Chapter 38
Russian Federation

Oleg N. Solontsov, Alexander A. Martinuk and Alexander V. Bukas

38.1 National Forest Inventory of the Russian Federation

38.1.1 History and Objectives

The National Forest Inventory (NFI) is conducted on the basis of article 90 of the Russian Federation forest code and in accordance with the national program of forest development for the years 2013–2020 (Resolution of the Government of the Russian Federation 2014).

The NFI is a new instrument for the assessment of the sustainability of forest management, which has not been used previously on the territory of the Russian Federation. The preparation work for the NFI began in 2007 with the adoption of a new forestry code (Anon 2014; Order Rosleshoza 2011a, b), which set a significant new strategy for the management of forests and for the provision of forest ecosystem services. The national forest inventory meets accepted international standards for sampling based large-area forest inventories, employing similar techniques to many other countries.

The NFI is a sophisticated instrument for forest resources assessment which uses various data sources and methods to provide the required information. Currently, the main activities are carried out within the NFI are: the evaluation of the

O.N. Solontsov (✉) · A.A. Martinuk · A.V. Bukas
Federal Forest Agency of Russia, Moscow, Russia
e-mail: olontsov@inbox.ru

A.A. Martinuk
e-mail: vniilm_martinuk@mail.ru

A.V. Bukas
e-mail: bukas73@mail.ru

O.N. Solontsov · A.A. Martinuk · A.V. Bukas
Roslesinforg, Moscow, Russia

C. Vidal et al. (eds.), *National Forest Inventories*,
DOI 10.1007/978-3-319-44015-6_38

quantitative and qualitative characteristics of the Russian forest, the assessment of forest measurement activities in the field, remote monitoring of forest management activities and the compilation of output tables and reports at regional level. The regional reporting units are the constitutional entities, federal states.

The main focus is on the assessment of the current state of forests expressed by a variety of quantitative and qualitative characteristics, and the establishment of a network of permanent sampling units (plots) allowing inference through the methods of mathematical statistics.

Information about the forest land of Russia is available from forest management planning inventories, which have been carried out periodically in the past. At the time of the NFI introduction, a terrestrial stand-level forest inventory was already operational for 42 % of the state's forests, which was reduced during the past 40–50 years. Other different methods of forest assessment were implemented in a further 57 % of the forest land. For the remaining 1 % of the forest land, remote sensing technology was applied. Due to this non-standardised approach nationally, it was considered best to establish a statistical sampling approach to assess the quantitative and qualitative attributes using harmonised definitions. This was considered the most effective way to achieve the main goals of the NFI formulated in the forest code, for large regions and the entire territory of the country, namely to:

- detect, in a timely manner, and predict the development trends of processes which have adverse impact on forests
- evaluate the forest protection and renewal activities
- provide information on the management in the area of forest use, protection, renewal and state forest inspection and oversight.

NFI information will be used by the federal state authorities and by the wider forestry and related sectors, regional authorities and administrations, and by local authorities and administrations responsible for forest management and ecology. The scientific NFI results are also made available for non-governmental organisations and the public.

38.1.2 Sampling Methods and Periodicity

The size of the National Forest Inventory is substantial. In the period between the years 2007 and 2014, a network of 41,700 permanent plots were established in the forest covering a total land area of 273.4 million ha, which covers 30 constituent entities of the Russian Federation (Fig. 38.1).

The NFI is carried out in all forests of the Russian Federation, and in all federal states. Ground-based sampling, coupled with aerial and satellite techniques were used. The federal state body mandated for the implementation of the NFI is the

Fig. 38.1 The constituent entities of the Russian Federation with the time schedule for NFI permanent plots establishment. *Light green* sampling planned for the year 2015; *dark green* terrestrial NFI plot sampling completed 2011–2013; *orange* terrestrial NFI plot sampling completed in 2014

Federal Agency of Forestry, which in turn acts through its territorial bodies and subordinated organisations.

The NFI work is conducted in accordance with the methodology approved by the Federal Agency. These regulations are generally sufficient to carry out the complex NFI work. However, from the experience gained so far, some improvements of methodology are required. This work will be carried out by leading scientific organisations and forestry specialists.

The assessment of quantitative and qualitative characteristics is a fairly complicated process, which can be divided into six stages:

- a basic digital map of forest land is created based on existing topographic maps and forest management plans
- the digital maps are updated with data from forest registers and earth observation satellites, for effects of anthropogenic and natural disturbances in forests
- the digital maps are the basis for a stratified random selection of NFI plot locations (coordinates)
- terrestrial (ground-based) plot measurements and assessments
- updated forest maps are used to estimate strata areas
- estimation of quantitative and qualitative characteristics of forests, combining strata and plot data.

The stratified selection of terrestrial NFI plots starts from existing digital forest maps and attributes from stand-wise databases. The data sources for the maps are the state's registers of forests and satellite images with a spatial resolution of at least 5 m. The aim is to identify forest sites with similar characteristics, and ultimately to minimise the sample size and the optimisation of the allocation of permanent

sample plots to the strata. The criteria for strata building are dominant species aggregated into species groups, land-use category, site class groups and age class groups. In total, 49 different strata types exist. Permanent plots are selected at random within strata aiming at a uniform distribution of sampling plots on operation units (Fig. 38.2).

The permanent plots of the NFI consist of three concentric circular plots for tree measurements. Two smaller circles for assessment of forest regeneration (trees <6 cm of dbh) and strip for assessment of the ground vegetation cover. A soil sample is taken close to the plot boundary (i.e. out of the plot). A diagram of the permanent plot layout of the NFI is shown in Fig. 38.3, and a summary of measurements in Table 38.1.

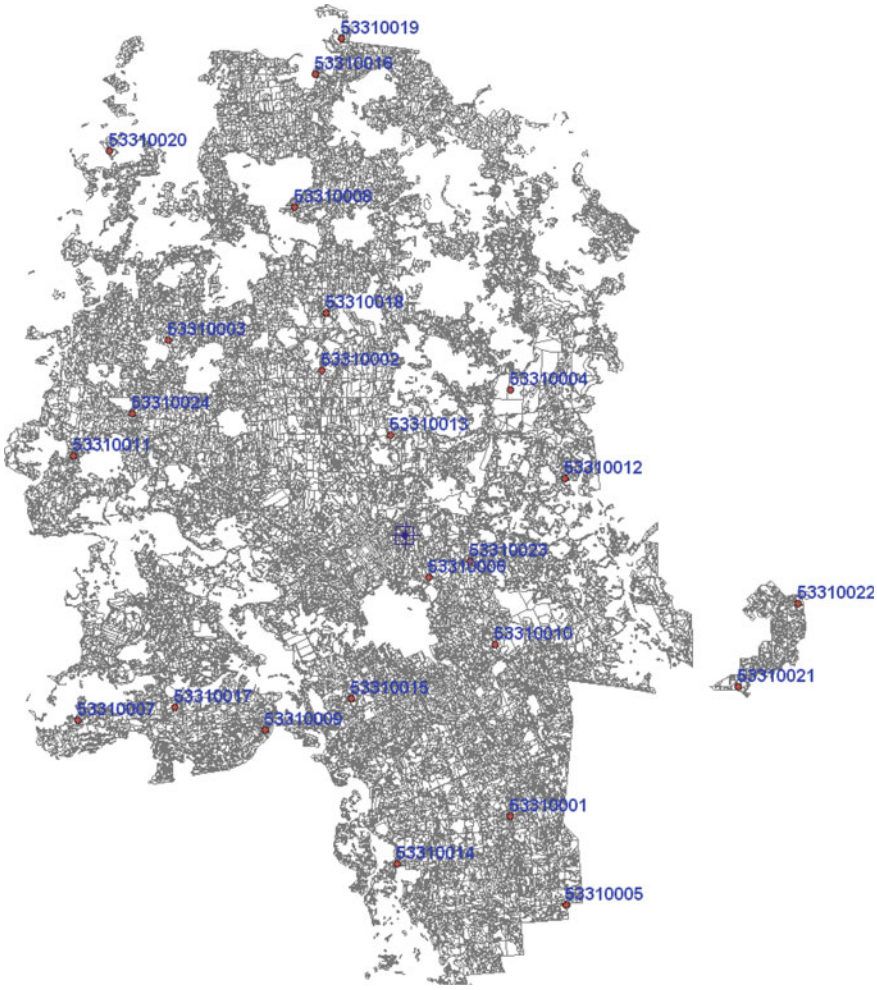

Fig. 38.2 Example of the placement of the permanent plots within an operational unit

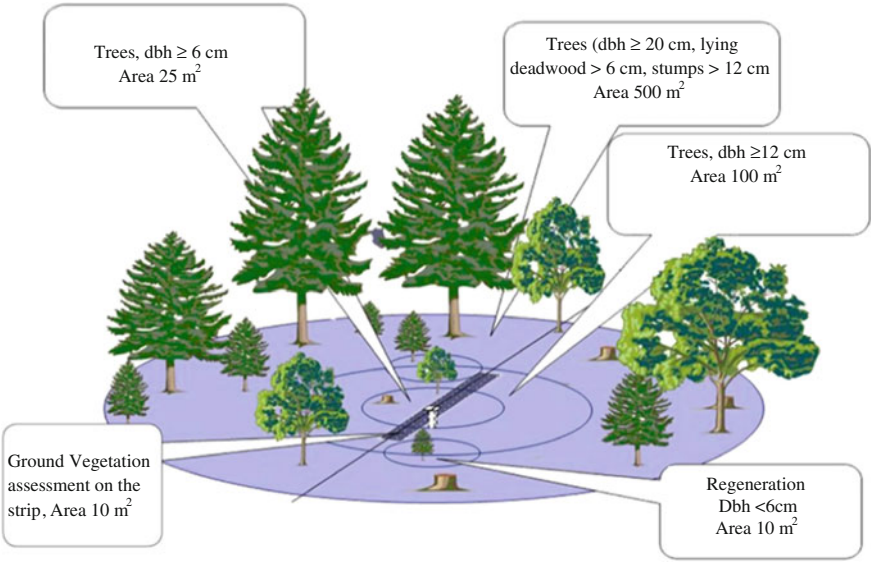

Fig. 38.3 Permanent plot layout of the National Forest Inventory

Table 38.1 Permanent plot details of the National Forest Inventory

Radius (m)	Area (m^2)	Threshold values of diameters of trees, stumps and lying dead wood, measured on separate concentric inventory circles
12.62	500	Trees with a diameter at breast height of 20 cm or more Lying deadwood wood with a diameter of 6 cm or more Stumps 12 cm diameter or more
5.64	100	Trees with a diameter at breast height of 12 cm or more Lying deadwood wood with a diameter of 6 cm or more Stumps 12 cm diameter or more
2.82	25	Trees with a diameter at breast height of 6 cm or more Lying deadwood wood with a diameter of 6 cm or more Stumps 12 cm diameter or more
1.78 two circles	20	Natural and artificial regeneration with a height of at least 0.2 m up to a diameter at breast height to 5.9 cm, young tree species and species of non-timber resources

Ground vegetation is assessed on a strip of 10 m in length and 1 m in width, passing through the centre of the plot in west-east direction

38.1.3 Data Collection

In total there are 117 different variables assessed and measured on the permanent plots, which can be divided into 8 categories:

- Plot and site data (ID plot; center plot co-ordinates; federal state; municipality; forest ecology zone; forest district; land-use type; ownership type; subject entitled for management and exploitation; forest enterprise; compartment identification, sub-compartment identification, area of forest compartment; forest designation category; forest protection category; type of inventory plot establishment; relief; aspect; slope; elevation; strata; site type evaluation, forest health status; biodiversity; forest vertical structure; canopy closure; forest stability; degradation of forest soil; management measures)
- Trees data including standing dead-trees (tree ID; co-ordinates; tree status; age; dbh; height; live crown base; fork; bread; IUFRO social status; tree ecological status; stem quality; living/dead tree information; tree top description; tree damage, location of the damage and damage intensity)
- Soil and ground vegetation data (erosion presence/absence; erosion type and intensity; soil type; soil structure; soil humidity; humus presence/absence; humus thickness; humus type; ground vegetation cover by different types of vegetation groups; ground vegetation cover of berry producing species; ground vegetation cover of medicinal species; ground vegetation cover of non-timber production tree species and shrubs)
- Forest diversity data (species diversity; species share; species distribution; tree distribution; dimensional diversity)
- Shrub layer data including non-timber tree species (species; height class; individuals count; average age)
- Forest regeneration data (regeneration presence/absence; regeneration vitality; height class; species, regeneration origin; individuals count; average age; average height; average diameter; damage type; damage intensity; number of damaged trees)
- Stumps and dead-logs data (dead-logs distribution; species; log length; log central diameter; log decay stage; rot type; stump height; stump diameter; time of cutting (classes); stump decay stage; rot type; rot intensity; branch cover)
- Stem profile and assortment structure data (stem form; stem profile; stem quality sections; stem branching and forking; stem damage)

The work on the permanent plots is performed by a unique technique using NFI software and measuring devices. The field equipment consists of a suite of instruments for high-precision measurements, a navigation equipment and integrated software (Fig. 38.4).

38.1.4 Data Processing, Reporting and Use of Results

The total sample of permanent forest plots in the Russian Federation consists of 82,500 permanent plots in forest. In accordance with the State's forestry development program, 80 % of the country's forest area is aimed to be surveyed by the NFI the year 2020.

Fig. 38.4 The field data measurement and equipment used in the NFI

For the calculation of the required number of permanent plots, the forest management database was used, which includes data about the distribution of growing stock in forests. The accuracy which should be achieved for total stock estimates was fixed to be between 1 and 5 %, depending on the intensity of forest use (Table 38.2). The accuracy ranges from 5 % in the Tundra region to 1 % in the EU and Southern Taiga parts.

The complete network of permanent plots has been completed for 19 constituent entities of the Russian Federation. For these, analytical reports on the state of the forests has been prepared. Table 38.3 shows the results of the calculations for the total growing stock based on the National Forest Inventory.

In addition to the information on growing stock, the reports from the National Forest Inventory include information on forest area, the wood quality, reforestation, soil cover, soils, non-wood goods from forests, biodiversity, carbon pools, forest ecological conditions and an assessment of the resource potential. The reports have been distributed to the state authorities, the scientific community and public organisations.

38.2 Land Use and Forest Resources

In 2015 the total area of forests was estimated to be 814,930,500 ha, representing 48 % of the global forest area (FAO 2015). The growing stock is estimated at 81.5 billion m3, with the an annual increment in excess of 1 billion m^3 per year

Table 38.2 Expected accuracy of total growing stock estimates (%) under the NFI by forest districts of the Russian Federation

The name of the forest district	Accuracy of stock estimates (%)
Tundra forests and sparse Taiga in the European Ural region of the Russian Federation	5
North-Taiga in the European part of the Russian Federation	3
Middle-Taiga in the European part of the Russian Federation	2
South-Taiga in the European part of the Russian Federation	1
Forests in the European part of the Russian Federation	1
Forest-Steppe in the European part of the Russian Federation	2
Steppe in the European part of the Russian Federation	2
Semi-Desert regions in the European part of the Russian Federation	5
North-Caucasian mountainous region	2
North-Ural Taiga region	3
Middle-Ural Taiga region	2
South-Ural steppe areas	2
West-Siberian Tundra forests and sparse Taiga regions	5
North-District of the West-Siberian Plain-Taiga	3
Middle-District of the West-Siberian Plain Taiga	2
South-District of the West-Siberian Plain Taiga	2
West-Siberian Forest-Steppe area	2
Central-Siberian Tundra forests and sparse Taiga area	5
Upland Central-Siberian Taiga region	4
Priangarskij Taiga region	2
Central-Siberian Forest-Steppe region	2
East-Siberian Tundra forests and sparse Taiga region	5
East Siberian Taiga region	3
Altai-Sayan Mountain-Taiga region	3
Altai-Sayan Mountain-Steppe district	4
Baikal mountain forest region	3
Baikal mountain-permafrost area	4
Baikal mountain forest region	3
East-Baikal Steppe area	3
Far east Tundra forests and sparse Taiga region	5
Kamchatka Taiga region	3
Far east Taiga region	2
Priamursko-seaside Conifer-Broadleaved Forest district	2
Far east Steppe region	4

(FAO 2015). The total growing stock by tree species group and for the regions where NFI data collection has been completed between the years 2007–2012 is presented in Table 38.3.

Table 38.3 Total growing stock by tree species group and for the regions in which NFI data collection has been done in years 2007–2012

Constituent entity of the Russian Federation	Total growing stock by tree species groups in million m^3				Accuracy of the total stock estimate (%)
	Total	Conifer	Broadleaved-hardwood	Broadleaved-softwood	
Altayskiy Kray	724.5	386.3	0.1	338.1	4.1
Bryanskaya oblast′	315.6	139.7	22.9	153.0	1.8
Vladimirskaya oblast′	318.5	165.2	11.7	141.6	4.0
Voronezhskaya oblast′	107.1	31.4	52.4	23.3	1.9
Jewish Autonomous Oblast	204.4	65.5	24.0	114.9	6.1
Kaluzhskaya oblast′	376.5	109.0	27.4	240.1	2.1
Leningradskaya oblast′	1270.8	666.7	2.7	601.4	2.0
Nizhegorodskaya oblast′	872.0	382.6	26.3	463.1	3.2
Altai Republic	701.4	570.7	0.0	130.7	6.2
Smolenskaya oblast	548.8	142.2	16.8	389.8	4.5
Tambovskaya oblast′	86.7	40.4	13.7	32.6	3.3
Tverskaya oblast	1047.6	475.5	8.9	563.2	1.8
Yaroslavskaya oblast′	417.1	149.5	0.9	266.7	4.0
Lipetskaya oblast′	45.1	18.2	13.3	13.6	2.8
Novgorodskaya oblast′	632.8	255.6	12.4	364.8	5.6
Orlovskaya oblast′	57.5	8.1	14.6	34.8	5.8
The Republic Of Karelia	1572.6	1122.7	0.0	449.9	2.0
Ryazanskaya oblast′	285.7	80.4	13.2	192.1	4.0
Tul'skaya oblast′	361.7	18.9	76.2	266.6	5.1

References

Anon (2014) Лесной кодекс Российской Федерации" от 04.12.2006 N 200-ФЗ, ред. от 21.07.2014, с изм. и доп., вступ. в силу с 01.03.2015. English edition: Anon (2014) The forestry code of the Russian Federation of 04.12.2006 N 200-FL, ed. 21.07.2014, as amended and in force since 01.03.2015

FAO (2015) Food and Agriculture Organization of the United Nations. Global forest resources assessment 2015: Main report. How are the world's forests changing? www.fao.org/forestry/fra. Accessed 4 Feb 2016

Order Rosleshoza—Приказ Рослесхоза (2011a) Об утверждении Порядка проведения государственной инвентаризации лесов, Зарегистрировано в Минюсте РФ 22.07.2011 N 21452. English edition: Order Rosleshoza from 06.06.2011 N 207 approving the procedure for National Forest Inventory, registered in Ministry of Justice of the Russian Federation 22.07.2011 N 21452

Order Rosleshoza—Приказ Рослесхоза (2011b) Приказ Рослесхоза от 10.11.2011 N 472, ред. от 07.05.2013, Об утверждении Методических рекомендаций по проведению государственной инвентаризации лесов. English edition: Order Rosleshoza from 10.11.2011 N 472, ed. by 07.05.2013, approving the methodological recommendations for the National Forest Inventory

Resolution of the Government of the Russian Federation (2014) Постановление Правительства РФ от 15.04.2014 N 318 - Постановление Правительства РФ от 15.04.2014 N 318 (2014) Об утверждении государственной программы Российской Федерации Развитие лесного хозяйства на 2013–2020 годы. English edition: On approval of the State Forestry Program of the Russian Federation in the years 2013–2020?