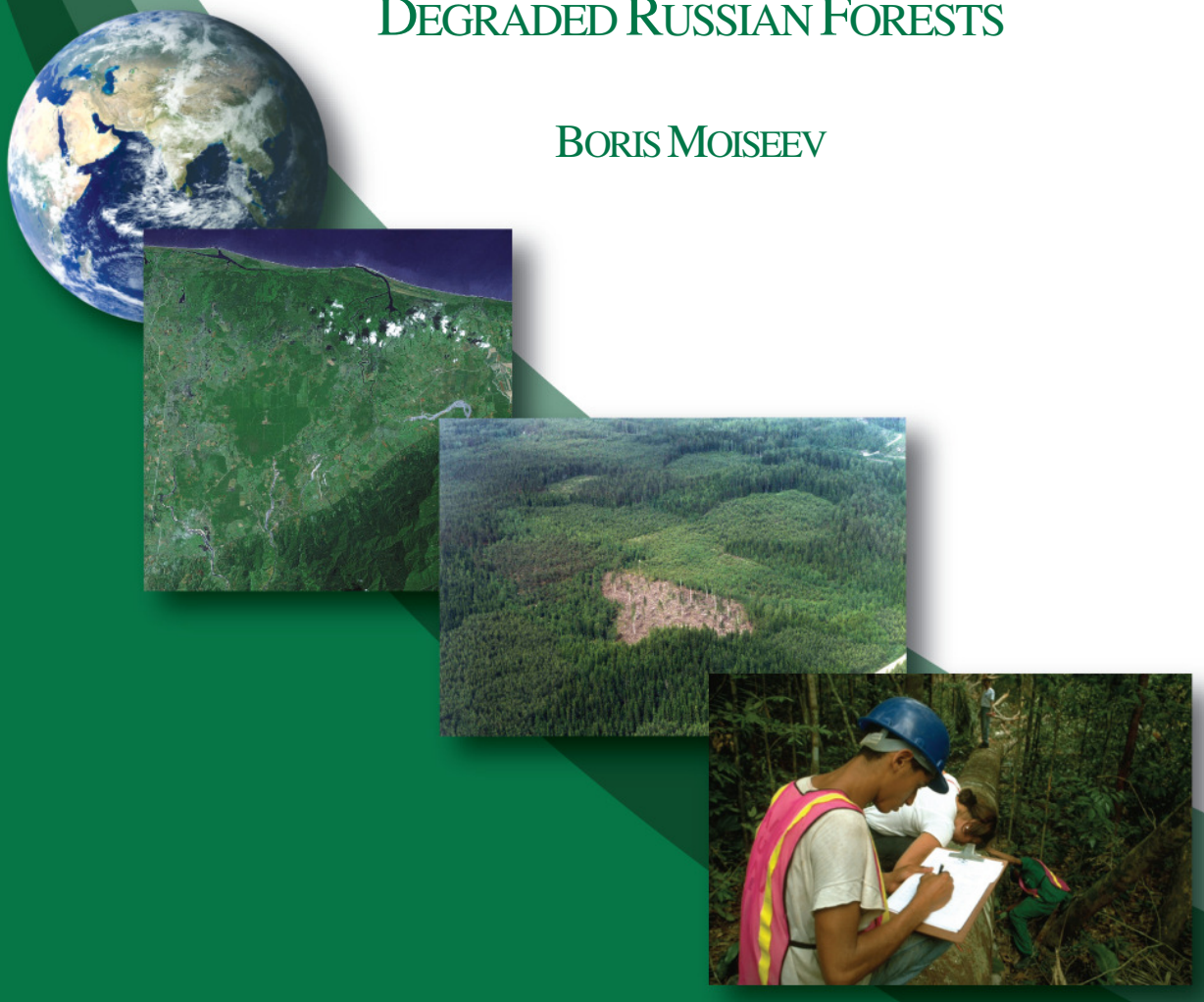
CASE STUDIES ON MEASURING AND ASSESSING FOREST DEGRADATION

RESULTS OF PATHOLOGICAL MONITORING IN DEGRADED RUSSIAN FORESTS

BORIS MOISEEV



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Sustainably managed forests have multiple environmental and socio-economic functions which are important at the global, national and local scales, and they play a vital part in sustainable development. Reliable and up-to-date information on the state of forest resources - not only on area and area change, but also on such variables as growing stock, wood and non-wood products, carbon, protected areas, use of forests for recreation and other services, biological diversity and forests' contribution to national economies - is crucial to support decision-making for policies and programmes in forestry and sustainable development at all levels.

Under the umbrella of the Global Forest Resources Assessment 2010 (FRA 2010) and together with members of the Collaborative Partnership on Forests (CPF) and other partners, FAO has initiated a special study to identify the elements of forest degradation and the best practices for assessing them. The objectives of the initiative are to help strengthen the capacity of countries to assess, monitor and report on forest degradation by:

- Identifying specific elements and indicators of forest degradation and degraded forests;
- Classifying elements and harmonizing definitions;
- Identifying and describing existing and promising assessment methodologies;
- Developing assessment tools and guidelines

Expected outcomes and benefits of the initiative include:

- Better understanding of the concept and components of forest degradation;
- An analysis of definitions of forest degradation and associated terms;
- Guidelines and effective, cost-efficient tools and techniques to help assess and monitor forest degradation; and
- Enhanced ability to meet current and future reporting requirements on forest degradation.

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Forest Resources Assessment Working Paper

Case Studies on Measuring and Assessing Forest Degradation

Results of Pathological Monitoring in Degraded Russian Forests

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Abstract

The Federal Institute "Roslesozashita" carried out pathological monitoring on the forestlands of the country in 2007. Pathological monitoring was undertaken on the basis of forest division into regions that consist by definition of zones of weak, average or strong pathological threat.

Zones of weak pathological threat are defined as areas where the quantity of dying trees and fresh dead trees exceeds normal natural falls, up to a maximum of 10% of the growing stock of the forest stand. Zones of average pathological threat are where the fall rate is 11 - 40% of the stock and zones of strong pathological threat are where the fall rate exceeds 40%.

As a result of the forest division into such districts, the forest stand areas of the Russian Federation have been defined as:
- Zone of weak pathological threat – 50.2%;
- Zone of average pathological threat – 38.5%;
- Zone of strong pathological threat – 11.3%.

On the basis of the preliminary division into districts and stratification of forests, pathological monitoring by selective ground methods was undertaken over an area of 18.0 million hectares, using 6200 Constant Monitoring Plots (CMP). Further monitoring was undertaken using the international programme ICP FOREST in the Kaliningrad, Leningrad, Novgorod and Pskov regions, where 230 CMP were established. In view of the establishment of a further 4975 CMPs in recent years, the pathological monitoring by selective ground methods can be executed on an overall area of 31.5 million hectares, with data from 11405 CMP collected and processed in 2007.

In the European part of Russia, the greatest concern has been from degradation of the spruce stands. The most extensive of the area is mass woods degradation in the Arkhangelsk region that has been observed since 1997. By the end of 2005, the degraded area has increased to a point where it is estimated to be more than 2 million hectares. Forestlands with unsatisfactory sanitary condition are identified as covering an area of 583.1 thousand hectares in the Siberian federal district.

Local pathological inspections have shown that 5.9 million hectares of forest have been lost over the last 15 years. In total, some 400,000 hectares of forest stands are destroyed annually. A principal cause of destruction of forest stands are fires, causing some 65% of the damage to destroyed forests.

1. Introduction

Forestlands of the Russian Federation occupy about 48 % of the territory of the country. Forests were and remain the predominant vegetative cover and the major natural complex in extensive areas of Russia.

According to the database of the federal enterprise "Roslesinforg" [1], in 2008, the total area of the Russian forest lands makes 1181.9 million hectares, including the area of the forest land fund (1118.3 million hectares), forestlands of the especially protected natural territories (26.6 million hectares), the former wood sites of the Ministry of Agriculture (29.4 million hectares), the forest lands of Ministry of Defense and city forests (5.6 million hectares) and forestlands of other categories (1.8 million hectares).

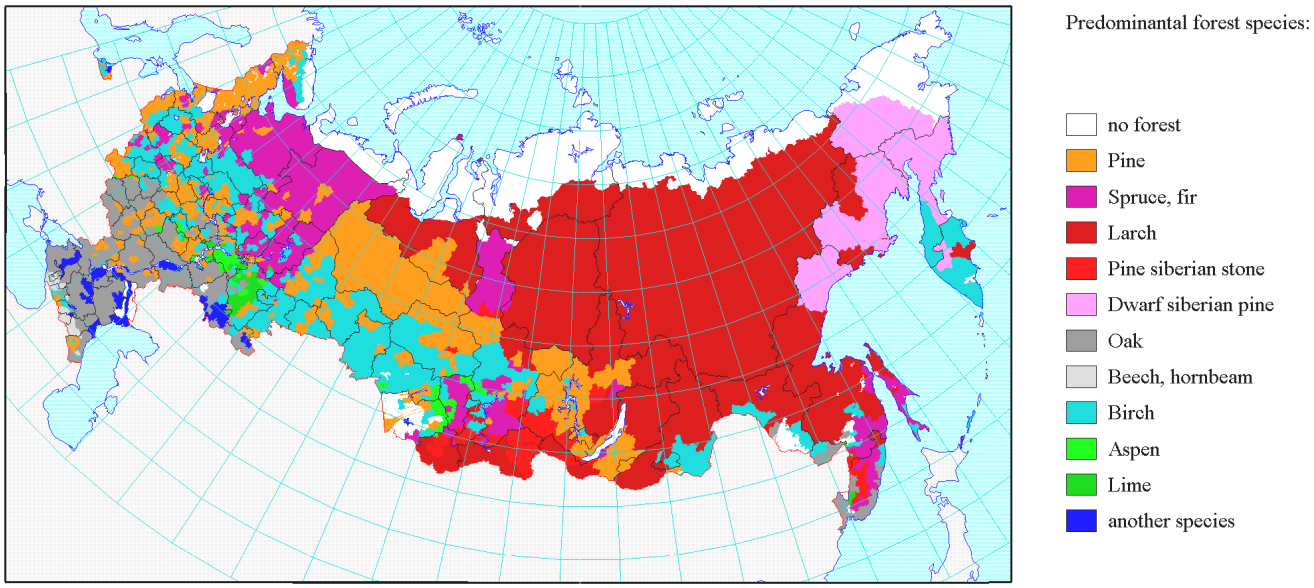

Figure 1. Predominant tree species in Russian forests

The forests of Russia are made up of 86% boreal forest. The predominant tree species in forest fund of the Russian Federation are: larch, pine, spruce, fir, Siberian pine (or “cedar” Siberian), oak, beech, birch and aspen, making up about 90 % of the lands covered by wood vegetation. Bushes (including pigmy Siberian pine, pigmy birch and willow) make up some 9 %, and other tree species (pear, chestnut, other nut trees) make up less than 1 % of the lands. See Figure 1.

The total growing stock in Russian forests is 83.3 billion m^3 according to measurements for 2008 [1]. As a whole in the country, the average growing stock in mature and over mature tree stands (without bushes) is 134 m^3 per hectare in forests possible for operation out of a total of 165 m^3. The net annual increment is low and does not exceed 1.25 m^3 per hectare.

More than half of all forests of Russia grow on the frost perennial soils (permafrost) of Siberia and the Far East, under severe climatic conditions. This determines their low productivity and the fragmentation of forestlands. Only 45 % of the area of forests is accessible to operations, and the prevailing part can be found in the European North, the Ural Mountains and along the Trans Siberian

railway. These areas are considerably degraded as a result of intensive operations in the past century. Economic availability of mature forests is low. The share of highly productive (I-III bonitet) mature and overmature coniferous forest stands hardly exceeds 20% of total forest area.

Annually, forests are subject to the influence of adverse factors of biotic and abiotic character. As a result of these processes there is a weakening of trees, raised pathological tree fall and often destruction of tree stands in significant wood territories of the country. The term “forest degradation” is absent in the Russian legislative both in normative documents and rules. However, this term is widely used in the scientific literature. Its definition is as follows: “Degradation of forest is loss of viability and destruction of forest ecosystem under influence of anthropogenous or natural factors” (Encyclopedia of forestry, vol.1, Moscow, MNR, 2006).

The process of forest degradation can be of two kinds: reversible and irreversible. The irreversible process of degradation occurs as a consequence of heavy technogenic pollution or bogging of cut down and burned areas. Irreversible processes of deforestation are not widely recognised in the Russian forest and are not considered separately by official statistics.

According to the State Register of forests (2008), the total unstocked forest area is equal to about 30 million hectares. It includes some 2.7 million hectares that is waste ground and glades. The forest condition of these areas can become irreversibly degraded. Such degraded wood lands were formed many years ago.

Reversible processes of degradation may occur as a consequence of the influence of forest fires, pests and diseases of wood and other factors. The wood vegetation is restored after damage or full destruction of forest stands after a period of time. Only this process is considered in the given work.

In the Russian Federation, the pathological condition of forests is assessed at regional and federal levels as well as at the local level. Monitoring is achieved through inspection of forest stands in the centres of insect attacks, disease and also where there has been fire. The statistical information is reported annually to regional and federal enforcement authorities.

2. Materials and Methods

Pathological Monitoring of Forests (PMF) is a system of measuring the condition of forests, the infringement of their stability, damage by harmful organisms and other negative influences of natural and anthropogenous character, supervision over the adverse factors influencing the condition of forests, and also system of their estimation and the forecast. The federal institute "Roslesozashita" and its regional branches [2] are responsible for undertaking PMF.

Pathological monitoring provides:

- Establishment of the reasons for damage, weakening and destruction of forests;
- Possibility to forecast both the development of pathological processes in forests and an estimate of their possible consequences;
- Possibility to estimate the efficiency of sanitary-improving actions, aviation and groundwork, on localization and liquidation of the pest centres;
- Preparation of reviews of the sanitary and pathological condition of forests, recommendations on maintenance of sanitary safety in forests;
- Possibility to gather information on the condition of forests, its storage, processing, in addition

to the attitudes of those who participate in the use of forests.

PMF objects are the forests of the Russian Federation, forest pests, including quarantine species, and other factors negatively influencing a condition of forests. The basic ways of realization of pathological monitoring are through:

- Regular field visits;
- Remote supervision of sanitary conditions of forests and pathological conditions;
- Pathological valuation;
- Accounts of number of pests and developments of diseases;
- Forwarding inspections.

The Federal institute "Roslesozashita" started the organization of pathological monitoring on the forest lands of the country in 2007 [2]. In conformity with articles 9-11 «Rules of sanitary safety in forests» (2006), the pathological monitoring is organized and undertaken on the basis of pathological division into districts of forests. Pathological division into districts consists in definition of zones of weak, average and strong pathological threat for forest stands. Borders of zones of pathological threat and pathological areas as a whole coincide with borders of the forest enterprises.

The state of tree stands where there is the presence of increased current tree fall is considered unsatisfactory. In healthy forest stands, the natural annual fall should not exceed a Gross Annual Increment (GAI), which usually makes 1 - 3 % from a growing stock of a forest stand. If in a forest stand the quantity of dying trees and dead trees exceeds normal natural fall and makes 4 - 10 % from a growing stock, the dying is considered weak; a fall rate of 11 - 40% from the stock, indicates an average degree; and tree fall of more than 40% indicates a high degree of dying.

Pathological Inspection of Forests (PIF) is undertaken with the purpose of planning and a substantiation of actions on protection of forest stands. PIF provides:

- Estimation of current sanitary (degree of deadwood, dying, pollution) and pathological (damage rate, defeat by harmful organisms) conditions of forests;
- Delimitation of damages to a forest;
- Accounts of number of pests and prevalence of diseases.

Carrying out PIF cannot be assigned to the persons using forests. PIF can be operative or current depending on tasks and organizational forms being carried out.

Operative inspections have the purpose to check the information on occurrence of harmful organisms or other damage to the forests, indications of leaf condition, an estimation of a condition of populations of harmful insects prior to the beginning of sanitary actions (control pathological inspections). Forest enterprises or forest parks organize such operative inspections.

Current inspections have the purpose of inventory through an estimation of the condition, areas and borders of the centres of degradation. Selective inspections of tree stands are undertaken to reveal the potential centres of pests and diseases of a forest, including inspection of lands that are subject to afforestation, contamination, pests and diseases and inspection of sites of the forest weakened by various other adverse factors. PIF are carried out through both ground measurements and remote sensing.

The sanitary condition of a forest stand is defined by the forest inventory or by the engineer on wood pathology. According to Sanitary rules (2006), there is a scale of categories for the state of trees on a forest parcel:
1 - Without signs of weakening;
2 – Weakened;
3 - Strongly weakened;
4 - Dying out;
5 - Dead trees of current year (fresh);
6 - Dead trees of the last years (old).

3. Results and Discussion

Pathological monitoring of forests (PMF) (See Figure 2)
As a result of the preliminary division of the forests of the Russian Federation into districts based on the sanitary condition, it has been established that the percent of forest stand areas falling into each zone of pathological threat is as follows:
- Zone of weak pathological threat (including the area of healthy forest stands) - 50.2 %;
- Zone of average pathological threat - 38.5 %;
- Zone of strong pathological threat - 11.3 %

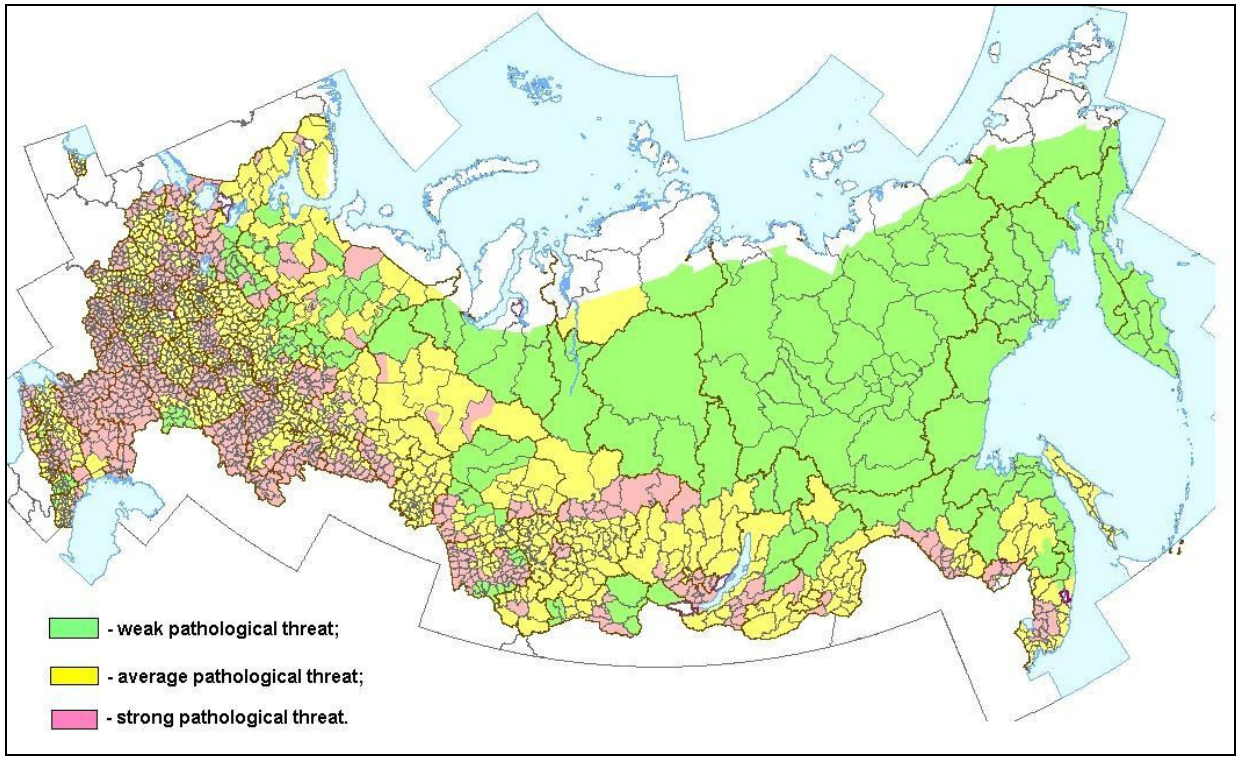

Figure 2. Preliminary division into districts based on the sanitary condition of the Russian forests

For each region of the Russian Federation, the pathological division into districts is presented in the form of tabulated data on distribution of the areas and in the form of maps and Geographic Information Systems (GIS). On the basis of the lead preliminary division into districts and stratification of forestland, the pathological monitoring by selective ground methods is organized over an area of 18.0 million hectares, thus 6200 of constant monitoring plots (CMP) were first incorporated in the 2007

data.

In the Kaliningrad, Leningrad, Novgorod and Pskov regions, the method of organization and conducting monitoring of a condition of forests under the international program ICP FOREST was used. The area of monitoring by this method was undertaken over an area of 9.3 million hectares with 230 CMP established in a regular network of 16x16 km and 32x32 km in 2007.

In view of a further 4975 CMPs (4.2 million hectares) established, the pathological monitoring by selective ground methods was executed over a total area of 31.5 million hectares, thus data from a total of 11405 CPM has been collected and processed. Remoteness and inaccessibility of the centres of pests and diseases, especially in forests of Siberia and the Far East, and also the complexity of forest inventory databases, complicate the organization of the network of pathological monitoring.
As a result of the main work, the sanitary and pathological condition of the basic forest species in a zone where pathological monitoring was conducted has been analyzed by selective ground methods. Further a brief analysis is given for the basic type of forest stands.

Pine stands (64.4 %) are in a satisfactory condition (where the volume of natural annual fall makes up less than 4 % of the growing stock volume). Increased current tree falls of pine stands are found on 35.5 % of the area of pine site, while only 0.1 % can be described as perishing (where fall is more than 10%). The most intensive negative influence on pine forests is fire. It may suggest that the modern redistribution of runoff and subsoil waters exceeds century fluctuations. Stem decay equals abiotic factors (windfall, windbreak, snow break) in weakening pine forests.

Pine ("cedar") Siberian stands occupy only about a third of observable sites (natural annual fall makes less than 4 % of a stock). In spite of the fact that dead stands are not noted, 68.5 % have increased current tree fall (4 - 10% of a stock). Of the weakened Cedar stands disease is the causative factor in 82% of cases (possibly due to the bulk Cedar forest being over mature), while anthropogenous factors (including extraction of nuts and recreational influences) is the causative factor in 13.4%. Fires in cedar forests were insignificant in 2007.

Spruce stands observed during the monitoring can be divided approximately equally between satisfactory or healthy (natural annual fall makes less than 4 % of a stock) and increased tree fall (tree fall is equal to 4 - 10% from a stock). Disturbance in Spruce stands appears to be relatively insignificant, with the process of degradation of spruce forests now considerably reduced. There is however overwhelming evidence of the influence of climatic factors during weakening of Spruce stands with more than 90 % of stands are weakened for this reason.

Fir stands are weakened from various diseases (about 70 % of forest stands of a fir have a tree fall of 4-40 %), perhaps connected to the reduced resistance of firs to bacterial diseases.

Larch stands have always been considered the most stable to different adverse influences, however, the monitoring data indicates that here forests with disturbed stability (tree fall is equal to 4 - 10% from a stock), make up 57.0 %. It could possibly be connected with the fact that the majority larch forests are currently over mature.

Birch stands: 40 % fall within the category of increased current tree fall (4 – 10 %), while 3 % fall in the category of 11 – 40 %. These results indicate wide deviations in stability. The reasons for this are most likely the consequences of large droughts and bacteria.

Oak stands: In a few cases (around 1 % of oak forests) up to 60 % of the oak stands fall into the category of increased tree fall (where tree fall is equal to 4 - 10% from a stock). The reasons for such a condition are diverse and can be clarified in detail in the corresponding literature. Essentially degradation of oak stands is due to a loss of genetic stability owing to centuries-old negative selection.

Lime stands are a more stable species than other deciduous stands, however in this study about a third of stands fall into the category of increased tree fall (4 – 10 %). The reasons are linked to soil-climatic factors in 85.3 % of cases [2].

Pathological Inspection of Forests (PIF)

For an analysis of the dynamics of the destruction of forests, the reasons causing their dying and weakening are incorporated in six groups: damage by harmful insects, damage by wild animals, defeat by diseases of a forest, influence of adverse weather conditions, forest fires and anthropogenous factors (pollution of environment by industrial emissions in particular). The ratio of the areas of the tree stands, which have been lost under the influence of these factors, varies over the years and differs in federal districts.

Weakening and damages to forests are non-uniform on years. Thus fluctuations express cyclic character determined by periodic changes of climatic conditions and, connected with them, actual burned forests and number of populations of insect pests. The areas of tree stands that have died out due to the influence of forest fires were not considered in the state account of the loss of forest stands in statistical reporting up until1989. The total area of the lost forest stands has sharply increased as their greater part perishes from these reasons since 1989. The dying of forests last decade has noticeably increased in comparison with the previous period. See Table 1 and Figure 3.

Table 1. Area dynamics of the dead stands, 1000 hectares [3]

Years	Forest fires	Insects and diseases	Other reasons	Total
1988	200.0	3.2	45.1	248.3
1992	313.1	20.6	158.4	492.1
1993	131.6	14.0	25.7	171.2
1994	225.3	26.5	22.6	274.5
1995	53.1	80.2	28.8	162.1
1996	291.0	198.0	26.1	515.1
1997	227.8	5.2	21.2	254.3
1998	245.9	8.2	25.1	279.2
1999	268.4	9.6	21.5	299.5
2000	637.4	25.8	36.7	699.8
2001	131.1	22.7	173.3	327.1
2002	286.0	29.1	19.5	334.6
2003	471.9	59.3	20.0	551.3
2004	138.6	221.2	43.4	403.1
2005	451.1	48.6	461.2	960.9
2006	154.0	60.1	50.0	264.1
2007	197.5	46.2	46.8	290.4
2008	158.5	48.8	52.6	259.9

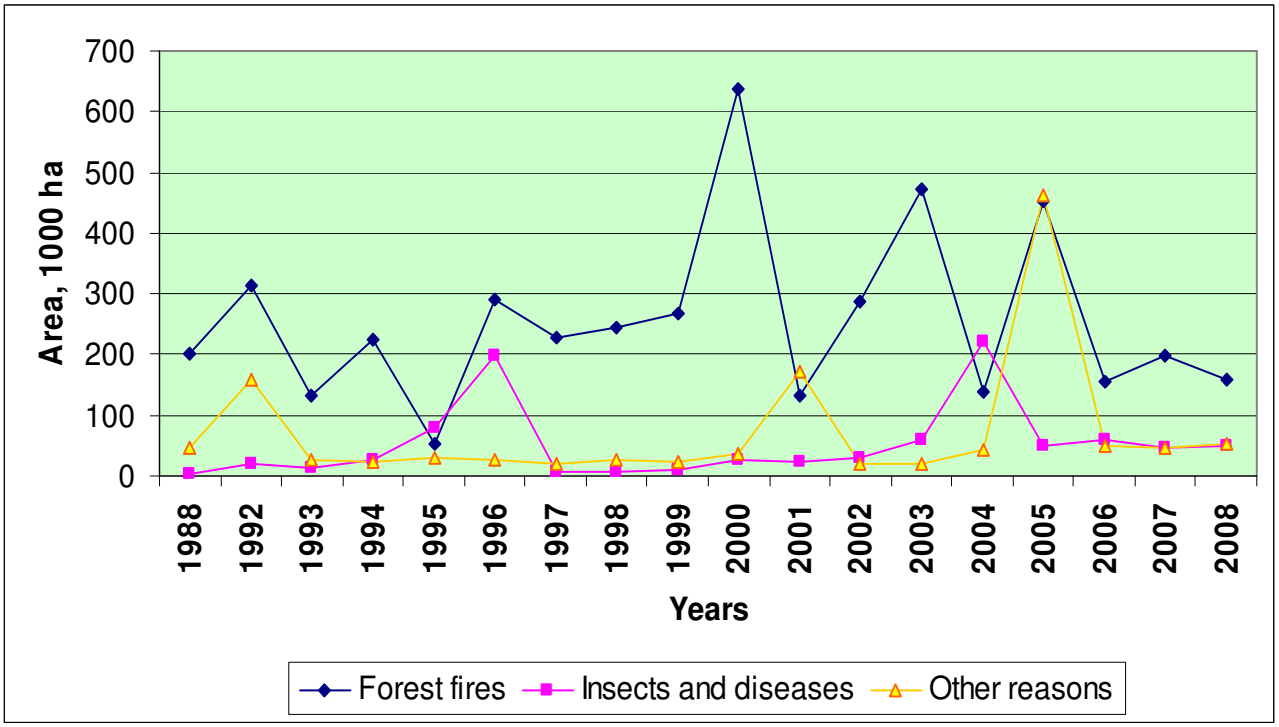

Figure 3. Area dynamics of the dead stands, 1000 ha

Table 1 provides a break down of 3 causative factors of forest degradation (fire, insects and diseases, and other reasons) that were measured for the twenty years from 1988 up until 2008. As a rule, forest fire was the principal cause of destruction of tree stands for all periods of regular supervision. Overall, fire was the reason for forest degradation in more than 65% of the total area of dying forest. The influence of fire on the condition of forests was the most significant contributor in 2000, when it made up more than 91 % of the causative factors. The influence of fire was revealed to have been at its least in 2004 when it made up 34% of the causative factors of forest degradation.

Over the period 1991 to 2000, 3 148 thousand hectares of tree stands were lost. Over the five years from 2001 to 2005, 2 527 thousand hectares have died out. In total, an area is of 5 724.8 thousand hectares of forest have been lost over the last 15 years.

The destruction of tree stands caused by weather conditions (including drought, storm, wind, change of a level of subsoil waters, frosts) is observed annually and has occurred in rather small territories as a rule. An exception was in 2005 when the dying of spruce stands under influence of a drought in a combination with other factors has occurred on the extensive areas of forests of the North West federal district (more than 450 thousand hectares).

Damage to forests by insects, leading to the destruction of significant areas, is observed constantly. Overall the average percent of trees dying from insect pests does not exceed 15%. However in 1995 and 2004, the leading factors of destruction of forest stands were insects and pests.

The destruction of tree stands from wood diseases is annually marked on the small areas basically in the European part of Russia. But since 2004, the value of this factor has started to increase because of an increase of anthropogenous loading in forests.

The influence on forests of anthropogenous factors and industrial emissions is slight in the last decade except in 2001. Destruction of forest stands from these factors does not exceed 2 - 3 %.

Wild animals have the biggest influence on tree stands of young coniferous forest. With the reduction of such young coniferous stands, there is a decrease in the numbers of wild animals.

The death of Spruce stands in the European part of Russia has been of great concern. It has occurred in the Arkhangelsk Region and has been observed since 1997. The spruce dying has developed with a dynamic intensity: since the beginning 2004 the area of dying has increased by approximately 50 % and it is estimated today to be more than 2 million hectares. This process has already extended to the Udorsky region of the Komi Republic. It is expected that the total area of dying out forests in this region can be as much as 5 million hectares [4].

According to official statistical data [3], over the period from 1988 – 2008, the forest fires in the country have annually affected an area of anywhere between 0.35 and 2.2 million hectares of forestlands (Table 2 and Figure 4). Fires can significantly harm the forests of Russia and their influence can be seen in the varying degrees of degradation of forest stands. Assessments from 2008 have shown that the percentage share of forest stands with weak damage to trees is equal to 35.3 %, with moderate damage occurring in 15.6 % and strong damage in 49.1 % of trees.

Table 2. Area dynamics of the damaged forests [3]

Years	Forest fires		Insects and diseases		Total, 1000 ha
	1000 ha	*Share of dead stands, %*	1000 ha	*Share of dead stands, %*	
1988	700	*28.6*	1516	*0.2*	2216
1992	522	*60.0*	1444	*1.4*	1966
1993	734	*17.9*	1667	*0.8*	2401
1994	519	*43.4*	3437	*0.8*	3956
1995	351	*15.1*	2435	*3.3*	2787
1996	1807	*16.1*	3170	*6.2*	4977
1997	669	*34.0*	2974	*0.2*	3643
1998	2277	*10.8*	2677	*0.3*	4954
1999	678	*39.6*	2596	*0.4*	3275
2000	1240	*51.4*	8401	*0.3*	9642
2001	868	*15.1*	10392	*0.2*	11260
2002	1274	*22.5*	8022	*0.4*	9296
2003	2100	*22.5*	4414	*1.3*	6514
2004	442	*31.3*	2673	*8.3*	3115
2005	736	*61.3*	4639	*1.0*	5375
2006	1274	*12.1*	4803	*1.3*	6077
2007	853	*23.2*	4073	*1.1*	4926
2008	605	*26.2*	3673	*1.3*	4278

Harmful insects and diseases of tree species have a substantial influence on the condition and efficiency of forests in the whole territory of the Russian Federation. In 2008, in the forests of the Russian Federation, insects and diseases together damaged 3 673 thousand hectares (see Table 2), made up of 71 % (2 601.1 thousand hectares) insect damage and 29 % (1 071.9 thousand hectares) disease. In

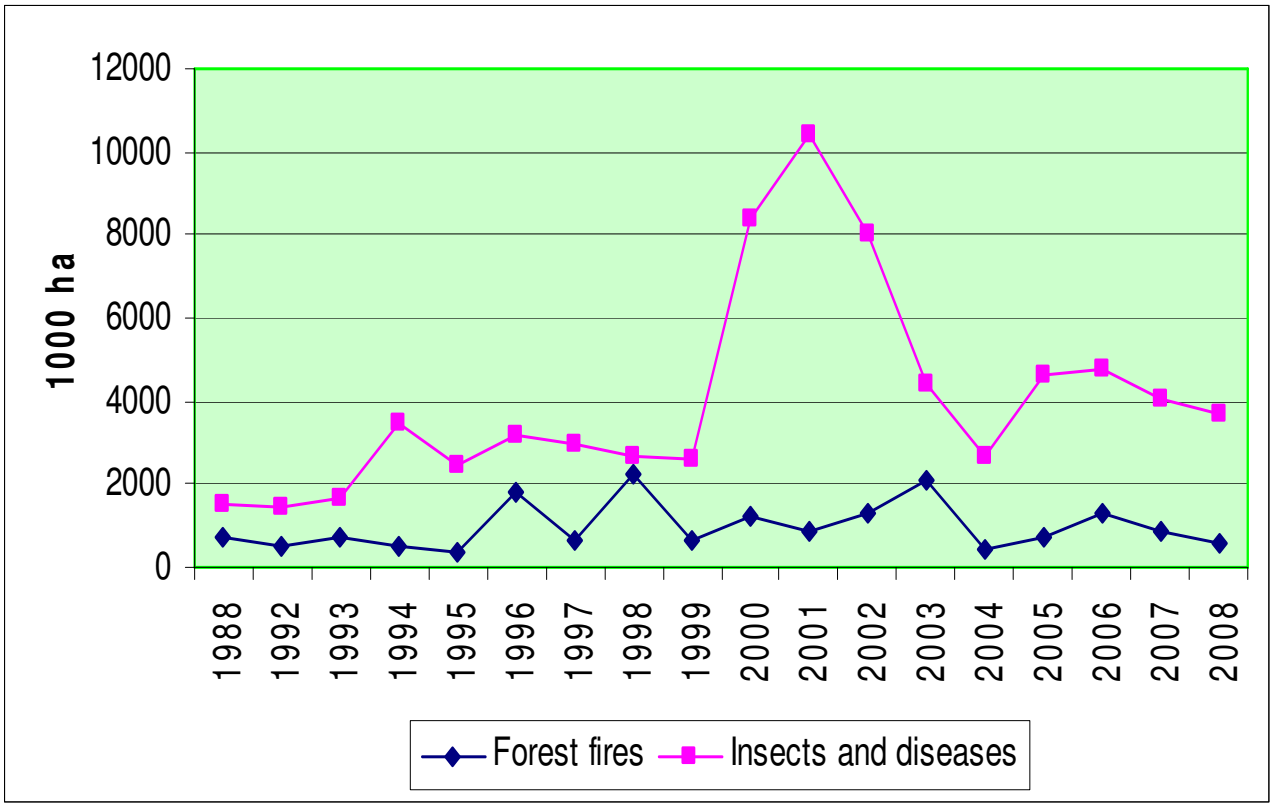

Figure 4. Area dynamics of the damaged forests, 1000 ha

2008, the percentage share of forest stands with weak damage to trees came to 46.5 %, with moderate damage making 36.8 % and with strong damage to trees making 16.7 %.

The dynamics of centres of pest outbreaks have expressed certain periodicity as well as biological processes. The average area of the pest outbreaks totals more than 3 million hectares for the period 1977 to 2008.

Sharp increases in areas affected by pests for the specified periods were observed at the end of the 1970s, in 1991 and over the period 2000 – 2001. The last episode was especially difficult when the areas of pests increased in area 3-5 times more than average long term parameters.

The root sponge (*Fomitopsis annosa*) is the most harmful and widespread of the diseases in Russian forests. It affects more than 25 forest species, including pine, spruce, fir and larch. Deciduous species are also affected by the root sponge, but seldom die out from it. Infection of tree stands with root sponge leads to weakening, then disintegration of the tree stand and, finally, to its destruction which can result in significant economic losses.

Bacterial diseases have recently increased in area in Russian forests. This group of diseases include a number of those that are least studied and difficult to diagnose, therefore, the revealed areas of bacterial invasion can appear extremely underestimated.

4. Conclusions

Led in 2007, the regional pathological monitoring of forests of the Russian Federation has shown that about 11 % of forests lie in a zone of strong pathological threat. The causes of the strong pathological threats to forests could be broken down as follows: forest fires - 60 %, adverse weather conditions - 19 %, damages by harmful insects - 11 %, diseases of a forest - 9 % and other factors - 1 %.

Over a period of 15 years, from 1991 – 2005, local pathological inspections have shown that some 5.9 million hectares of the forest stands have been affected. This means that around 400 thousand hectares of forest stands perish annually. A principal cause of destruction of areas of forest stands are forest fires, which affected some 65 % of forests that died.

Forest fires, insect pests and diseases are the reason for annual damage of forests to varying degrees in a range anywhere from 3 to 11 million hectares. In the European part of the Russian Federation, the mass dying of Spruce stands in the Arkhangelsk region is causing alarm. The reason for the dying is not established, while some 2 million hectares has been affected.

In 2008, the percentage share of forest stands with weak damage of trees by forest fires has made 35.3 %, with the moderate damage - 15.6 % and with strong damage of trees - 49.1 %. The average share of victims from fire of forest stands makes 29.2 % from a total area of the forests damaged by forest fires.

The dynamics of centres of pest outbreaks have expressed certain periodicity. The percentage share of forest stands with weak damage to trees is 46.5 %, with the moderate damage - 36.8 % and strong damage to trees - 16.7 %. The average share of the forest stands which have been lost as a result of the influence of pests and diseases makes 1.3 % from total areas damaged for this reason.

From official data [3], the total annual area of the damaged and lost forests does not exceed 1 % from all forest area of the Russian Federation. However, the real distribution of the centres of pests considerably exceeds the known area from statistics owing to the latent character of development of the majority of diseases. In addition, official statistical reports tend to underestimate essentially the area of the forests which have been affected by forest fires. According to space monitoring by the device Terra-MODIS led by the federal enterprise "Avialesoohrana", in 2008 [5], the real area of forest fires could be approximately four times greater than the area of fires presented in the statistical reporting by regional authorities.

The area of the reversible degraded forests of the Russian Federation has increased in recent years. It is possible to assume that in general the reason for such increases in degradation through forest fires and flashes of mass duplication of insect pests and diseases are connected certainly with climatic factors. Besides, the increase in the area of the centres of pest outbreak may be promoted by acid deposition and heavy metals arriving in wood soils.

The irreversible degraded forest area of the Russian Federation is compensated by agricultural fields growing with woody plants. This is a characteristic for many post-Soviet countries; however the new forests expanding into agricultural land are not necessarily of “good quality” in terms of species composition and numbers of trees per hectare. For this reason, the forest land of the country has constantly increased over the post-war period. According to some expert assessment, the annual area of the natural forest expansion may be around 40 – 60 thousand hectares.

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References

1. Roslesinforg Forest Resources Database as of 01.01.2008 (the database is not published)
2. A sanitary and pathological condition of the forest fund lands in 2007 // Roslesozashita report http://www.rosleshoz.gov.ru/activity/pathology/reports (in Russian)
3. The basic parameters of forestry activity for 1988, 1992-2007 years // Roslesinforg, Moscow, 2008 (the database is not published)
4. Zhigunov, A.V., Semakova, T.A., Shabunin, D.A. Mass a drying of forests in Northwest of Russia // http://www.rosleshoz.gov.ru/activity/pathology/reports (in Russian)
5. Kovalev N.A. Information system of remote monitoring ISDM-Rosleshoz. The block of monitoring of fire danger // Report at the Conference «Problems of the state forest inventory and planning in Russia», Moscow, 2009 (in Russian).