FOREST MONITORING SISTEM IN ROMANIA, DYNAMICS OF ROMANIAN FOREST HEALTH STATUS OVER THE PERIOD 1990-2002

OVIDIU BADEA, NICOLAE PĂTRAŞCOIU, MIHAI TĂNASE

Forest Research and Management Institute, Bucharest, Romania

ABSTRACT

During the 1980s, dieback intensified in the European forests. This fact convinced Romania and most of the European countries to develop the evaluation and surveying process covering the main factors having an impact on forests. In Romania, research dealing with the elaboration of a technical-organisational concept was developed between 1983 and 1985. This concept dealt with the surveying system used to control the quality of environmental factors in the forestry estate (Patrascoiu et al. 1985). The system had been experimented in the following period (1986-1989). In 1990, it was applied to the entire national forestry estate (Patrascoiu and Badea. 1990).

Today, the organization and functioning of the national forest monitoring system is ensured by the Ministry of Agriculture, Forests, Waters and Environmental, ROMSILVA and Forest Research and Management Institute (ICAS, as National Focal Centre).

This system is functioning in accordance with Low no.444/2002 on "Elaboration and Financing of National Monitoring System soil-land for agriculture and soil-forest vegetation for forestry".

The forest condition survey in Romania is done according to Resolution no.1 and 6 of the Strasbourg Ministerial Conference (1990), Agenda no.21 from Rio de Janeiro (1992) and Resolution no.3 of the Helsinki Ministerial Conference (1993). At international level, Romania takes part in the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP-Forests).

The main objectives of the forest survey in Romania are achieved with the support of investigations at two levels:

Level I - a large scale forest condition survey, based on permanent plots (4x4 km) and European (16x16 km) networks, with lower assessment intensity.

Level II - studies and research of intensive nature in a non-systematic survey network placed in forest ecosystems suitable for cause-effect relationship studies and located where critical threshold values of pollution are likely to be present.

Results on Romanian forest health status over the period 2000-2002

show that for all species the share of damaged trees (classes 2-4) registered values between 9.7% in 1991 and 21.2% in 1994. For conifers the share of damaged trees was between 7.0% (1991) and 16.6% (in 1993) and for broadleaves between 10.4% (in 1991) and 22.9% (in 1994).

At species level, Norway spruce (Picea abies) and beech (Fagus sylvatica) were the least affected, with shares of damaged trees between 6.4% (in 1991) - 15.3% (1993) and 6.3% (1991) - 15.1% (1994), respectively. For silver fir (Abies alba) the percentage of damaged trees registered the lowest value in 1991 (9.0%) and the highest in 1994 (22.3%). Among broadleaves, the most affected species were Quercus pedunculiflora + Quercus pubescens and Quercus frainetto, the share of damaged trees varying between 19.0% (in 1990) - 30.5% (in 1994) and 19.0% (in 1990, 1991) - 45.5% (in 1994), respectively.

Over the entire analyzed period, the forests from the southern and south-eastern part of the country were the most damaged mainly due to the drought which lasted for a long period (the last15-20 years) in these parts.

Keywords: forest monitoring, health status, descoloration, defoliation

INTRODUCTION

The negative impact of environmental factors on forests was similar in Romania to that described in most European countries, where damage and abnormal dieback were becoming progressively predominant. This process involved first oaks (between 1937-1943, 1947-1949, 1955-1958), and then other species such as silver fir, pine, beech, black locust and others between 1970-1978, 1984-1994.

Until the 1980s, the quality assessment of certain environmental factors (including forest health status) was indirectly done using non-specific methods. These methods were: (i) the revision of forest management plans (every 10 years), (ii) forest inventories based on management plans (1967, 1974, 1979, 1984), (iii) maintenance of an information system based on data on forest administration (SILV), (iv) specific research, (v) studies etc. These methods were deficient; the information gathered was insufficient because it came from different sources, and because it was recorded at different moments. In order to improve this situation, the elaboration of a single forest survey system (compatible at national and European level) was started. In this respect, between 1983 and 1985, a methodological concept of this system was developed, which was experimented between 1986 and 1989 in the forests managed by the Forestry Research and Management Institute (93 000 ha) and the Galati Forest Administration (40 000 ha). In 1990, the working concept was adapted and correlated with the one applied by the member countries of ICP-Forests and then applied to the entire Romanian forestry estate (Patrascoiu and Badea 1990).

Today, the organization and functioning of the national forest monitoring system is ensured by the Ministry of Agriculture, Forests, Waters and Environmental, ROMSILVA and Forest Research and Management Institute (ICAS, as National Focal Centre).

This system is functioning in accordance with Low no.444/2002 on “Elaboration

and Financing of National Monitoring System soil-land for agriculture and soil-forest vegetation for forestry".

The forest condition survey in Romania is done according to Resolution no.1 and 6 of the Strasbourg Ministerial Conference (1990), Agenda no.21 from Rio de Janeiro (1992) and Resolution no.3 of the Helsinki Ministerial Conference (1993). At international level, Romania takes part in the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP-Forests).

The main objectives of the forest survey in Romania are achieved with the support of investigations at two levels:

Level I - a large scale forest condition survey, based on permanent plots (4x4 km) and European (16x16 km) networks, with lower assessment intensity.

Level II - studies and research of intensive nature in a non-systematic survey network placed in forest ecosystems suitable for cause-effect relationship studies and located where critical threshold values of pollution are likely to be present.

The National Forest Survey Network (4x4 Km)

Assessment methods and parameters

The Romanian forest survey system, through the national permanent plot network, is based on:

- annual records including information on the status of tree crowns and the damage caused by different factors (biotic, abiotic, anthropic, pollution, fires,etc.)
- periodical records (every 5 years) related to the elaboration of the National Forestry Inventory (NFI) regarding the status and evolution of the main parameters of the forestry estate and its capacity to fulfil its socioeconomic functions at national and regional level.

In order to survey tree crown conditions and their physical damage, 30 (15 on every subplot) predominant, dominant and co-dominant trees were initially chosen on every plot, presenting moderate to strong physical damage.

For these 30 trees, defoliation and discoloration (definition see Table 1) are annually and the presence of the damage, caused by abiotic (wind, snow, frosts, etc.), biotic (game, insects, fungi) and anthropic (pollution, fires, etc.) factors is observed.

Field information is collected by foresters from every forest district in the country. Training is provided by specialists from the Forest Department, ROMSILVA and the Forest Research and Management Institute (ICAS).

Processing of field information, analysis of the result and elaboration of annual reports is done by the Forest Research and Management Institute. Methodological questions have been the subject of several scientific papers (Patrascoiu 1985b, 1991; Patrascoiu et al. 1987, 1990; Patrascoiu and Badea 1992; Badea and Patrascoiu 1993; Badea 1993ab; Badea 1990-1995; Badea 1995).

Table 1 Definition of defoliation and discoloration classes

Defoliation class	% of lost needles/leaves	Tree status
0	0-10	healthy
1	11-25	slightly defoliated
2	26-60	moderately defoliated
3	61-99	severely defoliated
4	100	dead
Discoloration class	**% of discolored**	**Tree status**
0	0-10	healthy
1	11-25	slightly discoloured
2	26-60	moderately discoloured
3	61-99	severely discoloured
4	100	dead

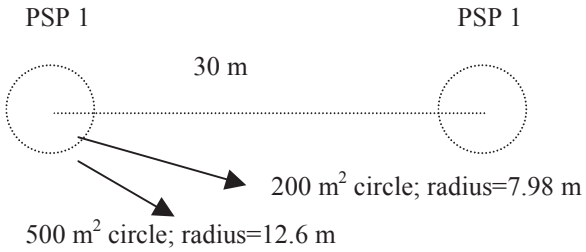

Figure 1. Design of sample subplots in the National Forestry Inventory

Results and discussion

Between 1990 and 2002 the percentage of healthy trees (class 0), combining all species, was higher in 1998 (66.9%) and 1999 (65.6%) than in 1990 (52.0%) and lower in 1992 (48.9%), 1993 (48.2%) and 1994 (47.3%). The percentage of more severely defoliated trees (class 2-4) was low in 1991 (9.7%) and higher in 1992 (16.7%), 1993 (20.5%), 1994 (21.3%), 1995 (16.4%) and 1996 (16.8%), compared to 1990 (13.0%) (Tables 2.1 and 2.2 and Figure 2).

For conifers the percentage of healthy trees (class 0) showed higher values in 1998 (70.0%), 1999 (70.4%) and 2000 (71.8%), compared to 1990 (55.0%), 1993 (52.9%) and 1994 (54.5%). The percentage of more severely defoliated trees (class 2-4) was lower in 1991 (7.0%), 1997 (9.7%), 1998 (9.0%), 1999 (9.1%), 2000 (9.8%), 2001 (9.6%) and 2002 (9.9%) compared to 1990 (11.0%), 1993 (16.7%) and 1994 (15.5%) (Tables 2.1 and 2.2 and Figure 4).

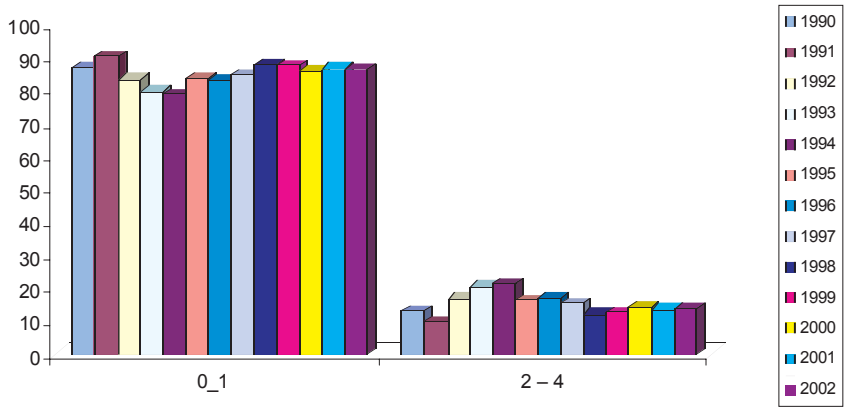

Figure 2. Defoliation dynamics 1990 to 2002- all species

Table 1. Defoliation of conifers, broad-leaved trees, all species and several main species over the peri od 1990 and 2001 (class 0)

Species	Class 0 (%)												
(groups of species)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Spruce	56.0	65.0	59.5	55.3	57.5	68.7	70.4	71.5	72.5	72.0	74.2	72.4	71.2
Silver fir	48.0	56.9	54.7	47.8	44.6	59.0	60.6	62.7	68.9	66.1	66.9	63.4	61.2
Conifers	**56.0**	**63.4**	**57.8**	**52.9**	**54.6**	**65.9**	**67.5**	**68.8**	**71.0**	**70.4**	**71.8**	**69.6**	**68.4**
Beech	58.0	68.0	49.9	54.3	53.0	58.8	60.2	64.2	70.7	68.1	65.0	63.2	66.3
Sesile oak	44.0	54.9	41.0	39.2	36.7	50.5	50.4	48.8	57.7	59.2	59.3	53.4	55.5
Pedunculate oak	38.0	42.7	41.5	37.9	34.6	47.7	44.0	43.7	58.1	55.9	59.0	55.9	59.0
Q.pedunculiflora + Q. pubescens	27.0	20.1	39.7	40.7	36.3	33.9		49.7	43.4	36.5	26.2	34.7	43.4
Q. cerris	43.0	53.7	42.1	39.0	38.7	40.5	43.9	48.8	57.5	53.6	53.7	54.7	51.0
Q.frainetto	44.0	46.3	27.2	25.0	22.0	35.4	49.4	42.4	50.2	49.6	42.5	51.5	31.0
Black locust	37.0	54.0	38.6	39.1	35.6	42.4		45.6	60.7	60.8	53.1	56.2	47.8
Broad-leaved trees	**51.0**	**61.1**	**48.4**	**47.0**	**45.6**	**53.3**	**54.3**	**57.1**	**65.7**	**63.9**	**62.5**	**60.0**	**60.6**
All species	**52.0**	**61.6**	**48.9**	**48.2**	**47.7**	**56.0**	**57.2**	**59.6**	**66.9**	**65.6**	**64.8**	**62.5**	**62.7**

For broad-leaved species, different defoliation classes followed a pattern similar to

Table 2. Defoliation of conifers, broad-leaved trees, all species and several main species over the period 1990 and 2001 (classes 2-4)

Species	Class 2 – 4 (%)												
(groups of species)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Spruce	10.0	6.4	10.3	15.3	13.4	9.3	9.2	8.5	8.0	8.2	8.7	8.1	8.4
Silver fir	15.0	9.0	11.7	19.2	22.3	13.5	13.3	11.3	10.7	11.6	13.1	13.7	13.9
Conifers	**11.0**	**7.0**	**10.9**	**16.6**	**15.5**	**10.4**	**10.4**	**9.7**	**9.0**	**9.1**	**9.8**	**9.6**	**9.9**
Beech	11.0	6.3	12.9	14.9	15.1	12.6	13.5	10.7	8.6	9.9	12.2	11.3	10.2
Sesile oak	16.0	13.3	22.8	27.6	30.7	20.3	20.9	21.0	16.8	16.3	16.9	16.6	16.2
Pedunculate oak	19.0	20.9	24.1	26.4	30.5	22.9	28.4	27.4	22.4	23.8	20.4	21.5	20.4
Q.pedunculiflora + Q. pubescens	24.0	32.5	32.0	40.3	42.6	37.1		31.2	31.2	33.5	28.5	32.7	31.2
Q. cerris	14.0	10.9	25.8	27.3	30.6	26.5	22.4	22.2	17.8	19.4	23.0	18.8	22.9
Q.frainetto	19.0	19.0	41.6	38.0	45.5	35.9	31.3	28.4	28.7	25.0	40.3	27.7	42.5
Black locust	21.0	15.4	27.2	32.9	39.0	27.8		28.0	20.4	21.1	28.9	22.5	28.9
Broad-leaved trees	**14.0**	**10.4**	**18.4**	**21.4**	**22.9**	**18.0**	**16.6**	**16.6**	**13.3**	**14.0**	**15.8**	**14.7**	**14.8**
All species	**13.0**	**9.7**	**16.7**	**20.5**	**21.2**	**16.4**	**16.8**	**15.1**	**12.3**	**12.7**	**14.3**	**13.3**	**13.5**

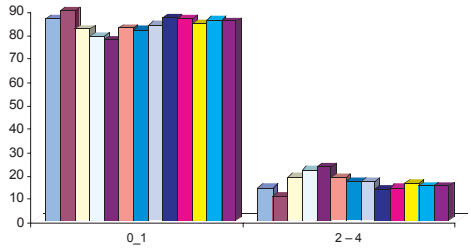

Figure 3. Defoliation dynamics 1990-2001
- broad-leaved trees -

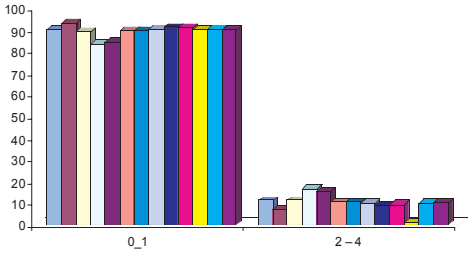

Figure 4. Defoliation dynamics 1990-2001
- conifers-

the one recorded for all species (Tables 1and 2 and Figure 3). Comparatively, conifers present a better health status than broad-leaved trees and all species together (Tables 1 and 2 and Figure 4).

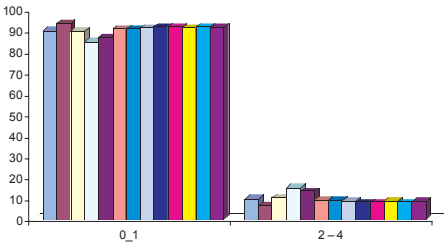

Figure 5. Defoliation dynamics 1990-2001
Norway spruce

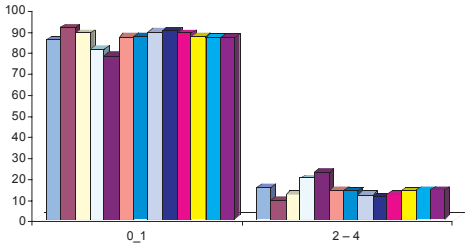

Figure 6. Defoliation dynamics 1990-2001
Silver fir

Spruce and beech are the least affected species. Thus, between 1990 and 2001, the percentage of more severely defoliated trees (class 2-4) varies from 6.4% (1991) to 15.3% (1993) for spruce and from 6.3% (1991) to 15% (1994) for beech (Tables 1 and 2.2 and Figures 5 and 7). The most affected conifer is silver fir, which showed 22.3% of more severely defoliated trees (class 2-4) in 1994 (Tables 1 and 2 and Figure 6).

The most affected broad-leaved species are *Quercus pedunculiflora* + *Quercus*

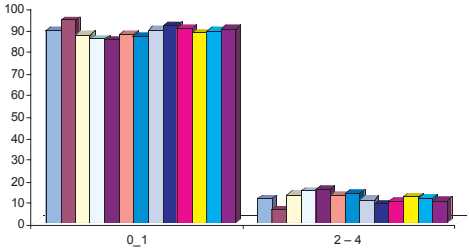

Figure 7. Defoliation dynamics 1990-2001
Beech

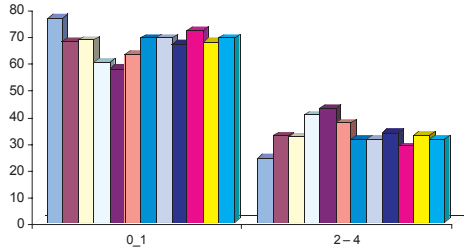

Figure 8. Defoliation dynamics 1990-2001
Q. frainetto -

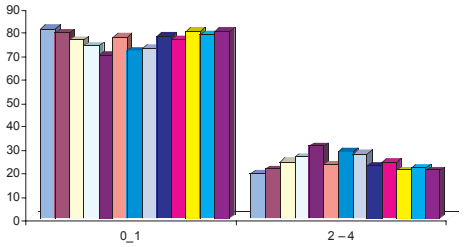

Figure 9. Defoliation dynamics 1990-2001
Pedunculate oak

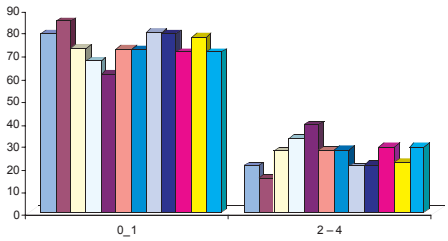

Figure 10. Defoliation dynamics 1990-2001
Black locust

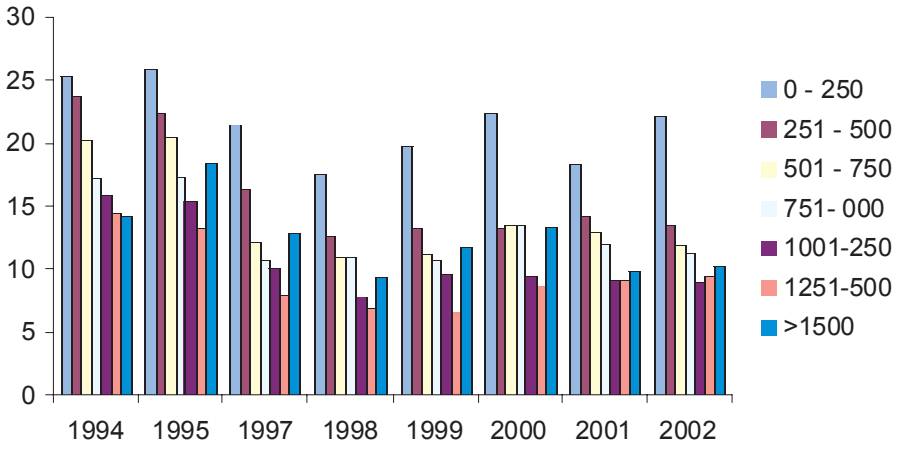

Figure 11. Defoliation on altitude classes - 2002

pubescens and *Quercus frainetto*. These species showed higher levels of more severely defoliated trees (classes 2-4), 24% in 1990 and 42.6 in 1994 (*Quercus pedunculiflora*+ *Quercus pubescens*) and between 19.0% in 1990 and 45.5% in 1994 (Quercus frainetto). These species are followed by *Robinia pseudaccacia*, *Quercus robur*, *Q. cerris* and *Q. petraea* (Tables 2.1 and 2.2 and Figures 8 - 10).

Analyzing the results on forests health status on altitudinal strata (250 m strata) it can be noticed a reduction of damaged trees share as the altitude increases, up to 1500 m (Fig. 11). This improvement in forest health status with altitude increase is a result of higher precipitation quantities, moderate temperatures during the vegetation season, lack of water deficit and insolation. Over the 1500 m altitude the shares of damaged trees increase due to the extreme vegetation condition (wind, soil, air pollution etc.)

In southern and southeastern parts of the country, the forests are more damaged due to the excessive draught for a long period. If in 2001 and 2002 the forest health status improved, in some parts of the country, as a reaction to the high precipitations quantities, over the vegetation season, in southern and southeastern part of the country the fo-

rest health status was similar as in the previous years (1998-2000). The reaction to the high precipitation quantities registered during the vegetation season was very low, because these forests need higher precipitation quantity for a long period (2-3 years).

At international level, Romania is generally a country with moderate affected forests. Over the period (1990-2002) the share of damaged trees was between 10.1% - 20.0% except 1991 (9.7%), 1995 (20.5%) and 1994 (21.2%).

References

BADEA, O., 1998, Forest Condition monitoring in Romania: Results on optimization of the national permanent plot network for the assessment of forest health status p.15-17, Imprimerie ONF - Fontaibleau.

BADEA, O., PATRASCOIU, N., GEAMBASU, N., 2000, Forest condition monitoring in Romania for 1997-1999 period, ICAS Bucuresti.

COMMISSION REGULATION (EEC) No.1696/1987 laying down certain detailed rules for the 1987. Official Journal of the European Communities, No. L161/1 of 22 June 1987, p.22.

COUNCIL REGULATION (EEC) No.3528/1986 on the protection of forests in the Community against atmospheric pollution. Brussels: 1986. Official Journal of European Communities No.L362/2 of 21 Nov. 1986, p.3.

MANUAL ON METHODOLOGIES AND CRITERIA FOR HARMONIZED SAMPLING, ASSESSMENTS, MONITORING AND ANALYSIS OF EFFECTS OF AIR POLLUTION ON FORESTS HAMBURG/GENEVA: Programme Co-ordinating Center, UN/ECE 1998.