Dynamics of Foci of Forest Pest Insects in Russia over the Last Decade

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Abstract

Procedures for obtaining data about the sanitary state of forests in Russia are discussed briefly. The single parameter of official statistical accounts is the area of forests that have been killed or that serve as foci for pest and disease outbreaks. However, this scant information allows us to observe the variation over time of forested areas that have been killed by several unfavorable factors: insects, wild fauna (ungulates and rodents), diseases, weather, and human activity. The dynamics of outbreaks of the most important needle- and leaf-eating insects in the Russian territory from 1990-2001 are discussed.

Materials and Methods

Forms of Compulsory Statistical Accounts Related to Forest Pathology

The composition of generalized data about disturbances in the state of Russian forests is determined by the form of statistical accounts approved by the State Statistical Committee of Russia. All subjects of the Russian Federation (RF) are obliged to provide information on the use of forest protection, the areas of forests that have been killed in total and by individual causal agents, along with the data on areas of foci of forest pests and diseases. This form, "the dynamics of areas of killed stands and foci of pests and diseases (ha) in the territory of the Russian Federation," designated as "Form No. 12" (within the list of all affirmed forms of statistical accounts) must be utilized by all forestry enterprises.

These data are published annually in the "Protection of Environment" issued by the State Statistical Committee of Russia, in the State Reports about the Condition of Environment of Russia and its Regions, issued by the Ministry of Natural Resources, and are also presented periodically on the web site of the Ministry.

This information is the only official source available and is absolutely necessary for one to understand the general ecological situation in Russian forests and to document areas of distribution of all disturbances caused by biotic, abiotic and anthropogenic factors. The value of these data can be enhanced further by adding data about monitoring the impact of forest pathogens; these data will be collected in the future.

Table 1 is a shortened version of the compound table containing statistical data on areas of stands killed by different factors of unfavorable impact (FUI) and areas of foci of pests and diseases over last 12 years (1990-2001). Data about forest protection measures (*lines 01-11)*, and some other lines which contain no useful information (for example, *line 20,* area of foci of pests + diseases, *line 35,* the total area of foci of certain pests including such different species as wood-eating pests, chafers, bark bugs, and others) have been eliminated.

Some explanation about the rules for filling out Form No. 12 is necessary in order to interpret that data that are presented. *Line 12,* the total area of stands killed, also includes the area of killed forest plantations, the area of dead stands to be felled in the course of a clear sanitary cutting, and stands destroyed by forest fires and other FUI; (*lines 13-19*) the main causes of dieback in stands; *line 16* includes the area of stands killed by unfavorable weather conditions (drought, frosts, changing the water-table level, wind throw, snow breakage); in the last case instead of " wind throw, snow

Table 1.—The area of stands killed and the area of pest and disease foci, by years (10^3 ha)*

Parameters	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
12. All dead stands, including those killed by	**158.5**	**419.3**	**492.1**	**171.2**	**274.5**	**162.1**	**515.1**	**254.3**	**279.2**	**299.5**	**699.8**	**486.4**
13. … pest insects	2.4	8.9	19.2	13.2	25.4	78.4	194.5	3.0	3.1	3.6	20.3	15.5
14. … wild animals.	13.3	9.3	9.3	3.9	5.3	4.5	1.0	1.5	1.1	0.2	1.2	0.7
15. … diseases	0.7	1.9	1.4	0.8	1.1	1.9	3.5	2.2	5.1	6.0	5.5	11.3
16. … weather conditions	45.0	184.7	86.9	19.6	15.9	22.9	24.2	18.6	15.3	20.1	33.6	11.0
17. … forest fires	95.4	213.4	313.1	131.6	225.3	53.1	291.0	227.8	245.9	268.4	637.4	127.1
18. … anthropogenic factors	1.6	1.2	62.2	2.2	1.4	1.5	0.8	1.1	8.7	1.2	1.9	161.4
19. …including industrial pollution	0.6	0.3	61.8	1.1	0.3	0.6	0.2	0.1	0.1	0.1	0.1	159.5
The area of foci of pests and diseases												
20. Needle-eating insects, including	**292.7**	**868.4**	**342.3**	**198.5**	**458.5**	**892.1**	**449.8**	**333.0**	**358.7**	**373.6**	**6518.4**	**10181.5**
21. …Dendrolimus sibiricus	4.2	84.6	140.9	12.2	145.1	574.8	245.6	81.7	120.8	152.3	6257.6	6858.5
23. … *Dendrolimus pini*	5.2	12.0	7.0	6.3	11.4	11.0	8.4	10.4	8.7	9.3	23.8	3.2
24. … *Lymantria monacha*	59.7	23.5	53.0	37.7	27.6	24.4	24.3	41.2	49.6	61.9	73.7	36.9
25. … *Bupalus piniarius*	11.7	12.0	11.0	16.7	149.9	36.2	5.3	21.1	17.7	5.6	4.6	140.1
26. … *Panolis flammea*	0.6	0.3	0.4	0.3	0.2	0.6	0.3	3.3	11.2	3.0	31.0	45.1
27. … *Diprion pini*	18.0	9.0	22.3	22.3	18.9	34.9	21.4	24.2	10.8	14.7	11.9	9.6
28. … *Neodiprion sertifer*	105.3	55.4	40.6	53.9	35.8	67.5	29.5	85.4	56.6	50.2	39.4	51.4
29. … *Acantholyda stellata*							27.3	32.8	32.4	35.9	42.5	8.1
… *Boarmia bistortata*							67.8	4.0	0	0	0	0
30. Leaf-eating insects, including	**1021.4**	**1832.5**	**716.0**	**1045.5**	**1351.9**	**1070.4**	**1624.8**	**1671.2**	**1084.1**	**974.1**	**623.2**	**1217.9**
31. … *Lymantria dispar*	479.7	1379.6	265.9	421.3	1078.7	855.2	1427.1	1310.8	755.8	571.5	238.6	985.4
32. … *Euproctis chrysorrhoea*	27.9	7.8	6.2	4.9	1.3	0.8	5.7	12.3	1.2	1.6	1.5	6.4
33. … *Tortrix viridana* and other leaf rollers	475.7	416.2	375.2	545.9	220.9	184.9	121.3	123.7	98.9	78.6	84.0	123.9
36. Wood-eating insects	**36.1**	**39.8**	**48.4**	**50.0**	**33.7**	**19.3**	**34.8**	**58.2**	**278.6**	**191.7**	**201.7**	**183.4**
37. *Melolontha* and other chafers	**107.7**	**106.9**	**105.7**	**107.5**	**101.5**	**99.9**	**93.4**	**83.4**	**77.5**	**76.2**	**79.0**	**76.3**
38. *Aradus cinnamomeus*	**20.6**	**19.3**	**19.7**	**17.2**	**16.8**	**15.5**	**12.7**	**10.2**	**9.7**	**9.0**	**7.7**	**5.5**
39. Rodents	**5.3**	**3.2**	**2.2**	**3.7**	**5.5**	**59.6**	**3.5**	**2.7**	**5.7**	**3.4**	**2.5**	**2.4**
41. Diseases, including	**79.2**	**163.4**	**207.8**	**239.1**	**1467.0**	**273.6**	**943.5**	**808.7**	**852.8**	**954.1**	**966.3**	**1081.1**
42. … root rot	44.0	49.7	72.0	87.9	99.4	115.1	136.1	136.7	134.8	138.9	145.4	160.8

*All data in the Form No. 12 must be given in ha, here they are presented in thousands ha to be more convenient for consideration

Table 2.—Areas of Russian forests killed by groups of factors (10^3 ha / percentage)

Year	Factors of unfavorable impact					
	insects	wild animals	diseases	weather	Fires	anthrop.
1990	2.4 / 1.5	13.3 / 8.4	0.7 / 0.4	45.0 / 28.4	95.4 / 60.2	1.6 / 1.0
1991	8.9 / 2.1	9.2 / 2.2	1.9 / 0.4	184.7/ 44.0	213.4 / 50.9	1.2 / 0.3
1992	19.2 / 3.9	9.3 / 1.9	1.4 / 0.3	86.9 / 17.7	313.1 / 63.6	62.2 / 12.6
1993	13.2 / 7.7	3.9 / 2.3	0.8 / 0.5	19.6 / 11.4	131.6 / 76.9	2.2 / 1.3
1994	25.4 / 9.3	5.3 /1.9	1.1 / 0.4	15.9 / 5.8	225.3 / 82.1	1.4 / 0.5
1995	78.4 / 48.3	4.5 / 2.8	1.9 / 1.2	22.9 / 14.1	53.1 / 32.8	1.5 / 0.9
1996	194.5 / 37.8	1.0 / 0.2	3.5 / 0.7	24.2 / 4.7	291.0 / 56.5	0,8 / 0,2
1997	3.0 / 1.2	1.5 / 0.6	2.2 / 0.9	18.6 / 7.3	227.8 / 89.6	1.1 / 0.4
1998	3.1 / 1.1	1.1 / 0.4	5.1 / 1.8	15.3 / 5.5	245.9 / 88.1	8.7 / 3.1
1999	3.6 / 1.2	0.2 / 0.1	6.0 / 2.0	20.1 / 6.7	268.4 / 89.6	1.2 / 0.4
2000	20.3 / 2.9	1.2 / 0.2	5.5 / 0.8	33.6 / 4.8	637.4 / 91.1	1.9 / 0.3
2001	15.5 / 3.2	0.7 / 0.1	11.3 / 2.3	11.0 / 2.3	127.1 / 26.1	161.4 / 33.2

breakage" which is the consequence of the impact it would be more correctly to say "the impact of wind and snow"; *line 20* includes data about needle-eating pests, and *line 30* includes data about leaf-eating insects. The sum of columns attributed to certain pest species can be less than the figures provided in *lines 20* and *30,* because the total areas can include damage by other species that are not listed; the instructions allows us to add new lines with data about the foci of pests that are important in certain years for certain regions, for example, the data provided for *Boarmia bistortata*.

Line 41 contains data about forest diseases in addition to the root rot mentioned in *line 42*: these include *Armillaria mellea* root rot, the canker (pathogen *Peridermium pini*), the Dutch elm disease (pathogen *Ceratocystis ulmi*), the oak wilt (pathogen *C. roboris*) which affect predominantly adults stands of various species, the pine shoot rust (pathogen *Melampsora pinitorqua*), disease of pine underwood and young plants in nurseries and plantations.

If stands, forest plantations, and nurseries are infected by several species of pests or diseases, it is recommended to mention the area infected by the dominant species.

Another supplementary form, Form No. 22 for forest-pathology information and accounting is prepared in November for forest management administration. It is then used for planning forest protection activities for the coming year. This form presents information about the area of foci at the beginning of the year, the area that is newly infested, the area of foci that was abolished including that which was eliminated by natural factors, the area of foci at the end of year, and what portion of it "needs to be treated". However, these kinds of data are not adequate for use for scientific purposes.

Table 2 presents data transformed from Table 1 followed by the contribution (in percent) of each group of factors that cause the death of forests. These data suggest that forest fire is the most dominating factor and that their impact is catastrophic: 51 to 91% of forests were killed between 1990—2001; the proportion killed by fire was less than 50% only in 1995 and 2001.

The contribution of insects in the death of forests seems to be insignificant as compared to fire and caused less than 10% mortality during the period of this report. The exception occurred in 1995-1996 after an outbreak of *Dendrolimus sibiricus* in Siberia, which caused 38-48% mortality of trees. It is likely that in current and succeeding years, the area of forests killed may increase significantly as a result of recent outbreaks of *D. sibiricus* and other needle-eating insects in the Asian part of Russia.

These two forms, No. 12 and No. 22, are prepared for forests of all subjects of the RF and separately for certain especially preserved territories. The territory of Russian forests are divided into 12 regions (Lesnoi Fond Rossii, 1999): Pribaltiiskii (the Baltic region), Severnyi (the Northern region), Severo-Zapadnyi (the North-Western region), Tsentral'nyi (the Central region), Volgo-Vyatskii (the Volga-Vyatka interfluve region), Tsentral'no-Chernozyomnyi (the Central Black Soil region), Povolzhskii (the Volga region), Severo-Kavkazskii (the Northern Caucasus region), Uralskii (the Ural region), Zapadno-Sibirskii (the Western Siberia region), Vostochno-Sibirskii (the Eastern Siberia region), and Dal'nevostochnyi (the Far East region). The classification of separate subjects of the RF to these regions is made in the above-mentioned reference rather conventionally, but it insight about the distribution of certain disturbances within different regions of Russian forests.

Dynamics of foci of insect defoliators

Table 1 presents data about areas of outbreak foci of the most important needle- and leaf-eating insects included in the form of compulsory statistical accounts. The remaining tables provide information about the distribution of foci of defoliators by regions. Only data for infested areas exceeding 100 ha are included.

Table 3.—Dynamics of foci of *Dendrolimus sibiricus* by region, 10^3 ha

Year	Regions			
	Ural	West Siberia	East Siberia	Far East
1990	0.0	2.6	0.8	0.8
1991	0.9	27.1	45.4	11.2
1992	0.9	76.8	62.0	1.2
1993	0.0	6.8	5.4	0.0
1994	0.0	13.7	131.4	0.0
1995	0.0	5.1	569.7	0.0
1996	0.0	7.7	107.3	130.6
1997	0.0	10.8	70.0	0.9
1998	0.0	34.6	85.8	0.4
1999	0.0	54.3	76.2	21.7
2000	0.7	238.6	77.7	5940.7

Table 4.—Dynamics of foci of *Dendrolimus pini* by region, 10^3 ha

Year	Regions					
	Black Soils	Volga	Northern Caucasus	Ural	West Siberia	East Siberia
1990	0.0	0.1	1.1	4.0	0	0.0
1991	9.0	0.1	2.8	0.1	0	0.0
1992	2.9	0.1	3.9	0.1	0	0.0
1993	3.1	0.1	3.0	0.1	0	0.0
1994	2.4	3.7	5.2	0.1	0	0.0
1995	0.2	3.5	7.2	0.1	0	0.0
1996	1.8	1.3	5.2	0.1	0	0.0
1997	0.6	0.6	8.9	0.0	0	0.0
1998	1.2	0.5	6.8	1.1	0	0.0
1999	1.1	0.2	3.8	1.3	0	3.0
2000	0.8	0.2	0.9	1.3	18.7	2.0

Table 5.—Dynamics of foci of *Bupalus piniarius* by region, 10^3 ha

Year	Regions					
	Northwestern	Volga	Northern Caucasus	Ural	West Siberia	East Siberia
1990						
1991	0	0	0.4	3.4	0.1	0
1992	0	0	0.4	4.8	0.1	0
1993	0	0.1	1.4	2.6	12.5	0
1994	0.2	0	1.4	2.6	16.3	0.4
1995	1.6	0	1.4	1.2	1.1	0
1996	2.2	1.8	1.4	24.0	0	0
1997	2.2	1.8	3.0	113.6	0	0
1998	2.2	1.8	2.2	3.6	3.0	0
1999	0.2	1.8	2.1	2.3	3.0	1.2
2000	0	1.8	3.3	3.8	3.0	0
2001	0	1.8	0.8	6.0	3.0	0

Table 6.—Dynamics of foci of *Panolis flammea* by region, 10^3 ha

Year	Regions				
	Centr.	Black Soil	Volga	Northern Caucasus	Ural
1990	0.0	0.0	0.0	0.0	0.4
1991	0.0	0.0	0.0	0.0	0.4
1992	0.0	0.0	0.0	0.0	0.4
1993	0.0	0.0	0.0	0.0	0.3
1994	0.0	0.0	0.0	0.0	0.2
1995	0.4	0.0	0.0	0.0	0.2
1996	0.1	0.0	0.0	0.0	0.2
1997	0	0.0	0.0	3.2	0.1
1998		0.0	0.7	10.4	0.0
1999		1.3	0.7	1.1	0.0
2000		6.2	6.1	18.7	0.0

Table 7.—Dynamics of foci of *Neodiprion sertifer* by region, 10^3 ha

Year	Regions							
	North	Central	Black-Soils	Volga	Volga-Vyatka	Northern Caucasus	Ural	West Siberia
1990	0.0	1.7	10.1	15.8	2.0	9.1	8.3	59.9
1991	6.7	1.6	4.8	11.4	0.7	2.1	14.8	13.3
1992	5.5	0.0	1.4	13.4	0.0	6.7	10.5	3.1
1993	5.4	0.0	2.4	20.7	0.0	10.2	9.5	5.7
1994	0	0.0	4.1	12.2	0.0	7.6	3.5	8.3
1995	0.1	0.0	2.6	7.5	0.0	7.4	1.3	48.8
1996	0.1	0.0	2.4	16.2	0.0	9.3	0.8	0.7
1997	0.1	0.0	20.3	29.8	0.0	23.8	0.6	10.8
1998	0.0	0.0	11.6	24.8	0.0	12.8	1.9	5.3
1999	0.0	0.0	8.2	16.4	0.0	17.7	2.1	5.7
2000	0.0	0.0	6.9	13.3	0.0	8.9	6.5	3.9

Table 8.—Dynamics of foci of *Lymantria dispar* by region, 10^3 ha

Year	Regions							
	Baltic	Central	Volga	Northern Caucasus	Ural	West Siberia	East Siberia	Far East
1990	0.0	0.0	40.9	248.2	12.2	0.0	9.9	0.0
1991	0.0	0.0	25.9	64.9	10.6	0.0	1205.6	0.0
1992	0.1	0.0	9.9	77.5	128.5	3.3	0.0	0.1
1993	0.6	0.0	3.7	100.1	77.0	13.4	0.0	0.2
1994	0.2	0.0	4.1	192.8	304.6	67.1	0.0	0.1
1995	1.6	0.0	5.3	180.8	295.7	122.9	0.4	0.0
1996	1.4	0.0	24.9	327.1	588.0	52.9	128.1	0.0
1997	0.2	48.8	22.6	283.0	80.5	197.8	322.4	0.0
1998	0.0	118.0	19.6	176.5	40.0	170.5	84.6	0.2
1999	0.0	63.7	0.3	165.2	94.5	172.9	0.0	0.2
2000	0.0	8.3	0.2	41.1	46.0	104.7	2.5	0.2

Forest pathology monitoring (FPM) in the Russian Federation

In the document "The Concept of Forest Protection and the Basis for the Organizing Structure of the Service for Forest Protection in the Russian Federation," developed by Russian specialists in entomology and phytopathology by order of the Russian Federal Service for Forest Management, it was mentioned as early as 1993 that the structure, content, and reliability of official statistical data about the condition of Russian forests both totally and by regions are inadequate for preparing analytical reviews and forecasts, and consequently for providing opportunities for effective forest management. Data on tree mortality in forests caused by pests and diseases were considered by authors as the least reliable. The situation will be improved only by implementing the specialized system for assimilating data on FPM that has been developed by workers from the Russian Center on Forest Protection in recent years. Since the beginning, this process requires a more detailed interpretation of data on the influence of pests, diseases and other FUI on the condition and death of forests from the statistical accountings.

The system of FPM in Russia has developed rapidly in recent years. The Statement on FPM in Russian forests (1997) proclaims as its goal the development of a system for an operative and permanent survey on the condition of forests, disturbance of their stability caused by pest organisms and other natural and anthropogenic factors over time, so that timely information can be provided about the condition of stands and the need for planning and applying forest protective measures.

The National Center for the forest pathology monitoring established in 1990 by the All-Union Scientific Center for Forest Resources, issued regular reports on the sanitary condition of Russian forests in 1991, 1992, and 1993. In 1994 the report was issued by the Moscow specialized enterprise for forest pathology. After a brief interruption caused by the re-organization of the Service on Forest Protection, the reports of the sanitary condition of Russian forests have been issued by the Russian Center for Forest Protection in 1999—2001.

The Service of Forest Protection has recently received "Guidance for the Organization and Execution of Forest Pathology Monitoring" (2002), which will promote further its development and improvement.

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