100-150	13-20	decrease	decrease
Subtotal pct <sup>3</sup>	200-250	26-33	250-300	33-40	decrease	decrease
<b>Anthropogenic factors</b>						
Harvesting	20	3	100	13	the same	the same
Pollution	5	1	15	2	decrease	decrease
Fires	20	3	100	13	the same	the same
Subtotal <sup>3</sup>	45	6	215	28	the same	the same
Total <sup>3</sup>	240-290	31-38	460-510	60-67	decrease	decrease

<sup>1</sup> The data presented in this table are the author's expert estimates of disturbed forest areas (except the total area of burnt stands and stands damaged by pests) and may not agree with point of view of Federal Forest Service of Russia.

<sup>2</sup> Percent of total stocked area.

<sup>3</sup> Sum subtotal and total do not equal to mathematical sum of items because different factors can act simultaneously in the same territory.

## **Aging and Mortality of Forests Stands**

Aging of trees is a genetically determined process of weakening and disturbing plants and their communities. As a rule, deterioration of old trees' condition reveals itself through action of various factors such as climatic stresses, insect pests, rots, etc. The age structure of stands in the ecoregions and administrative territories of Russia is extremely non-uniform (*table 2*). The forests of the European part of the country are strongly depleted by logging, and the areas of the old-growth forests in some regions are very small. The territories of Siberia and eastern Russian, on the contrary, have a large portion (> 50 percent) of mature and overmature forests. The forests of the overmatured and weakened stands categories amount not less than 150 Mha.

As a result of succession processes, during the next century these forests will be a strong source of carbon dioxide.

## **Fires**

According to the national inventory data from 1988, the total area of burnt stands in Russia is 27 Mha (Forest Fund of the USSR 1990). About 17 to 20 Mha of these stands have burnt as a result of negligence of people. Statistical data do not include the area of forests burnt by surface fires. This type of forest fire damages tree stands; but more importantly, other compartments of ecosystems are also damaged, such as understory, litter, and part of organic substances of soils. Natural reforestation of young forest stands requires about 10 to 20 years. However, for recovery of other components of ecosystems, for example lichen cover, 50 to 100 years or more are necessary (Gorshkov 1994). This difference explains why the area of disturbed forest ecosystems is larger than the area of damaged tree stands. Main territory of wild fires occurs in the Asian part of Russia, especially Yakutia and eastern Russian. We can expect that global climate warming will increase the number and areas of fires, burnt stands, and disturbed forest ecosystems (*table 2*).

## **Pests**

Russia has 10 Mha of forests damaged by different pests (*table 2*; Isaev, pers. comm.). In 1995 in Middle Siberia about 1 to 2 Mha of conifers stands were damaged by the Asian gypsy moth alone.

Based on unfavorable age structure of Russian forests, namely, large areas of overmature forests (*table 1*) we can predict increasing outbreaks of insects, fungi, and other pathogens in the future.

## **Harvesting**

As a result of harvest activity, Russia has about 25 Mha of disturbed tree stands and about 100 Mha of recovering forest ecosystems (*table 2*). It is very difficult to predict the rate of clearcutting, other types of fellings, and future damage of forests. This is mostly because Russia is presently undergoing various, often unpredictable, political and economic changes.

## **Air Pollution**

Area of stands damaged by air pollutants equals about 5 Mha (0.6 percent of total stocked area) (*table 2*). About 15 Mha of forest ecosystems (2 percent of total stocked area) have injured lichen cover. This relative damage is much better than in other industrialized countries.

After Russia became a new independent country, atmospheric deposition of air contaminants in Russia decreased during the last 4 years. This decrease is not the result of improved industrial technology, but an economic depression and a decrease in industrial production. *Table 3* shows the dynamics of sulfur dioxide emission from two industrial giant copper-nickel smelters in the European and Asian parts of Russia.

**Table 3** — Emissions of sulfur dioxide from Norilsk and Monchegorsk smelters (1,000 t/year) (Barkan, pers. comm.; Idimichev and others 1995; Pozniakov 1993; Vlasova and others 1991).

Smelters	Years										
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Norilsk	2648	2724	2325	2244	2242	2216	2180	ND <sup>1</sup>	ND	1863	1860
Monchegorsk	257	254	243	224	212	200	287	196	182	137	135

<sup>1</sup> No data available.

It is well known that the weakening of plants and their communities by pollutants changes the consortive interrelations in ecosystems. In particular, it may stimulate outbreaks of forest insects. On the other hand, the combined damaging effects of pollutants on the ecosystems already weakened by other anthropogenic or natural stresses are much stronger and faster than air pollution effects alone (Alexeyev 1995). This consideration is extremely important for the Russian forests because a significant part of them are damaged by multiple stresses.

Hopefully, the impact of atmospheric pollution in the next century will be less pronounced because of changing social awareness (Green Peace, and other ecological movements).

## Conclusion

About one-third of tree stands and two-thirds of forest ecosystems of Russia are disturbed by natural and anthropogenic factors. Most prevalent are natural causes of disturbance; their impact affects 200 to 250 Mha of stands and 250 to 300 Mha of forest ecosystems. Natural disturbance processes are an integral part of natural forest life. Nevertheless, determinations of the size of damaged areas and trends of the observed changes must take into account management strategies of the Federal Forest Service of Russia. Not less than 45 Mha stands (6 percent of stocked area) are under the impact of anthropogenic influence. Atmospheric pollution is the most dangerous form of the anthropogenic stresses in forests in Russia.

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