VIRGIN FORESTS OF BULGARIA

- inventory and strategy for sustainable management and protection of virgin forests –

September 2005

Royal Dutch Society for Nature Conservation

Bulgarian Forest Research Institute

This project was funded by the PIN/MATRA fund of the Ministries of Agriculture, Nature and Food Quality and Foreign Affairs

Paraganlica virgin forest Bulgaria

Inventory and strategy for sustainable management and protection of virgin forests in Bulgaria

PIN/MATRA/2002/011

Authors:

Ivan Raev (ed)

Boyan Rosnev

Alexander Alexandrov

Emil Popov

Grud Popov

Todor Lubenov

Hristo Tsakov

Plamen Mirchev

Maria Glushkova

Zdravko Vasilev

Geko Spiridonov

Review:

Jacques de Smidt

Josef Fanta

Bert Maes

Peter Veen

This report can be downloaded from website: www.veenecology.nl

ISBN: 954-9746-11-9

Pirin Mountains: Pinus heldreichii forests

Table of Contents

1. Introduction

The contract PINMATRA/2002/011 concerning "Inventory and strategy for sustainable management and protection of virgin forests in Bulgaria" between Royal Dutch Society for Nature Conservation (KNNV) and the Forest Research Institute of the Bulgarian Academy of Sciences (FRI-BAS) was signed in 2002. The term of validity of the contract covers the period 1 October 2002 – 30 September 2006. This project was funded by the International Nature Management Program MATRA of the Dutch Ministries of Agriculture, Nature and Food Quality and of Foreign Affairs.

The main objective of the project is long-term conservation of virgin forests, which means forests of autochthonous tree species on the territory of Bulgaria, that have retained to a high extent their primary properties.

The tasks to be implemented in the framework of the project for attainment of this objective are:--

- To work out criteria and indicators for selection of virgin forests;
- To work out criteria and indicators for assessment of virgin forests;
- To explore and identify virgin forests in Bulgaria;
- To provide description of the environmental conditions underlying the formation of virgin forests;
- To provide description of forests classified as virgin forests with a focus on biodiversity, types of forests and sustainable management practices;
- To map virgin forests by geographic regions and total for Bulgaria on the basis of field studies and satellite images, topographic and economic maps;
- To work out a conceptual paper concerning a strategy for conservation of virgin forests in Bulgaria;
- To raise the awareness of the need of concerted efforts for protection and reasonable management of virgin forests in Bulgaria among broad circles of stakeholders;
- Recommendations on monitoring and future research.

The implementation of the project was a joint effort of experts from The Netherlands and Bulgaria:

- Project leaders: Dr.Peter Veen and Prof. Ivan Raev;
- Steering Committee: Dr. Peter Veen (KNNV), Dipl. Eng. Stoycho Byalkov, M.Sc. (Ministry of Agriculture and Forests) and Prof. Ivan Raev (FRI-BAS);
- From The Netherlands: Dr. Peter Veen, prof. Josef Fanta, Dr. Jacques de Smidt, Dr. Bert Maes;
- From Bulgaria: Prof. Ivan Raev and Boyan Rossnev, Deputy Leader;
  Researchers Group I: Dr. Grud Popov (Group Leader), Dr. Emilia Velizarova, Dr. Georgui Hinkov, Ms. Silvia Koynarliyska, Research Fellow, Ms. Veronika Ferdinandova, Research Fellow, (partial involvement) and Mr. Dimitar Dimitrov, Research Fellow, (partial involvement);
  Researchers Group II: Academician Alexander Alexandrov (Group Leader), Dr. Hristo Stoykov, Dr. Georgui Ts. Georgiev, Dr. Zdravko Vassilev (partial involvement), Mr. Georgui Ts. Georgiev, Research Fellow, (partial involvement) and Mr. Velichko Kolev, M.Sc. (Eng.);

Researchers Group III: Prof. Ivan M. Marinov (Group Leader), Dr. Plamen Mirchev, Dr. Emil Popov, Dr. Sotir Glushkov and Dr. Ivan Ts. Marinov (partial involvement);
Researchers Group IV: Prof. Hristo Tsakov (Group Leader), Dr. Peter Petkov, Dr. Rumen Petrin, Dr. Tsvetan Zlatanov and Dr. Roman Efremov;
Group V (GIS): Mr. Todor Lyubenov, Research Fellow (Group Leader), Dr. Ivan Ts. Marinov;
External expert: Zheko Spiridonov, Nature Fund;
Technical assistants: engineers, technicians and officials from FRI-BAS and Dr. Galia Bardarska (Institute of Water Problems-BAS); accounting: Nedyalka Yotsova and the team of Department Finances of FRI-BAS; driver of the jeep for field trips, delivered in the framework of the project: Borislav Petrov.

In the process of preparation of the Project Proposal letters of support were received from the Dr. Miglena Plugchieva, Vice-Minister of Agriculture and Forests, Mrs. Fathme Iliaz, Vice-Minister of Environment and Water, and Academician Ivan Yukhnovski, President of the Bulgarian Academy of Sciences. In the course of the project the research teams obtained full support from the regional forest management administrations, the state forestry enterprises (SFEs), the state game breeding stations (SGNSs), the directorates of the national and nature parks and from the Executive Environment Agency. There was a very good interaction with the *Agrolesproject* Sole-proprietor Joint-stock Company.

Thanks to the financial support under the MATRA Programme of The Netherland's Government and the close collaboration with these institutions we were able to achieve good results from the research effort.

The researchers were split into four groups and each investigated a different part of the mountains:

- Researchers Group I: the Western Balkan range, the southern slopes of Rila Mountain and Strandzha Mountain;
- Researchers Group II: part of the Central Balkan range, the northern slopes of Pirin Mountain and parts of Rhodopes Mountain;
- Researchers Group III: part of the Central Balkan range, Sredna Gora Mountain, the southern slopes of Pirin Mountain, Ossogovo Mountain and the southwestern border mountains;
- Researchers Group IV: the Eastern Balkan range, the northern slopes of Rila Mountain, Vitosha Mountain and parts of the Rhodopes.

A representative survey among all stakeholders was conducted in the period 2004-2005 to review the future management and protection of virgin forests in Bulgaria. A methodological training course was conducted in 2003 for the team in the Rila Mountain. A public review after the 2-year studies was organized in 2004 in which the Executive Environment Agency was involved. On 20 September 2005 a final workshop was held, organized by FRI-BAS, with all participants and a broad circle of stakeholders, including Mr. Yordan Dardov, Vice-Minister of Environment and Water.

During the three years of the project on virgin forests in Bulgaria a number of interviews were broadcasted on the *Horizont* and *Hristo Botev* radio stations, special emissions were realized on *7 Dni* TV Programme in the *EcoKambana* (Eco-bell) series. Several articles were published in the *Gora* (Forest) Magazine and daily and weekly newspapers. Information on the project was posted on www.gwpbg.org. All this contributed to broader publicizing of the objectives of and results from the project.

2. Forests in Bulgaria in the past and today

2.1. A short history

The presence of vast old forests in Bulgaria is told in historical data from the end of the14-th to the 19-th century. Thy covered the Sofia field (according to Lala Shakhin pasha), and the beech forests in Vitosha mountain.

In the19-th century Boué, Kanic and Jireček gave detailed descriptions of forests are more detailed. They mention oak and beech forests in Central Balkan range; oak forests in Strandzha mountain; pine, fir, spruce and beech forests in Rila mountain and vast forests in the Rhodopes.

From the 16-th to the 19-th century forests gradually decrease. This process is due to the increasing demand for wood and charcoal as energy source. The Turkish army developed the melting of iron ore in the Rila-Rhodopes massif, along the rivers Iskar, Struma and Mesta, in the western outlying of Kyustendil and Tran, as well as in Balkan range – Tchuprene, Etropole and Troyan ridges. Also for the heating of Istanbul large quantities of firewood and charcoal have been produced in the 19-th century in Strandzha mountain, Eastern Balkan range and Eastern Rhodopes.

The exploitation of forests was developed on a large scale during the Crimean War (1853-1856). This was continued for the construction of telegraph and railroads (Constanța – Cernavodă, Ruse – Varna, Edirne – Belovo), and for export leading to over-exploitation of Eastern Rila mountain.

After the Liberation (1878) the fast development of industry, small-scale farming, trade and transport increased demand for timber, firewood and .converting forests into arable land.

The complex of wars: Balkan (1912-1913), Inter-Alliance (1913) and First World War (1914-1918) were the direct reason of forest fires and lead to illegal exploitation of forests due to the disintegration of society.

The political and economic changes after the Second World War (1941-1945) lead to the nationalisation of forests, intensive cutting and large-scale afforestation, fast development of the road network in forests, access to formerly inaccessible forest massifs and their use. brought to increasing of the increment of forests through New afforestations were connected to these activities. These, however, were another cause of reduction of the autochthonous and old forests.

2.2. Structure and function of the forests

Area, property and condition

The area covered by forests is 3551.5 thousand ha, which is 30 % of the total territory of the country. From them 1123.7 thousand ha are coniferous and 2427.8 thousand ha – broadleaved. The natural forest ecosystems cover an area of 2254,9 thousand ha and the plantations (artificial forests) – 1296,6 thousand ha.

After 1989, previously nationalized forests were partly given back to their former owners (private forest owners, municipalities, monasteries, etc.). The ownerships were (after Agrarian report of the Ministry of Agriculture and Forests, 2004):

- state forests – 79,54 %;
- private persons – 9,74 %;
- religious communities – 0,55 %;
- municipalities – 9,97 %;
- other legal bodies– 0,20 %.

Structure and age

The structure of the forests show a great variation. The broadleaved forests predominate – they cover 68,4 % of the total area, and the coniferous - 31,6 %.

The species composition of forests is very rich, which is a result from their particular situation The biogeographic position between the Mediterranean, Steppe and European broadleaved forest areas and from sea level up to 2900 m explains the great diversity in species composition. Also the variety in relief and of basic rocks that contributed to the variety of soils and the wide range of hydrological conditions, have established ecological niches for rich biological diversity, including trees and shrubs. The geoghraphic belts are well formed The influence of man is mainly depending on their accessibility.

The most widely spread tree species in Bulgaria are the members of the genus oak – 32,2 % of the forest area from the plains up to 600-700 m, followed by the beech – (16,9 %) in the zone from 600 to 1200-1300 m.

In the coniferous forests the largest area is covered by the Scots pine (Pinus sylvestris)– 16,5 %, followed by the Austrian black pine (Pinus nigra) – 9,3 %, Norway spruce (Picea abies) – 4,6 %, silver fir (Abies alba), Macedonian pine (Pinus peuce), mountain pine (Pinus mugo) – 1 % and 9,5 % other broadleaved and coniferous tree and shrub species.
The natural coniferous forests are situated in the higher mountain parts – from 600-700 up to 2200 m.

The forests of Austrian black pine in Slavyanka mountain; Scots pine in Northern Rila mountain, Pirin mountain and the Rhodopes; Norway spruce in the Rhodopes and Rila mountain; Macedonian and Heldreich pine (Pinus heldreichii) in Rila mountain, Northern Pirin mountain and Slavyanka mountain are unique.

The age structure of forests has been significantly changed in the last 50 – 60 years. The average age of the conifer forests towards 2004 is 42 years, of the broadleaved high-stem forests – 67 years and of the coppice ones – 48 years.

Functions

The three main functions of the forests are:

- basic timber-production and environmental functions – 65,9 %;
- recreation and protection against erosion, wind and snow.– 26,6 %;
- conservation of nature _- 7,5 %.

The nature reserves include 6 categories (according to IUCN), i.e.: reserve, national park, natural monument, maintained reserve, nature park, protected locality. The total area of the protected nature territories in Bulgaria amounts to 578,875 ha or 5,22% of the territory of Bulgaria (Raev, Dimitrov, 2005).

The mountain pine forest formations, which grow over 2000 m a.s.l., form the first forest barrier against strong winds and prevention from huge quantities of snows and waters, which are slowly absorbed and feed the underground runoff of rivers.

Biodiversity and gene pool

The majority of biodiversity in Bulgaria finds its natural habitat in the forests. This applies in particular to the protected territories and to the forests in inaccessible closed basins.

Other areas of great species richness are the floodplain forests in the lower course of the rivers Kamtchiya, Ropotamo, Veleka, etc., and the vast oak forests in Eastern Balkan range and Strandzha mountain. In these mountains are primary forests of *Quercus petraea* Liebl., *Q. frainetto* Ten., *Q. cerris* L., numerous Mediterranean shrub species like *Quercus ilex* L., *Q. coccifera* L., *Rhododendron ponticum* L.and many herbal species.

The Central Balkan National Park and the reserves Boatin, Tsaritchina are survival areas of the authentic beech forests in Europe. They are the gene pool to be used for restoration of this forest ecosystem in Bulgaria and surrounding copuntries.

Coniferous forests with complete autochtonous biodiversity and gene pool are found on vast areas in Rila, Pirin mountains and the Rhodopes. The highest Norway spruce and silver fir trees in Europe, reaching up to 62 m, grow in the reserve Parangalitsa. The Macedonian and Heldreich pine ecosystems do still exist in Pirin and Slavyanka mountains. Particularly famous is the *Pinus leucodermis* Ant. specimen growing in Pirin mountain, which is more than 1300 years old (the so-called Baykusheva mura in Banderitsa area, Pirin mountain).

Rila, Pirin and Slavyanka mountains are rich in biodiversity, particularly in the forests of *Pinus nigra* Arn., *P. silvestris* L., *P. leucodermis* Ant., *P. peuce* Grisb., *P. mugo* Turra, etc. .

Totally there are 15 coniferous and 344 broadleaved tree and shrub species in forests of Bulgaria, which are preserved and grow well. The Bulgarian flora includes between 3250 and 3750 higher plants in 130 families and 872 genera (Peev et al., 1993). Besides, there are 170 species of angiosperm plants, 100 subspecies and about 200 Balkan endemic plant species and subspecies (Atlas of the Endemit Plants in Bulgaria, 1992).

The animal biodiversity in Bulgaria is also rich – 22 species of reptiles, 405 bird species, 94 mammal species and 210 fish species in rivers.

All this biotic variety is preserved on a relatively limited territory – in reserves, national and nature parks and inaccessible natural forests. Considerable genetic capital has been preserved also in forests used as seed bases and in watershed areas.

3. Definitions of virgin forests. Criteria for selection and assessment

3.1. Methods for inventory of virgin forests

Definition of virgin forest

The definition of virgin forest used in the project is:

Virgin forest is a natural woodland where tree and shrub species are in various stages of their life cycle (seedlings,young growth, advanced growth, maturity and old growth) and as dead wood (standing and laying) in various stages of decay, thus resulting in a more or less complex vertical and horizontal structure. This is the expression of continuous existence without limit in time.

The dynamics of the virgin forest is determined by the ecological properties (such as longevity) of the dominant species, by the impact of other organisms (such as the outbreaks of phytophagous insect species) and by the impact of abiotic factors such as wind, snow, flooding and fire. As an effect, treeless stages may occur in gaps or on larger surface.

Within the concept of virgin forest, variants occur caused by their position in different biogeographic zones (macro climate), above sea level (local climate), topography (micro climanat) and the availability of nutrients and water. These variants show characteristic composition of species and spatial structure.

Criteria for selection and assessment of virgin forests

Naturalness

According to Biriş, Radu, Donița, (2001) the degrees of primarity, naturalness and authenticity are synonyms

The naturalness is a basic indicator for the presence of virgin forest. It is determined by:

- the natural origin of the tree, shrub and herb vegetation;
- absence of human activity or only slight traces of activity some 40-50 years ago expressed through incidental cuttings, mechanical damages, grazing of animals in the past, etc.;
- age structure of the stands: presence of old trees and of trees or groups of trees of different ages, result of natural influences and succession processes;
- the presence of endemic species. This increases the value of the forests but is not an obligatory indicator;
- the vegetation in good health status (the presence of dry or fallen trees as a result of natural influences should be considered natural);
- presence of typical mammals and birds.

We accept the indicator for a degree of naturalness as suitable and basic for assessment of the forests. This indicator will clearly distinguish the investigated forests.

Minimal area

This is a very important indicator on which depends the opportunity to preserve a virgin forest from influence and to let the natural processes flow normally .
According to Heiss (after Biriş et al., 2002) "only territories with enough large area can stand for long periods of time the anthropogenic influences and the natural damages or damages caused by human activities. A large territory can compensate the lack of naturalness but the naturalness cannot compensate the size when it is necessary to protect the ecological system".
The size of the natural forest should be conformed to the proximity of the dangers threatening its natural existence – proximity to settlements, region of occurrence – low-mountain, medium-mountain, high-mountain, as well as its accessibility.
The minimal areas for the different types of forests were determined as follows:

- deciduous forest - 30 ha
- coniferous forest - 20 ha
- mixed forest - 25 ha

Forests with smaller territories are nevertheless described if they are considered that they must be preserved as virgin forests for special reasons, e.g. as stepping stone or gene pool.

Age structure

The age structure is an important element. The presence of trees with exceptional age and sizes in mixture with trees at different stages of development of the succession processes is typical and an almost obligatory element of the virgin forests.

The maximum age differs per tree species depending on its longevity and the site.
For the conditions in Bulgaria the minimal age of the "mature" and "venerable" trees is estimated to be 100-120 years. Stands with groups of younger age are accepted when they represent stages from the development of the natural forest ecosystems.

Natural boundaries

The virgin forests should preferably be protected by sustainable natural boundaries. These could be watersheds, gorges, rivers or ravines. In the lower and medium forest vegetation zones and in the plains buffer zones of at least 50-100 m. can durably protect the forest from threats mainly of anthropogenic character.

Tables with criteria and parameters for selection and assessment of virgin forests

Table 3.1

A. Criteria for selection of virgin forests

A1. Naturalness
- natural tree vegetation
- absence of human activity
- absence of human activity in the last 40-50 years on at least 90% of the territory
- variety of trees according to size
- presence of fallen, standing, dry (dead) and semi-dry trees
- presence of typical mammals and birds

A2. Age structure
- presence of variety of trees and shrubs according to age
- presence of big-sized (venerable) trees

A3. Boundaries
- presence of natural boundaries

Table 3.2

B. Parameters and indicators for ecological assessment of virgin forests

B 1. Parameters for assessment of the structure of the ecosystems

B 1.1. Degree of naturalness

B 1.2. Composition of the tree stand (diversity)

B 1.2.1. Presence of protected plant species

B 1.2.2. Presence of endemic species

B 1.3. Age structure

B 1.4. Area and compactness
B 1.5. Variety of types of forests
B 1.6. Variety of mammals and birds
B 1.7. Natural boundaries

B 2. Parameters for the functioning of the ecosystems

B 2.1. Presence of succession processes (stability of the ecosystem)
B 2.2. Health status (assessment on the basis of present damages - defoliation, yellowing of leaves (needles), mechanical damages as a result of abiotic and

biotic factors)
B 2.3. Threats for the ecosystems and biodiversity

B 3. parameters for the accessibility, relief and buffering

B 3.1. Accessibility (assessed according the possibilities for access)

B 3.2. Inclination of the terrain
B 3.3. Buffer zones

B 4. Parameters for scientific and educational potential

B 4.1. Level of information (after information of the forest management plans, management plans and scientific publications)
B 4.2. Possibilities for educational activity
B 4.3. Possibilities for utilisation like gene pool

3.2. Method of inventory

General issues

There are 90 reserves in the country with a total area 80,901 ha (some of the closed basins are in the reserves). There are 3 national and 10 nature parks on a territory 193,048 and 260,073 ha respectively. The human activity in some of the nature parks is high (Raev, Dimitrov, 2005). Due to this reason only part of these territories fit the criteria for virgin forests.

Stages of the inventory

The field activities were carried out in 2003-2005 and the following work was done:

1. Forming working groups composed of 4 to 7 specialists in the field of silviculture, inventory, entomology and phytopathology, ecology and phytocoenology.

These teams investigated: the Balkan range and Sredna gora Mt. (2003); Rila Mt., Western Rhodopes and the mountains in South-West Bulgaria (2004); Eastern Rhodopes and Strandzha Mt. (2005).

2. Each team was provided with:

- a map 1:25 000 with sections and subsections;
- a topographic map 1:25 000;
- satellite image of the region 1:25 000;
- information from the forest management plan about the territories, which will be investigated, with data about each ecosystem;

- roulette (20 or 50 m), instruments for measurements of the height and diameter of the trees in the polygons;

- GPS-apparatus for determination of the altitude above sea level and the geographic co-ordinates of the sample plots.

3. Preliminarily obtained information:

- from satellite images, giving the idea about the presence of such forests;

- from questionnaires by specialists in the state forest enterprises about the presence of closed basins, their situation and area, watershed areas and seed bases;

- about the situation of reserves, national and nature parks and the available forest ecosystems according to forest management plans.

4. Field measurements:

- the route method is used;

- the type of forest is described, on each area over 0,5 ha and is drown on the map 1: 25 000;

- a note-book is filled, to decide if the forest fits with the criteria for selection (see "Instructions for inventory of the virgin forests in Bulgaria", Sofia, 2002);

- when the requirements are fulfilled a note-book is filled, to characterise the structure and functioning of the ecosystem. It contains data about the tree species, understorey and shrubs (the assessment of all indicators is by sight). Data are collected about the undergrowth (species; average, maximal and minimal height; coverage – assessment by eye in %). The herb vegetation is described by species and occurrence, using the enclosed list (Instruction, 2002);

- the type of forest is described after the typological classification of Penev et al. (1969). The list of the basic forest types in Bulgaria is given (Instruction, 2002);

- in each forest type, a sample plot 100:10 m is established on a representative place and described;

- photographs of venerable trees or typical landscapes are taken.

5. Comparison of the field data with the preliminary data for selection and assessment of the ecosystems and with those from the satellite images and their exact plotting on the maps.

6. Presentation of all field data and documents according the requirements of the project for processing and plotting of the forests in GIS.

Different densities

Density of the forest is on many sites not homogeneous because of the strongly rough mountain terrains, where the virgin forests are situated, their compactness according to composition and types of sites. It was decided to include forests only if they have an area of more than 1,0 ha.

Three types of forest density were distinguished:
1. *Homogeneous in density*) (figure 3.1).
2.Heterogeneous in density The composing areas must also exceed 1,0 ha to be described separately (figure 3.2).

3**.** *Fragmented forest* –The forest contains areas larger than 0,5 ha without tree vegetation (rocks, glades, etc.) (figure 3.3).

Typological classification

The typological classification of the forests developed by Penev et al. (1969) was used. This includes the description of the types of forests, based on the species composition, the soil fertility and the productivity of the tree stands.
The climate is the domant ecological factor for these types. This results in four forest vegetation zones in Bulgaria: of the oak forests, of beech-coniferous forests, of spruce-Macedonian pine forests and of dwarf pine formations. Each zone is divided into sub-zones and regions, first of all on the basis of the climate (horizontal and vertical), secondly on the type of soils and their fertility.

In each zone, indicator plants are used, the productivity of the main tree species, their presence or absence, as well as the relief as re-distributor of the soil variety and moisture, warmth and light, to determine the type of forest as a complex indicator.

The 35 types of forests are identified by means of the tree and herb species composition, the zones and regions and the types of sites.

Realisation and description of the sample plot
The sample plot of 100:10 m (1000 m^2), is most often orientated along the length of the slope and is representative for the predominating types of ecosystems (figure 3.4). The co-ordinates of one corner are recorded by GPS-apparatus, as well as the north direction.

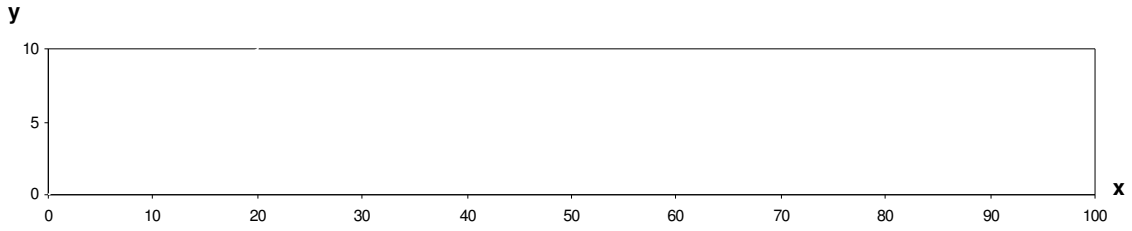


Figure 3.4. Form and size of the sample plot

From the sample plot are described:

- all tree species and, if possible, the diameters are measured at 1,3 m;
- the average height of each tree species by eye or by special instrument;
- the species composition and cover percentages of the canopy
- the species composition and cover percentages of the understorey;
- the species composition and cover percentages of the herb layer
- the cover percentage, age and height (min-max)of the undergrowth;
- the occurring mosses;

- the type of forest according to the classification of Penev et al. (1969).

Working method of the GIS-group

All geographic and tabular data collected from remote sensing images and in the field are by the stored by the GIS specialist in geodatabase (GDB). The GDB is designed, developed and created for this project. The GDB is produced with MS Visio Professional 2000 using UML 2.0 standard according ESRI's data model template. GDB is created in MS Access 2003 environment. Filling, editing and analyzing of data were completed in Arc GIS 9.0 with Service Pack 3. For the project dissemination purpose is developed a lot of projects for free ESRI viewer ArcReader 9.0.

The GDB is organized in two core geo objects – main geographic layers and feature aimed data. The main geographic layers are administrative boundaries (regions, municipalities, settlements); populated places; transportation network of the country (roads, rail roads); relief (relief raster was processed form Satellite Radar Topography Mission /SRTM/ - NASA mission); water bodies; river network; Corine Land Cover CLC2000. Main purpose of these layers Feature aimed data is focused on virgin forest location and attribute information in it. In GDB are stored unique identifiers for every element of virgin forest. Geo data for the virgin forest are organized into two feature layers and fifteen tables. GDB schema is posted on figure 5.

Data on virgin forest are analyzed on main indexes as: slope, aspect, elevation, forest belts, age, forest types and main tree species.

In total 12 maps are designed and printed for the whole territory of Bulgaria. These maps include data for location and boundaries of the virgin forests, relief, hillshade, land cover, administrative boundaries, roads, rail roads, water bodies, river network, populated places.

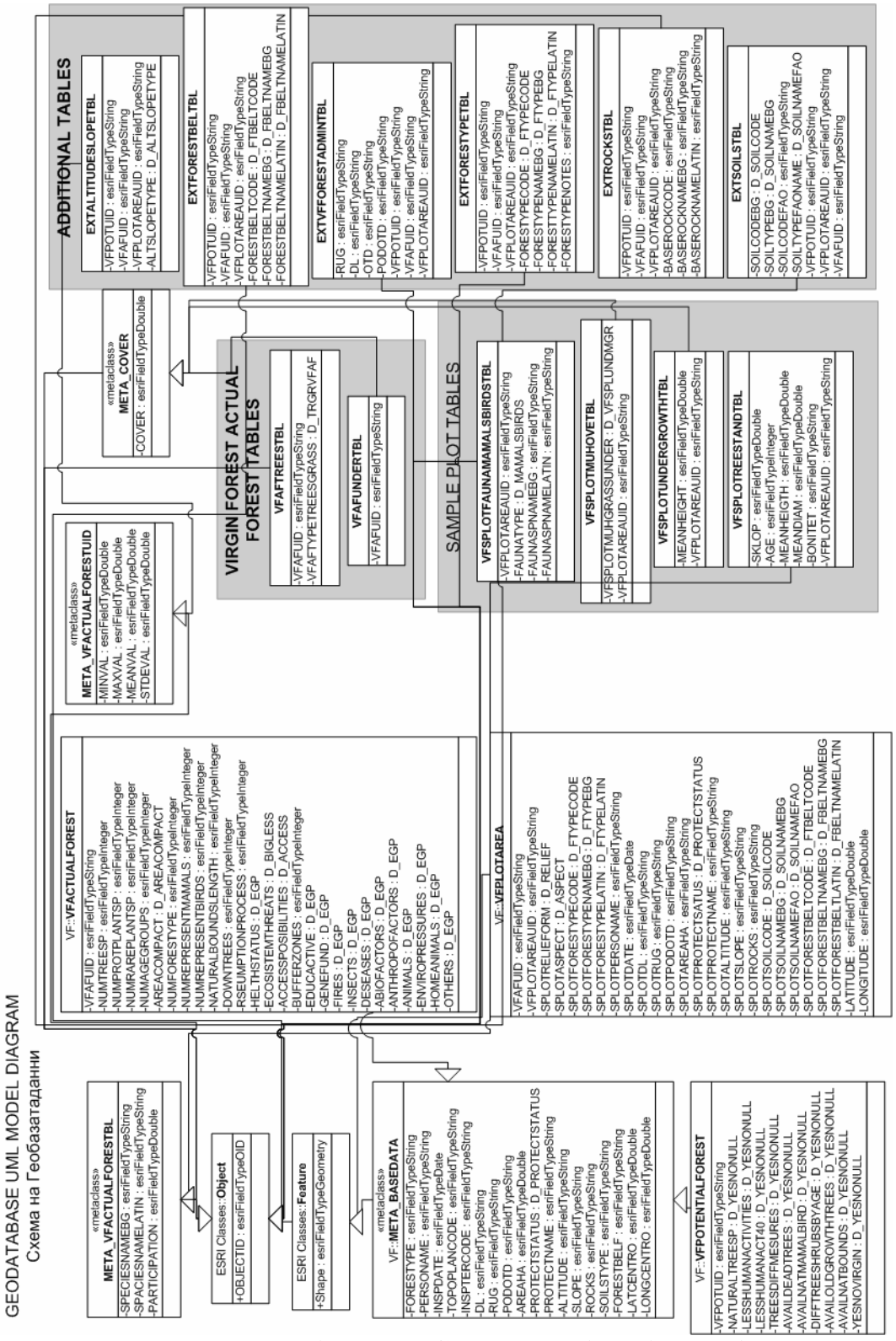


Figure 3.5. Geodatabase inheritance diagram

4. Virgin forests in the Balkan range

4.1. Physical and geographic characteristics

The Balkan range is orientated from west to east, starts at the Belogradchik Pass, traverses Bulgaria lengthwise and reaches Cape Emine on the Black Sea. It is divided in three parts: Western - up to the Zlatishki Pass, Central – from the Zlatishki Pass to the Vratnik Pass, and Eastern – up to Cape Emine on the sea coast. The Central Balkan is the highest (Peak Botev, 2376 m a.s.l.), the Western Balkan reaches an altitude of 2168 m (Peak Midzhur) and the Eastern Balkan is lower and traversable (Mishev et al., 1989).

The Balkan range is characterized by its long and gentle north slopes, which create much better environmental conditions for forest vegetation than the steep south slopes.

The main geological formations in the high-altitude parts of the Western and Central Balkan are diabasphylytoid formation and granitoides of Paleozoic age in the cores, and carbonate rocks of Trias, Jura and Low-Cretacean age in the mantles (Yordanova et al, 2002).

The Balkan range has a temperate continental climate. It represents a natural barrier for the dominant northwestern winds and causes additional condensation and increase of rainfalls. For this reason the cloudiness here is higher, winds are the strongest, and the precipitation rate is the highest as compared to the other mountains: the rainfall for the altitude belt of 1200-2376 m varies from 1031 to 1363 mm (Climate Directory, 1990). The maximum rainfall occurs during the spring-summer season, which is a proof of the continental nature of their distribution. The months with the highest rainfall rates are May and June and the driest month is February. In the lower parts of the mountain the precipitation rates are about 700 mm, at an altitude of 1200 m. – about 1000 mm and at the high altitude parts – up to 1400 mm. Snowfall accounts for about 30% of the annual precipitation and the continuity of the snow cover is from 40 to 180 days. It is worth noting that on the wind-exposed north slopes the rainfall is by some 100-150 mm higher than on the south slopes at the same altitude. This gives a certain advantage to the northern slopes, which are better provided with moisture (Climate Directory, 1990).

The mean annual air temperature varies from 8.0^{o}C in the mountain skirts to -0.7^{o}C at Peak Botev. The January temperature is -1^{o}C on the average in the mountain skirts and reach -9^{o}C at Peak Botev. The July temperature is in the range of 21^{o}C to 7.5^{o}C (Climate Directory, 1983).

Northwestern winds predominate, followed by northeastern and southern winds. On the mountaintops the average annual wind speed is about 10 m/s and is the highest countrywide (Climate Directory, 1982).

The river runoff varies from 240 – 300 mm in the lower parts of the mountain to 500 – 600 mm at 1500 m a.s.l. on the north slopes. The runoff along the south slopes is smaller by some 120–150 mm because of the difference in rainfall and in evaporation rates. Ground water accounts for about 40% of the river runoff in the summer. The rivers run in south-north direction and are right hand tributaries of the river Danube. The more important among them are Archar, Lom, Ogosta, Iskar (which takes it source from Rila Mountain), Vit, Osam and Yantra. The rivers Stryama, Tundja and some other smaller rivers run along the south slopes of the mountain. The maximum runoff through the year is in April and the minimum in September. The same applies for the rivers collecting waters from the south slopes of the mountain (Penchev et al., 1989).).

The so far described characteristics refer above all to the Western and Central Balkan. To the east of the Vratnik Pass the Balkan range becomes gradually lower, it splits into two ridges and descends to the sea level.

Sandstones and marls of Low-Cretacean origin predominate. The climate is temperate continental and to the east, in the direction of the Black Sea, it becomes ever milder. The mean January temperature varies from –1.0°C to 2.0°C in the sections at the seaside. The mean annual temperatures vary from 11.5°C to 12.5°C along the seaside. The rainfall is about 500-600 mm, increasing with the higher altitude to 600-700 mm (Climate Directory, 1983).

Northern and northeastern winds predominate. Along the coastline sea breezes are typical in summer. The water bearing capacity of the river system in the area is by some 120-180 mm lower than that characteristic for the rest of the mountain.

Along the north slopes of the Western and Central Balkan mainly *District-Eutric Cambisols* have been identified, which below 800 m.a.s.l. change into *Grey luvisols*. Towards the upper boundary of the forest the *District-Eutric Cambisols* are replaced by *Umbric Cambisols*. The *District-Eutric Cambisols* are widely spread. They begin at about 700-800 m a.s.l. and go up to 1600-1700 m a.s.l. and have a decisive importance for the forest ecosystems in the mountain. Gradients from 10° to 35° predominate, however in some of the reserves they go up to and above 45°. The zone of *District-Eutric Cambisols* in the Balkan range is composed of sandstones, clay schists, limestone sandstones, limestone, and to a lesser extent granites and syenite. The humus-accumulating horizon (A) is of a lesser depth (about 20 cm). The transitional horizon (B) is deep, hard to identify. For this reason these types of soil go down to a depth of 1-1.5 m (horizon A + B). They possess a relatively light mechanical composition, good porosity and high productivity (Grozeva, 1997).

Along the northern slopes below 800 m.a.s.l. *District-Eutric Cambisols* change into *Grey luvisols*, which results in lower porosity and poorer fertility. In the Balkan range *Umbric Cambisols* are spread above the belt of *District-Eutric Cambisols*, i.e. above 1600-1700 m up to 2200 m a.s.l. They are developed on granite, diorite and gneiss. They possess high humus content, however they are shallower. Their skeleton content is also high. They are neither so rich, nor so deep as the *District-Eutric Cambisols*.

Chromic Luvisols are formed along the southern slopes of the mountain below 700-800 m. Similar to the *Grey luvisols* they concede to the *District-Eutric Cambisols* in terms of richness, although on flatter sites they possess high fertility. Farther up towards the ridge of the Balkan range the sequence of *Chromic Luvisols* layers is very similar to that along the northern slopes.

As far as the Eastern Balkan is concerned, the soils there represent a combination of *Grey luvisols* along the northern slopes, *District-Eutric Cambisols* in the parts of higher altitude and *Chromic Luvisols* along the southern slopes of the Eastern Balkan.

4.2. Forest vegetation in the Balkan range

Biogeographic regions

Two main biogeographic areas with different forest vegetation can be distinguished in the Balkan range, based on climatic differences (Velchev, 2002):

1. Mediterranean- nemoral type forests, with broadleaved evergreen tree species;

In the lower parts of the mountain, up to about 700 m a.s.l., formations of *Quercus cerris* and *Quercus frainetto* are well represented. They prefer higher air temperatures and lower precipitation. These tree species represent the xerophyte vegetation. Since human settlements are often situated in their vicinity, they are strongly affected by anthropogenic activities.

Farther up, from 600-700 m to 900-1000 m a.s.l., the formations of *Quercus delechampii* and of *Carpinus betulus* are spread. They require higher precipitation and richer soils. These are Mesophyte formations. Some locations are well preserved, particularly in the protected nature areas. A large portion of these forests is mixed with other broadleaved tree species, as a transition to forests that require higher precipitation rates.

The formation of *Fagus sylvatica* follows above the formations of *Quercus delechampii* and *Carpinus betulus*. This is the most common forest formation in the Balkan range. It forms a continuous belt of forest communities at the altitude from 800-1000 m to 1500-1600 m. It may nevertheless be encountered at lower altitudes as well. This is a typical Mesophyte formation. It is most often found in pure stands, but occurs also in mixed stands with *Carpinus betulus, Abiea alba, Pinus nigra* etc. (Kochev, 1983).

In the Eastern Balkan, in connection with the lower altitude and the vicinity to the sea, besides the formations of *Quercus cerris, Quercus frainetto, Quercus delechampii and Carpinus betulus* we should note the participation of the following:

Quercus pubescens formation. It is a Xerophyte and Thermophyte formation, strongly influenced by human activity;

Carpinus orientalis formation. It is even more Xerophyte than the formation of *Quercus pubescens;*

Quercus polycarpa formation. It extends higher up to 300-400 m a.s.l. and can be found next the belt of Carpinus orientalis - Quercus polycarpa;

The *Fagus orientalis* formation has a limited distribution. It prefers shady and humid sites – mainly in the valleys - and consequently its spread may be of inverse nature. Air humidity is also of importance. This is an endemic and relic vegetation type.

2. Boreal-montane type, coniferous forests.

From this type, the following forest formations are represented in the Balkan range at the altitude range from 1300-1600 m to 2000-2200 m.

At the sunny-exposure parts of this zone one may find the formation of *Pineta sylvestris.* The rocks are predominantly silicate, the soils – *Dystric-Eutric Cambisols*. This formation has a limited distribution. The spread of the *Picea abies* formation is also limited. This is an endemic forest vegetation. The area has been reduced as the effect of human activities.

In the Central Balkan there are several spots of the *Pinus peuce* formation at the altitude of 1700 m to 2000 m., close to the upper timber line. In ecological terms it ranks between the formations of *Picea abies and Pinus sylvestris,* developing exclusively on silicate geological substrate.

Formations of *Abies alba* are to be found on a limited portion of the area.

Altitudinal zonation

Zakhariev et al. (1970) distinguished the following forest zonation in the Balkan range:

-. The Belt of alluvial lowlands, flooded terraces and land plots along the banks of streams and rivers from 0 to 700 m a.s.l . A good example is the area south of Varna, especially along the lower stretches of the river Kamchia. The mean annual temperature is between 11.4°C and 12.9°C, the mean January temperature is 0.5°C-2.4°C and the precipitation rate – between 500 and 580 mm, the snow cover is retained for some 10 to 40 days. The soils are alluvial, formed from river sediments, rich, with ample ground water close by. The forests are mixed stands of ash-trees (*Fraxinus oxycarpa)*, Common Oak (*Quercus robur),* elm-species (*Ulmus spp*.), willows (*Salix*), poplars (*Populus spp*.) etc. This is the so-called dense forest type.

- The Low-mountain belt of *Quercus delechampii, Fagus sylvatica* and *Abies alba* forests at the altitude from 600 (500-700) m to 1000 (900-1100) m. It is situated in the mountain skirts of the Balkan range. The mean annual temperature is between 7.5°C and 9.9°C. The vegetation period is from 161 to 195 days. The precipitation rate is from 570 to 672 mm with May-June maximums and January-March minimums. The continuous snow cover is from 48 to 82 days. The soils are of a transitional type between the *Grey luvisols* and *Dystric-Eutric Cambisols*. The forests are mainly pure or mixed stands of *Quercus delechampii* and *Fagus orientalis*.

- The Middle mountain belt of *Fagus sylvatica, Abies alba* and *Picea abies* at an altitude from 1000 (900-1100) m to 1500 (1400-1600) m.: on vast steep slopes and rounded peaks. The mean annual temperature is between 4.8°C and 7.0°C. The length of the vegetation period is from 123 to 149 days. The precipitation rate is in the range of 832-1296 mm with July maximum. The snow cover lasts between 84 and 142 days. The soils are *Dystric-Eutric Cambisols* .The forests are pure or mixed forests of *Fagus sylvatica, Abies alba* and *Picea abies*.

- The Upper-mountain belt of *Picea abies* forests from 1500 (1400-1600) to 1800 (1700-1900) m a.s.l.: Deeply indented valleys, steep slopes and leveled hilltops. The mean annual temperature is between 4.2°C and 5.1°C. The length of the vegetation period is between 99 and 120 days. The precipitation rate is from 1032 to 1269 mm with a maximum in June. The snow cover lasts for about 140 days. *Dystric-Eutric Cambisols* and *Umbric Cambisols* predominate. The forests are mainly mixed forests of *Fagus sylvatica* or *Picea abies* with other tree species.

- The High-mountain belt of forests of *Abies alba* and *Pinus peuce* from 1800 (1700-1900) to 2000 (1900-2100) m a.s.l. On high and very steep slopes, hilltops and single peaks. The mean annual temperature is about 3.3°C. The vegetation period is about 83 days. The precipitation rates are up to 1228 mm with a maximum in June. The snow cover lasts for about 169 days. The soils are *Umbric Cambisols*. The forests are uniform or mixed stands of *Pinus peuce, Pinus sylvestris* or *Pinus mugo.*

4.3. Identified virgin forests

The identification of virgin forests went in two steps. The first step was a preliminary study by researchers from the Forest Research Institute at the Bulgarian Academy of Sciences, conducted in 2003 and 2005, of the total volume of available documentation, consisting of satellite images, forest management plans, maps, the personal contribution of many colleagues from the State Forestry Enterprises, the Regional Forest Boards, "Agrolesproject", the National Forestry Administration and the Management Directorate of the "Central Balkan" National Park. In this first labor-intensive step the

areas were identified with a high chance of containing virgin forests. In the second step each of these areas was visited by expeditions of the groups of researchers. This was a most significant portion in the process of identification. During these visits sample plots were described. By this method full information was collected on the physical and geographic characteristics and biometric indicators of the investigated ecosystems. The sample plots were selected on being representative for the forest vegetation in the investigated polygon.

This process was often complicated by the difficult access to the terrains, on which such forests exist.

In the Balkan range a total of 60 494.2 ha of forests has been investigated. Within this total 34954.3 ha have been identified as virgin forests, unevenly distributed across the mountain. The majority of them are in the Central Balkan (85.4%) and the rest – in the Western and Eastern Balkan (respectively 9.9% and 4.7%). The largest areas of virgin forests (above 4000 ha each) exist in the State Forestry Enterprises (SFE) Karlovo, Cherni Ossam and Ribaritsa. Ranking next are the forestry enterprises or Game Nursery Enterprises (GNE) possessing significant areas of such forests (area size from 1000 to 4000 ha): Pirdop, Rozino, Cherni Vit, Vitinya, Rossitsa, Rusalka, Etropole, Berkovitsa and Chuprene. Areas below 1000 ha are characteristic for the SFE/GNE Borima, Botevgrad, Buynovtsi, Vratsa, Varshets, Gabrovo, Govezhda, Elena, Kipilovo, Klisura, Kotel, Lessidren, Plachkovtsi, Sliven, Staro Oryahovo, Teteven etc.

As might be expected, the largest areas of virgin forests in the Balkan range have been identified in the *reserves* - 22548.6 ha or 64.5%. Ranking first are the reserves “Djendema”, “Steneto” and “Tsarichina” with areas between 4200 and 3400 ha, followed in west-east direction by the reserves “Chuprene”, “Severen Djendem”, “Boatin”, “Peeshti Skali” and “Stara Reka” with areas of 1000 to 2000 ha each. The rest of the reserves (a total of 16) contain smaller areas – from 20 to 900 ha. The exclusive wealth of virgin forests in the Balkan range is under the protection of the Law on Protected Areas and that under its most severe provisions, so it might be expected to ensure good protection against violation attempts.

In the category of *closed basins* (CB), where are no roads and because of the very steep terrain and indented relief there has been no economic exploitation of the forests, are situated a total of 7249.2 ha or 20.7% of the virgin forests in the Balkan range. The largest number of closed basins exists in the forestry enterprises Pirdop (1516.4 ha) and Vitinya (1037.2 ha), followed by Etropole (976.4 ha), Cherni Ossam (922.4 ha), etc. These closed basins contain forests of beech and also of some other dominant species. They are of great scientific and cultural value, as they have never been subjected to economic exploitation and have really preserved their original state. They should be the focus of specific care, since they are not protected by the legislative framework, however rank as a priority object for targeted protection for the sake of Bulgaria and Europe.

Ranking the third in terms of area are the virgin forests in the *“Central Balkan” National Park*, which do not possess the status of a reserve, however fall under the Category II to IUCN, which ensures good conservation. This group comprises a total of 4306.1 ha or 12.3% of the virgin forests in the Balkan range.

The rest of the virgin forests in the mountain are situated in *water supply zones* (WSZ)(690.4 ha), one *nature park* (NP) (68.6 ha), *seed production stands* (SPS) (68.8 ha) and one *historic locality* (HL) (22.6 ha).

The largest share of virgin forests in the Balkan range are found on granites - 32.7%; followed by those on sandstone (13.0%), crystalline schist (9.7%) and many other substrate formations.

An interesting aspect is the distribution by altitudinal level. The largest number of virgin forests has been found in the range of 1200 – 1400 m a.s.l. (26.9%), followed by those at the altitude between 1400 and 1600 m (21.4%), 1000 – 1200 m (20.0%) and 800 and 1000 m a.s.l. (11.1%). Therefore, 79.4% of the virgin forests in the Balkan range have been identified at the altitude range of 800 – 1600 m. This agrees with the fact that the altitudinal range of 900 – 1600 m represents the zone of climatic optimum for the majority of tree species in Bulgaria (Raev, 1983).

Virgin forests on northern exposures predominate (30.2%), followed by the forests on eastern exposures (25.7%) and western exposures (24.7%). The preference of virgin forests to northern exposures is related to the ecological conditions in favor of forest: relative high moisture and soil fertility, which is typical for these habitats.

Related to parts of the relief of the terrain, virgin forests near the upper end of the slope predominate (64.6%), followed by those near the bottom end of the slope (22.8%).

Virgin forests on steep terrains (21^{o}-30^{o}) predominate (38.9%), followed by those on very steep and ravine locations (above 31^{o}) – 29.0% and on inclined terrains (11^{o} - 20^{o}) – 24.7%. Therefore, 68.9% of the virgin forests in the Balkan range are formed on steep, very steep and ravine terrains. Probably this is one of the main reasons for their survival till the present time.

Figure 4.1. Studied forest stands and identified virgin forests on their area in the Balkan range

Code No.	Region	State Forestry Enterprises	Protection status and accessability	Dominant tree species	Investigated area (ha)	Area identified as virgin forest (ha)
1	Western Balkan range	Chuprene	BR	*Picea abies*	1439.0	1129.0
2		Govezhda	CB	*Fagus sylvatica*	96.0	0
3			CB	*Fagus sylvatica*	1685.8	69.2
4		Berkovitsa	R	*Picea abies*	161.0	160.8
5			WSZ	*Fagus sylvatica*	640.5	297.7
6			WSZ	*Fagus sylvatica*		259.2
7		Mezdra	CB	*Fagus sylvatica*	413.6	0
8		Govezhda, Chiprovtsi	CB	*Fagus sylvatica*	165.6	143.2
9		Chiprovtsi	CB	*Fagus sylvatica*	372.7	49.3
10		Midjur		*Fagus sylvatica*	120.1	0
11		Vratsa, Berkovitsa	CB, SPS	*Fagus sylvatica*	131.9	37.4
12		Vratsa	CB	*Fagus sylvatica*	308.5	175.6
13		Svoge		*Fagus sylvatica*	367.0	0
14		Botevgrad	CB	*Fagus sylvatica, Quercus robur*	521.0	26.9
15			NR	*Fagus sylvatica*		73.9
16		Vitinya	CB	*Fagus sylvatica*	544.8	138.6
17			CB	*Fagus sylvatica*	377.2	377.5
18			CB	*Fagus sylvatica*	199.5	187.6
19			CB	*Fagus sylvatica*	85.8	0
20			CB	*Fagus sylvatica*	346.5	0
21			CB	*Fagus sylvatica*	365.8	333.5
22			CB	*Fagus sylvatica*	229.7	0
				Total:	***8572.0***	***3459.4***
23	Central Balkan range	Steneto	BR	*Fagus sylvatica*	3593.8	3593.8
24		Kozya Stena	R	*Fagus sylvatica*	904.3	896.7
25		Severen Djendem	R	*Fagus sylvatica*	1640.4	1640.4
26		Tsarichina	R	*Fagus sylvatica, Picea abies, Pinuspeuce*	3423.7	3423.7

27		Boatin	R	*Fagus sylvatica, Picea abies*	1598.0	1598.0
28		Ribaritsa	NlP	*Fagus sylvatica*	880.0	533.5
29		Trojan	NlP	*Fagus sylvatica*	139.2	139.2
30		Klisuura	NlP	*Fagus sylvatica*	950.0	409.7
31		Teteven	CB	*Fagus sylvatica*	364.0	136.1
32		Teteven	NlP	*Fagus sylvatica*	144.5	144.5
33		Ribaritsa	Part CB	*Fagus sylvatica*	780.0	363.8
34		Cherni Vit	Part CB	*Fagus sylvatica*	910.0	446.3
35		Cherni Ossam	Part CB	*Fagus sylvatica*	1620.0	922.4
36		Apriltsi	CB	*Fagus sylvatica*	450.0	195.6
37		Lessidren	Part CB	*Fagus sylvatica*	1100.0	350.4
38		Borima	Part CB	*Fagus sylvatica*, Quercus sp.	730.0	236.7
39		Pirdop	Part CB	*Fagus sylvatica*	10216.1	1516.4
40		Etropole	Part CB	*Fagus sylvatica*	1700.0	976.4
41		Maglizh	CB	*Fagus sylvatica, Carpinus betulus, Quercus petraea*	686.8	46.8
42			PL	*Quercus petraea, Carpinus betulus Carpinus orientalis*	102.9	90.4
43		Rossitsa	R	*Fagus sylvatica*	1120.4	1114.4
44		Buynovtsi	NR	*Fagus sylvatica*	764.8	34.7
45		Gabrovo	WSZ	*Fagus sylvatica*	211.3	133.5
46			CB	*Fagus sylvatica*	420.8	338.5
47		Plachkovtsi	CB	*Fagus sylvatica*	250.7	193.5
48		Elena	R	*Fagus sylvatica*	614.1	92.6
49			CB	*Fagus sylvatica*	102.5	91.3
50		Sahrane, Mazalat	R	*Fagus sylvatica, Quercus sp.*	1555.2	1072.2
51		Mazalat	R	*Fagus sylvatica, Abies alba u др.*	295.8	117.0
52		Mazalat	CB, NlP	*Fagus sylvatica Abies alba u др.*	720.5	61.1
53		Mazalat	NlP	*Fagus sylvatica, Carpinus betulus*	990.8	430.3
54		Karlovo	R	*Fagus sylvatica, Picea abies, Abies alba*	2002.0	1994.7
55			R	*Fagus sylvatica, Abies alba, Quercus petraea*	4521.3	4213.2
56			IM	*Fagus sylvatica*	78.5	22.6
57		Rozino	NR	*Pinus nigra, Quercus petraea*	76.0	51.2
58			NlP	*Fagus sylvatica*	2304.8	1933.3
59		Klisura	NlP	*Fagus sylvatica*	855.3	315.6
				Total:	*48818.5*	*29870.5*
60	Eastern	Shumen	NP, R	*Fagus orientalis, Carpinus betulus*	262.0	68.6

61	Fore-Balkan	Preslav	NR	*Aesculus hippocastanum, Carpinus betulus*	70.2	70.2
62	region	Preslav	NR	*Cercis .siliquastrum, Carpinus betulus*	104.5	22.3
63		Omurtag	CB	*Fagus orientalis*	17.9	17.9
64		Kipilovo	NR	*Abies alba, Carpinus betulus*	143.6	143.6
65		Ticha	CB	*Fagus orientalis, Quercus petraea*	158.9	158.9
66		Kotel	R	*Fagus orientalis*	566.0	178.8
67		Varbitsa	NR	*Fagus orientalis, Acer pseudoplatanus*	80.7	80.7
68		Smyadovo	CB	*Fagus orientalis, Carpinus betulus*	93.9	93.9
69		Sliven	R	*Fagus orientalis, Carpinus betulus*	708.0	202.5
				Total:	***2205.7***	***1037.4***
70	Balkan range	Tsonevo	NR	*Quercus petraea, Q.frainetto*	70.4	70.4
71	Black Sea coastal	Sherba	NR	*Quercus.frainetto, Quercus petraea, Fagus orientalis*	60.7	60.7
72	region	Staro Oryahovo	NR	*Quercus frainetto, Q.cerris, Q. petraea*	71.3	71.3
73		Kamchiya	BR	*F.oxycarpa, Q.robur, U. minor*	695.6	384,6
				Total:	***898.0***	***587.0***
				Grand total for the Balkan range:	**60 494.2**	**34 954.3**

CB – Closed basin
NlP – National park
NP – Nature park
R – reserve
BR – biosphere reserve

NR – nature reserve
SPS – Seed production stand
PL – Protected locality
WSZ – Water supply zone
HL – Historical locality

In protected virgin forests in the Balkan range the forests of *Fagus sylvatica* are predominant – 64% of the total, followed by *Picea abies* forests – 6.7%, *Abies alba* forests – 4.9%, *Quercus petraea* forests - 3.1%, *Carpinus betulus* forests – 2.6%, *Carpinus orientalis* forests – 2.0% etc. Only 13.4% of the virgin forests in the Balkan range consist of endemic coniferous species. This reflects the moderate climate of these mountains. Until now they escaped to become plantations of more productive coniferous species.

Nearly 26.9% of the forests are aged below 100 years, 32.3% are aged between 100 and 150 years, 27.4% are aged 150-200 years and only 1.7% are aged above 200 years. Nevertheless they all fit in the definition given earlier. This means that they are of natural origin, possess well-preserved structure and geochemical cycle, and have been left intact in terms of human presence and activities during the recent 40-50 years.

4.4. Typical complexes of virgin forests

The term "polygons" is used to denominate relatively homogeneous complexes of virgin forests, uniform in terms of species composition of the forest, the spatial closeness of the tree stands, as well as the physical and geographic characteristics preconditioning the specific ecosystems. It is necessary to add here, however, that both in the course of establishment of the "polygons" and during the proper identification of a given forest as a "virgin forest", a certain subjectivism is unavoidable despite the large number of explicit criteria. This is probably one of the explanations for the relatively small percentage of virgin forests in the Western Balkan range. It does, however, mean that there is a significant potential for expansion of that most precious part of the forest wealth of our country.

Starting from the Western Balkan range and moving eastward, the polygons are numbered and described below. (The numbers of the polygons follow the sequence assumed by the researchers. When no virgin forest has been identified in a given studied polygon, it drops off the general numbering and for that reason there are certain numbers missing):

Polygon 1: Biosphere reserve "Chuprene" State Forestry Enterprise (SFE) Chuprene. Virgin forests area 1129.0 ha, mainly *Picea abies* of the type "*Picea abies* forest with *Vaccinium myrtillus*" (Penev et al., 1969). One of the largest and best preserved locations of old *Picea abies* forests in the Balkan range – a proof for its broader spread in the mountain in the past. There is also significant participation of *Fagus sylvatica* of the type "*Fagus sylvatica* with *Galium odoratum"*.

Polygon 3: SFE Govezhda. Closed basin. Area: 69.2 ha. *Fagus sylvatica* – 100%. Type "*Fagus sylvatica* forest with mixtoherbosum ".

Polygon 4: SFE Berkovitsa, "Gornata Koriya" Reserve. Area: 160.8 ha. *Picea abies* – 70%, *Abies alba* – 20%, *Fagus sylvatica* – 10%. Type "*Fagus sylvatica - Abies alba* forest", "*Abies alba - Picea abies* forest", "*Fagus sylvatica - Abies alba - Picea abies* forest" and "*Picea abies* forest".

Polygon 5: SFE Berkovitsa. Water supply zone. Area: 297.7 ha. *Fagus sylvatica* – 100%, single trees of *Picea abies*, *Betula alba*, *Acer pseudoplatanus.* Type of forest: "*Fagus sylvatica* forest with forest plant litter", "*Fagus sylvatica* forest with *Vaccinium myrtillus*", "*Fagus sylvatica - Picea abies* forest on a rocky terrain", "*Fagus sylvatica* forest with *mixtoherbosum*".

Polygon 6: SFE Berkovitsa. Water supply zone. Area: 259.2 ha. *Fagus sylvatica* – 100%, single units of *Acer platanoides, Acer pseudoplatanus.* Type of forest: "*Fagus sylvatica* forest with *Dryopteris filix-mas*".

Polygon 8: SFE Chiprovtsi. Closed basin. Area: 143.2 ha. *Fagus sylvatica* – 100%, single units of *Acer pseudoplatanus*, *Picea abies*. Type of forest: "*Fagus sylvatica* forest with cereals ".

Polygon 9: SFE Chiprovtsi. Closed basin. Area: 49.3 ha. *Fagus sylvatica* – 100%, single trees of *Acer heldreichii, Acer platanoides, Tiliatomentosa.* Type of forest: "*Fagus sylvatica* forest with forest plant litter".

Polygon 11: SFE Vratsa and SFE Berkovitsa. Closed basin and seed production stand. Area: 37.4 ha. *Fagus sylvatica* – 100%, single individuals of *Populus tremula, Acer pseudoplatanus, Fraxinus*. Type of forest: "*Fagus sylvatica* forest with *Rubus fruticosus*".

Polygon 12: SFE Vratsa. Closed basin and seed production stand. Area: 175.6 ha. *Fagus sylvatica* – 100 %, single trees of *Acer pseudoplatanus, Acer platanoides, Sorbus torminalis*, *Fraxinus ornus, Fraxinus excelsior*. Type of forest: "*Fagus sylvatica* forest with *Luzula",* "*Fagus sylvatica* forest with *Galium odoratum*, "*Fagus sylvatica* forest with *mixtoherbosum*".

Polygon 14: SFE Botevgrad. Closed basin. Area: 26.9 ha. *Fagus sylvatica* – 100%, single units of *Sorbus aucuparia*, *Acer pseudoplatanus*, *Carpinus betulus*, *Acer platanoides*, *Fraxinus*, *Populus tremula.* Type of forest: "*Fagus sylvatica* with *Geranium macrorrhizum*".

Polygon 15: SFE Botevgrad, "Uchilishtna Gora" Reserve. Area: 73.9 ha. *Fagus sylvatica* – 90%, *Quercus petraea* – 10%, single units of *Quercus frainetto*, *Quercus cerris*, *Carpinus betulus, Acer campestre*, *Acer platanoides, Fraxinus, Tilia sp., Sorbus torminalis*, *Prunus avium*. Type: "*Quercus delechampii* forest with *Luzula*", "*Quercus delechampii - Fagus sylvatica* forest with *Rubus fruticosus",* "*Fagus sylvatica* forest with forest plant litter".

Polygon 16: SWE Vitinya. Closed basin. Area: 138.6 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus, Quercus petraea.* Type: "*Fagus sylvatica* forest with forest plant litter".

Polygon 17: SGBS Vitinya. Closed basin. Area: 377.5 ha. *Fagus sylvatica* – 100%, single trees of *Acer pseudoplatanus*. Type: "*Fagus sylvatica* forest with *mixtoherbosum*".

Polygon 18: SGBS Vitinya. Closed basin. Area: 187.6 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus, Quercus petraea, Acer pseudoplatanus*, *Acer platanoides*. Type: "*Fagus sylvatica* forest with *Luzula*".

Polygon 21: SGBS Vitinya. Closed basin. Area: 335.5 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus, Quercus petraea*, *Sorbus aucuparia*, *Acer campestre*. Type: "*Fagus sylvatica* forest with graminae".

Polygon 23: SFE Cherni Ossam, "Steneto" Biosphere Reserve. Area: 3593.8 ha. *Fagus sylvatica* – 95%, *Picea abies* – 3%, *Carpinus betulus* – 1%, *Ostrya carpinifolia* – 1%, single trees of *Salix caprea*, *Acer platanoides, Quercus delechampii, Acer pseudoplatanus, Fraxinus excelsior, Fraxinus ornus, Ulmus glabra*, *Prunus avium*, *Acer heldreichii*, *Sorbus aucuparia, Populus tremula*. Types of forests: Nos. 15, 16, 17, 18, 19, 20, 25, 26, 27 and 10 (Re. to the Methodology of the project).

Polygon 24: SFE Trojan. "Kozya Stena" Reserve. Area: 896.7 ha. 1200 m. *Fagus sylvatica* – 95%, *Picea abies* – 2%, *Abies alba* – 1%, single trees of *Acer pseudoplatanus*, *Carpinus betulus, Ostrya carpinifolia, Carpinus orientalis, Salix caprea*, *Fraxinus ornus, Quercus delechampii, Fraxinus*

excelsior, *Ulmus glabra*, *Sorbus aucuparia, Populus tremula*. Types of forests: Nos.15, 16, 17, 18, 19, 20 and 10.

Polygon 25: SFE Apriltsi. "Severen Djendem" Reserve. Area: 1640.4 ha. *Fagus sylvatica*, *Picea abies*, *Abies alba* – 99%, *Ulmus glabra, Fraxinus excelsior*, *Sorbus aucuparia, Populus tremula, Salix alba*, *Alnus glutiinosa*, *Prunus avium*, *Acer heldreichii*, *Acer platanoides, Salix caprea*, *Fraxinus ornus, Carpinus betulus, Ostrya carpinifolia* – 1%. Types of forest: Nos. 15, 16, 17, 18, 20 and 10.

Polygon 26: SFE Ribaritsa. "Tsarichina" Reserve. Area: 3423.7 ha. *Fagus sylvatica* – 38%, *Picea abies* – 26%, *Abies alba* – 20%, *Pinus peuce* – 15%, *Populus tremula, Sorbus aucuparia, Ulmus glabra*, *Acer pseudoplatanus, Salix caprea*, *Acer heldreichii*, *Ostrya carpinifolia* – 2%. Types of forests: Nos. 10, 16, 17, 20, 25, 26, 27, 30 and 34.

Polygon 27: SFE Cherni Vit. "Boatin" Reserve. Area: 1598.0 ha. *Fagus sylvatica – 99%*, *Carpinus betulus, Acer platanoides*, *Salix caprea*, *Acer pseudoplatanus*, *Ulmus glabra, Sorbus torminalis, Sorbus aucuparia*, *Abies alba, Populus tremula, Corylus avellana.* Types of forests: Nos. 10, 16, 17 and 18.

Polygon 28: SFE Ribaritsa. "Central Balkan" National Park. Area: 533.5 ha. *Fagus sylvatica* – 70%, *Picea abies* – 20%, *Abies alba* – 10%, single trees of *Acer heldreichii*, *Salix caprea*, *Sorbus aucuparia*, *Populus tremula*. Type: "*Fagus sylvatica* forest with *Luzula*", "*Picea abies - Abies alba – Fagus sylvatica* forest with *Vaccinium myrtillus"*.

Polygon 29: SFE Trojan. "Beklemeto" Locality. "Central Balkan" National Park. Area: 139.2 ha. *Fagus sylvatica* – 99%, *Acer pseudoplatanus, Sorbus aucuparia, Salix caprea*, *Acer platanoides, Carpinus betulus* – 1%. Types of forests: Nos.10, 16, 17 and 20.

Polygon 30: SFE Pirdop. "Central Balkan" National Park. Area: 409.7 ha. *Fagus sylvatica* – 100%. Types of forests: Nos. 10, 12, 17, 20.

Polygon 31: SFE Teteven. Closed basin. Area: 136.1 ha. *Fagus sylvatica*, *Carpinus betulus* – 75%, *Fraxinus ornus* – 5%, *Tilia tomentosa* – 5%, *Carpinus orientalis* – 5%, *Quercus cerris* – 3%, *Populus tremula* – 2%, *Acer campestre* – 2%, *Fraxinus* – 1%, *Prunus avium* – 1%. Types of forests: Nos. 10, 14, 16 and 17.

Polygon 32: SFE Teteven. "Central Balkan" National Park. Area: 144.5 ha. *Fagus syilvatica* – 97%, *Picea abies* – 2%, *Abies alba* – 1 %, single trees of *Acer heldreichii*, *Salix caprea*, *Sorbus aucuparia,Populus tremula.* Types of forests: Nos. 14, 16, 17 and 26.

Polygon 33: SFE Ribaritsa. Closed basin. Area: 363.8 ha. *Fagus sylvatica* – 95%, *Carpinus betulus, Ulmus glabra*, *Acer pseudoplatanus* – 2 %, *Acer platanoides*, *Fraxinus excelsior* – 2 %, *Populus tremula,*, *Salix caprea* – 1 %. Types of forest: Nos. 10, 14, 16 and 17.

Polygon 34: SFE Cherni Vit. Closed basin. Area: 446.3 ha. *Fagus sylvatica* – 77%, *Carpinus orientalis* – 10%, *Carpinus betulus* – 5%, *Quercus cerris*, *Tilia tomentosa* – 5%, *Prunus avium, Acer pseudoplatanus* – 1%, *Pyrus pyraster*, *Fraxinus ornus* – 1%. Types of forest: Nos. 10, 12 and 14.

Polygon 35: SFE Cherni Ossam. Closed basin, part of "Central Balkan" National Park. Area: 922.4 ha. *Fagus sylvatica* – 96%, *Acer platanoides*, *Fraxinus excelsior* – 2%, *Carpinus betulus* – 1%, *Acer pseudoplatanus* – 1%, single units of *Prunus avium*, *Ulmus glabra, Tilia tomentosa*, *Sorbus torminalis*, *Salix caprea* etc.

Polygon 36: SFE Apriltsi. Closed basin. Area: 195.6 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus, Quercus delechampii*, *Acer pseudoplatanus, Acer platanoides*, *Fraxinus excelsior*. Types of forests: Nos. 10, 16 and 17.

Polygon 37: SFE Lessidren. Closed basin. Area: 350.4 ha. *Fagus sylvatica* – 93%, *Populus tremula* – 3 %, *Salix caprea* – 2%, *Carpinus betulus* – 1%, *Prunus avium* – 1%.

Polygon 38: SFE Borima. Closed basin. Area: 236.7 ha. *Fagus sylvatica* - 88%, *Carpinus betulus* – 6%, *Quercus cerris* – 2%, *Quercus frainetto* – 2%, *Acer campestre* – 2%. Types of forest: Nos. 10, 12, 13.

Polygon 39: SFE Pirdop. Closed basin. Area: 1516.4 ha. *Fagus sylvatica* - 91%, *Salix caprea, Carpinus betulusi* - 5%, *Populus tremula* – 1%, *Carpinus orientalis* – 1%, *Acer pseudoplatanus* – 1%, *Acer campestre*, *Fraxinus ornus* – 1%. Types of forests: 16, 17, 19 and 20.

Polygon 40: SFE Etropole. Closed basin. Area: 976.4 ha. *Fagus sylvatica* - 100%, single units of *Carpinus betulus, Populus tremula, Acer pseudoplatanus*, *Salix caprea*, *Fraxinus ornus* etc. Types of forest: Nos. 16, 17, 19 and 20.

Polygon 41: SFE Maglizh. Closed basin. Area: 46.8 ha. *Fagus sylvatica* – 80%, *Carpinus betulus* – 10%, *Quercus petraea* – 7%, *Acer pseudoplatanus* – 3%. Type "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 42: SFE Maglizh. "Maglizhka Klrsura" Protected locality. Area: 90.4 ha. *Quercus petraea* – 60%, *Carpinus betulus* – 20%, *Carpinus orientalis* – 10%, *Fraxinus ornus* – 10%, single trees of *Tilia sp., Quercus pubescens*. Type "*Quercus delechampii - Carpinus betulus* valley forest".

Polygon 43: SGBS Rossitsa. "Peeshti Skali" Reserve. Area: 1114.4 ha. *Fagus sylvatica* – 100%, single trees of *Fraxinus*, *Carpinus betulus, Acer pseudoplatanu.* Types of forest: "*Fagus sylvatica* forest with *Vaccinium myrtillus",* "fresh *Fagus sylvatica* forest with *Vaccinium myrtillus","Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 44: SFE Buynovtsi. "Haydushki Chukar" Maintained reserve. Area: 34.7 ha. *Fagus sylvatica* – 100%, single trees of *Acer pseudoplatanus*, *Acer platanoides*, *Sorbus torminalis*. Type of forest: "*Fagus sylvatica* forest with *Luzula*".

Polygon 45: SFE Gabrovo. Water supply zone. The sources of river Yantra. Area: 133.5 ha. *Fagus sylvatica* – 100%, single trees of *Acer pseudoplatanus*, *Acer platanoides*, *Carpinus betulus.* Types of forest: "*Fagus sylvatica* forest with *Vaccinium myrtillus",* "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 46: SFE Gabrovo. Closed basin under Peak Stoletov. Area: 338.5 ha. *Fagus sylvatica* – 100%, single trees of *Ulmus glabra*, *Acer pseudoplatanus, Sorbus torminalis*, *Acer platanoides*, *Fraxinus*, *Carpinus betulus, Fraxinus ornus.* Type of forest: "*Fagus sylvatica* forest with *Vaccinium myrtillus"*.

Polygon 47: SFE Plachkovtsi. "Mahnatata Skala" Closed basin. Area: 193.5 ha. *Fagus sylvatica* – 100%, single trees of *Acer pseudoplatanus*, *Acer platanoides, Carpinus betulus* etc. Type of forest: "*Fagus sylvatica* forest with *Luzula*'.

Polygon 48: SFE Elena. "Byalata krava" Reserve. Area: 92.6 ha. *Fagus sylvatica* – 98%, *Carpinus betulus* – 1%, *Acer pseudoplatanus* – 1%, single units of *Ulmus sp*., *Acer platanoides* etc. Type: "*Fagus sylvatica* forest with *Prunus laurocerasus*".

Polygon 49: SFE Elena. Closed basin, "Popov trap" Locality. Area: 91.3 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus, Acer pseudoplatanus* etc. Type: "*Fagus sylvatica* forest with *Galium odoratum*".

Polygon 50: SGBS Mazalat. "Sokolna" Reserve. Area: 1072.25 ha. *Fagus sylvatica* – 40%, *Quercus petraea* – 20%, *Carpinus orientalis* – 10%, single trees of *Acer pseudoplatanus*, *Acer platanoides.* Type of forest: "*Fagus sylvatica* forest with *Luzula"*.

Polygon 51: SGBS Mazalat. "Leshnitsa" Reserve. Area: 117.0 ha. *Fagus sylvatica* – 80%, *Carpinus betulus* – 15%, *Acer pseudoplatanus* – 5%. Type: Тип "*Fagus sylvatica* forest with *Luzula"*, "*Fagus sylvatica* forest with *Rubus fruticosus"*.

Polygon 52. SGBR Mazalat. Closed basin. Area: 61.1 ha. *Fagus sylvatica* – 90%, *Carpinus betulus* – 5%, *Abies alba* – 5%, single trees of *Populus tremula, Acer pseudoplatanus*, *Salix caprea*. Type: "*Fagus sylvatica* forest with *Luzula*".

Polygon 53: SGBR Mazalat. "Central Balkan" National Park. Area: 430.3 ha. *Fagus sylvatica* – 80%, *Carpinus betulus* – 15%, *Acer platanoides* – 5%, single units of *Salix caprea*, *Sorbus aucuparia*, *Betula pendula*, *Fraxinus*. Type: "*Fagus sylvatica* forest with *Luzula*".

Polygon 54: SFE Karlovo. "Stara reka" Reserve. Area: 1994.7 ha. *Fagus sylvatica* – 30%, *Abies alba* – 30%, *Picea abies* – 30%, *Quercus petraea* – 10%, single trees of *Alnus glutinosa*, *Salix caprea*, *Acer pseudoplatanus*, *Carpinus betulus.* Type:"*Fagus sylvatica* forest with *Luzula*", "*Fagus sylvatica* forest with *Vaccinium myrtillus"*.

Polygon 55: SFE Karlovo. "Djendema" Reserve. Area: 4213.2 ha. *Fagus sylvatica* – 50%, *Abies alba* – 20%, *Quercus petraea* – 20%, *Carpinus betulus* – 10%, single trees of *Acer pseudoplatanus, Betula pendula*, *Picea abies, Fraxinus excelsior*. Type of forest: "*Fagus sylvatica* forest with *Vaccinium myrtillus"*, "*Fagus sylvatica* forest with *Luzula*", "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 56: SFE Karlovo. "Chevira" Historical location. Area: 22.6 ha. *Fagus sylvatica* – 100%. Type of forest: "*Fagus sylvatica* forest with *Luzula*".

Polygon 57: SFE Rozino. "Chamdja" Reserve. Area: 51.2 ha. *Pinus nigra* – 90%, *Quercus petraea* – 10%, single trees of *Carpinus betulus, Quercus cerries, Pinus sylvestris*. Type of forest: "*Quercus delechampii - Carpinus betulus* valley forest".

Polygon 58: SFE Rozino. "Starata mechka" locality. "Central Balkan" National Park. Area: 1933.3 ha. *Fagus sylvatica* – 90%, *Pinus nigra* – 1%, *Abies alba* – 1%, *Acer pseudoplatanus* – 1%, *Fraxinus excelsior* – 1%, *Carpinus betulus* – 1%, single trees of *Quercus petraea*, *Acer heldreichii*, *Corylus colurna.* Type of forest: "*Fagus sylvatica* forest with *Luzula"*, "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 59: SFE Klisura. "Govedarnika" locality, "Central Balkan" National Park. Area: 315.6 ha. *Fagus sylvatica* – 95%, *Abies alba* – 3%, *Quercus petraea* – 2%, single trees of *Acer pseudoplatanus*, *Carpinus betulus*, *Acer campestre*, *Betula pendula*, *Pinus sylvestris.*.Type of forest: "*Fagus sylvatica* forest with *Luzula*", "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 60: SFE Shumen. "Bukaka" Reserve. Area: 68.6 ha. *Fagus sylvatica* – 70%, *Carpinus betulus* – 20%, *Quercus fraineto* – 10%. Types of forest: "valley-type *Quercus delechampii - Fagus sylvatica - Carpinus betulus* oak forest".

Polygon 61: SGE Preslav. "Dervisha" maintained reserve. Area: 70.2 ha. A*esculus hippocastanum* – 50%, *Carpinus betulus* – 20%, *Fagus sylvatica* – 20%, *Tilia tomentosa* – 10%, single trees of *Juglans, Acer pseudoplatanus* etc. Type of forest: valley-type *Quercus delechampii - Fagus sylvatica* oak forest".

Polygon 62: SGE Presllav. "Patleyna" maintained reserve. Area: 22.2 ha. *Cercis siliquastrum* - 80%, *Carpinus betulus* – 20%, single trees of *Tilia tomentosa*, *Fraxinus ornus*. Type of forest: "valley oak forest with *Cercis siliquactrum*".

Polygon 63: SFE Omurtag. Closed basin. Area: 17.9 ha. *Fagus sylvatica/orientalis* – 100%, single units of *Carpinus betulus, Quercus delachampii*, *Populus tremula*. Type of forest: "valley-type *Quercus delechampii - Fagus sylvatica - Carpinus betulus* oak forest".

Polygon 64: SFE Kipilovo. "Ardachluka" Managed reserve. Area: 143.0 ha. *Abies alba* – 50%, *Carpinus betulus* – 30%, *Acer pseudoplatanus* - 10%, *Fraxinus ornus* – 10%, single trees of *Prunus avium, Tilia tomentosa*, *Quercus delechampii, Populus tremula.* Type of forest "valley-type *Quercus delechampii - Fagus sylvatica - Carpinus betulus* oak forest".

Polygon 65: SGE Ticha. "Madancha" closed basin. Area: 158.9 ha. *Fagus sylvatica* – 60%, *Quercus delechampii* – 30%, *Carpinus betulus* – 10%, single trees of *Acer pseudoplatanus* etc. Type of forest: "fresh *Fagus sylvatica – Quercus delechampii* forest with *Carpinus betulus"*.

Polygon 66: SGR Kotel. "Orlitsata" Reserve. Area: 178.8 ha. *Fagus sylvatica* – 90%, *Carpinus betulus* – 10%, single units of *Acer pseudoplatanus, Sorbus torminali*s. Type of forest: "fresh *Fagus sylvatica - Quercus delechampii* forest with *Carpinus betulus"*

Polygon 67: SFE Varbitsa. "Momin grad" Managed reserve. Area: 80.7 ha. *Fagus sylvatica* – 50%, *Carpinus betulus* – 30%, *Acer pseudoplatanus* – 10%, *Corylus colurna* – 10%. Type: "fresh *Fagus sylvatica – Quercus delechampii* forest with *Carpinus betulus*".

Polygon 68: SFE Smyadovo. "Lipata" closed basin. Area: 93.9 ha. *Fagus sylvatica* – 70%, *Carpinus betulus* – 20%, *Corylus colurna* – 10%, single trees of *Acer pseudoplatanus.* Type of forest: "valley-type *Quercus delechampii - Fagus sylvatica - Carpinus betulus* oak forest".

Polygon 69: SFE Sliven. "Kutelka" Reserve. Area: 202.5 ha. *Fagus sylvatica* – 50%, *Carpinus betulus* – 20%, *Quercus delechampii* – 20%, *Quercus cerris* – 5%, *Acer pseudoplatanus* – 5%. Type of forest: "fresh *Fagus sylvatica - Quercus delechampii* forest with *Carpinus betulus*".

Polygon 70: SFE Tsonevo. "Vurtov Dol" Managed Reserve. Area: 70.4 ha. *Quercus delechampii* – 40%, *Quercus frainetto* – 20%, *Carpinus betulus* – 10%, *Acer campestre* – 10%, *Fraxinus exelsior* – 10 %, *Tilia tomentosa* – 5%, *Acer pseudoplatanus* – 5%. Type of forest: "fresh *Quercus delechampii - Quercus frainetto - Quercus cerries* oak forest".

Polygon 71: SGBS Sherba. "Valchi Prehod" maintained reserve. Area: 60.7 ha. *Quercus frainetto* – 40%, *Quercus petraea* – 20%, *Fagus orientalis ???* – 20%, *Carpinus betulus* – 20%, single trees of *Sorbus torminalis, Prunus avium*, *Acer campestre.* Type of forest: "fresh *Quercus frainetto – Quercus delechampii* forest with *Fagus sylvatica"*.

Polygon 72: SFE Staro Oryahovo. "Kirov Dol" managed reserve. Area: 71.3 ha. *Quercus frainetto* – 40%, *Quercus cerris* – 30%, *Quercus delechampii* – 30%. Type of forest: "fresh to wet *Quercus delechampii* oak forest"..

Polygon 73: SFE Staro Oryahovo. “Kamchia” biosphere reserve. Area: 384.6 ha. *Fraxinus oxycarpa* – 60%, *Quercus robur* – 20%, *Ulmus campestus* – 10%, *Carpinus betulus* – 10%, single trees of *Acer campestre, Quercus cerris, Alnus glutinosa, Populus alba, Salix alba* etc. Type of forest: “flooded oak forest (dense forest)”.

5. Virgin forests in Sredna Gora

5.1. Physical and geographic characteristics

The name Sredna Gora is a well matching description of its position on the crossing point, in the middle between the Balkan mountain range, Vitosha Mountain, Plana Mountain, Rila Mountain, Rhodopes Mountains, Sakar Mountain and Strandzha Mountain. For the readers from abroad we would like to remind that in the ancient Slavonic language the word "Gora (forest)" means "mountain" and hence "Sredna Gora" means "central mountain".

Sredna Gora is the second longest mountain chain in Bulgaria – more than 250 km. It starts in the west at the river Iskar in the Pancherevo Gorge and ends in the east with Zaychin Peak, where the river Tundja makes a wide curve. The Sredna Gora range consist of three parts, from west to east: Ihtimanska Sredna Gora, Sashtinska ("Actual") Sredna Gora and Sarnena ("Doe") Sredna Gora. with Bogdan Peak (1604 m.), part of Sashtinska Sredna Gora is the highest point. Ihtimanska Sredna Gora reaches up to 1275 m with Trana Peak and with Bratan Peak (1236 m) Sarnena Sredna Gora is the lowest, long-winded and most accessible part.

The rock substratum is mixed – Proterozoic and Paleozoic methamorphic, mainly in Ihtimanska Sredna Gora, as well as granites, limestone, andesite etc. in the other two parts.

Most of the water sources discharge via the river Maritsa into the Aegean basin. Only some rivers take their source from Ihtimanska Sredna Gora flow into the river Iskar. The main watershed runs along the ridge of Vakarelska Mountain, Belitsa and the mountain - foothill Galabets. The most important rivers are Topolnitsa (155 km), Luda Yana the most torrential one and Pyasachnik. Moreover dozens of small rivers take here their sources. Two medium-size dams have been constructed in the river Topolnitsa and one in the the river Pyasachnik. 20-60% of the rainfall is transformed in river runoff. The water capacity of the river basins shows great differences because of the great variety in physical and geographic conditions (Nikolov, Yordanova, 2002).

Sredna Gora falls under two climatic regions – temperate continental for Ihtimanska and Sashtinska Sredna Gora and transient continental for the southern part of Sashtinska Sredna Gora and Sarnena Sredna Gora (Velev, 2002). There are no such sharp temperature disparities as in the high mountains, because of the low average altitude with only minor variations . Below 700 m.. the mean annual temperature is 10.7° C, this is 6.1° C above 700 m. The lowest winter temperatures are recorded from the closed lowlands Ihtimanska (-31.8°) and Koprivshtenska (–31.9° C). The average temperature during the warmest month is 18-19° C (Kyuchukova, 1986).
The maximum rainfall is in May-July (in the higher parts of the mountain also in August) and the minimum –in the period December-February. This spring-summer maximum demonstrates the continental nature of the climate. In Sredna Gora the average precipitation is 715 mm (650-800 mm) below 700 m and 780 mm (700-900 mm) above 700 m. The snow cover in the higher parts of the mountain appears in December and stays till the end of March. On the southern slopes this period is shorter (Koleva, Peneva, 1990). Northwestern and western winds (rarely northern) predominate (Kyuchukova, 1982).

Several types of soil occur in the mountain. Predominant are *Eutric Cambisols*, followed by *Umbric Cambisols dark and Umbric Cambisols light.* Less frequent are *Chromic Luvisols,* present as *Leached*

Chromic Luvisols under oak-tree stands and as *Podsol Chromic Luvisols* only on very small areas. Intra-zonal Rankers, Delluvial and Alluvial Fluvisols are mainly found near the larger water courses. Medium deep and deep soils predominate, serving as the basis for some of the most prospective forest stands (Marinov, 1985).

Measurements on the depth of the soil layer (horizon A+B) showed: a) very deep soil layer (more than 120 cm) – 3.3%; b) deep soil layer (60-120 cm) – 28.6%; c) medium-deep soil layer (30-60 cm) – 54,3%; d) shallow soils (15–30 cm) – 13.2%; e) very shallow soils (below 15 cm) – 0.6%.

5.2. The forest vegetation

European vegetation province and subdivision

Sredna Gora belongs to the European broadleaved district (Velchev, 2002). Ihtimanska Sredna Gora and Sashtinska Sredna Gora fall under the Illyrian (Balkan) province, Srednogorski district, while Sarnena Sredna Gora falls under the Macedonian-Thracian province, Upper Thracian District, Srednogorski region (Bondev, 2002).

On the territory of Sredna Gora Mountain is encountered the nemoral type of vegetation of broadleaved deciduous forests of the Central European type

In the low part of the mountain, up to about 700 m a.s.l., the formations of *Querceta cerris* and *Querceta frainetto* occur. They prefer higher temperatures and lower precipitation rates. These forests are representatives of the xerophyte vegetation. Since they are situated in close vicinity to the human settlements they are strongly affected by anthropogenic activity.

The mesophyte formations *Querceta dalechampii* and *Carpineta betuli* are distributed farther up, from 600-700 m to 900-1000 m. The forests are mainly pure or mixed forests of *Quercus petraea* and *Fagus sylvatica*, although *Quercus frainetto*, *Carpinus betulus*, *Quercus cerris*, *Carpinus orientalis*, as well as many other species are also present. They require higher precipitation rate and richer soils. Some of these forests are relatively well conserved, especially in the protected nature areas.

The mean annual temperature is in the range of 8.7°C - 6.9°C. The vegetation period lasts between 176 and 154 days. The precipitation rate is from 616 to 831 mm with a May-June maximum and a January-March minimum. The snow cover lasts for some 63-75 days.

The formation of *Fagus sylvatica* makes an almost unbroken middle mountain forest belt from 800-1000 m. up to the mountain ridge. This makes Fagus the most common tree species on this mountain. *Fagus sylvatica, Abies alba* and *Picea abies* occur at the altitude from 1000 to 1275 m on Ihtimanska Sredna Gora and from 1200 to 1600 m on Sashtinska Sredna Gora. The mean annual temperature is between 5.7°C and 4.8°C. The vegetation period lasts 127 to 122 days. The precipitation rate is from 943 to 1078 mm with the maximum in June. The snow cover stays between 128 and 122 days. The soils are *Umbric Cambisols*. The forest stands consist mainly of *Fagus sylvatica* and *Quercus petraea.*

Virgin forests

Four locations of virgin forests with a total area of 1170.6 ha have been identified. The majority of the locations are situated in the central and the highest part in the mountain – Sashtinska Sredna Gora –

SFE Panagyurishte and SFE Karlovo. They comprise stands that got recently the status of protected areas. However, already for a long time they have been under the protective management regime as water supply zones and historic locations or the access to them is extremely difficult. The types of forest are: *Fagus sylvatica* forest with *Luzula, Fagus sylvatica* forest with *Galium odoratum* and *Fagus sylvatica* forest with forest plant litter.

Figure 5.1. Investigated territories and identified virgin forests in Sredna Gora

	Investigated territory	State forest enterprise	Protection status	Predominant tree species	Area of studied territories, ha	Area of identified virgin forest, ha
1	Sredna Gora Mountain	Pirdop	Part of CB	*Fagus sylvatica*	638.6	549.1
2		Panagyurishte	WSZ	*Fagus sylvatica*	854.8	592.8
3		Panagyurishte	HL	*Fagus sylvatica*	92.3	20.3
4		Karlovo	HL	*Fagus sylvatica*	20.6	8.4
				Total	**1606.3**	**1170.6**

The largest areas of virgin forests have been identified in a closed basin of SFE Pirdop – 549.1 and in a water supply zone on the territory of SFE Panagyurishte – 592.8 ha. There are some isolated virgin forests on the territory of historic locations – total area 28.7 ha. The distribution of the identified virgin forests by altitude shows that 78% of them are situated in the altitude range 800 – 1200 m. Virgin forests on relatively humid and shady exposures predominate (59.9%). Virgin forests on inclined terrains (11 - 20^{o}) predominate – 50%. The share of those situated on steep terrains (21 - 30^{o}) is 30%. Only a small portion of the virgin forests is situated on very steep and ravine locations, because such conditions are rather rare in Sredna Gora.

Among the preserved virgin forests in that mountain *Fagus sylvatica* forests predominate (60%), followed by *Quercus petraea* forests (32%). Apart from the pure beech forests also the valuable mixed *Fagus sylvatica* - *Carpinus betulus* stands occur in the region, where *Carpinus betulus* demonstrates good growth in association with *Quercus petraea.*

Other species occurring as single individuals or small groups in the *Quercus petraea* formations are *Acer pseudoplatanus, Acer platanoides, Sorbus torminalis, Sorbus aucuparia* and *Fraxinus excelsior.*

The average age of the *Quercus petraea* formations in the region is high. Individual *Quercus petraea* specimens reach as much as 200 years-of-age. Despite the old age of the *Quercus petraea* stands their health status is good. Nearly 12% of the individual virgin forests are some 150-200 years old, the age of 15% is in the interval 120-150 years and 63% are aged between 80 and 100 years.

5.3. Typical virgin forest complexes in Sredna Gora Mountain

Polygon 1: SFE Pirdop. Part of closed basin. Area: 549.1 ha. *Fagus sylvatica* 100%. Type of forest: "*Fagus sylvatica* forest with *Galium odoratum"*.

Polygon 2: SFE Panagyurishte. 'Moley" water supply zone. Area: 592.8 ha. *Fagus sylvatica* – 100%. Type of forest "*Fagus sylvatica* forest with *Galium odoratum"*..

Polygon 3: SFE Panagyurishte. "Oborishte" historical locality. Area: 20.3 ha. *Fagus sylvatica* – 100%. Type of forest: "*Fagus sylvatica* forest with forest plant litter".

Polygon 4: SFE Karlovo. "Chevira" historical locality. Area: 8.4 ha. *Fagus sylvatica* – 100%. Type of forest "*Fagus sylvatica* forest with *Luzula* ".

6. Virgin forests in Vitosha Mountain

6.1. Physical and geographic characteristics

According to the physical and geographic division Vitosha Mountain falls under the South Bulgarian Province. It is part of the transitional fault Kraishte-Sredna Gora region and occupies the Western Sredna Gora part of the Plana-Zavala mountains row (Mishev, 1989). The name Vitosha has a Thracian root and means twin-peak, called after the two rocky peaks Reznyoivete.

Vitosha is the only not very indented domes mountain in our country. It extends in northwestern-southwestern direction and its highest point – Cherni Vrah Peak (2290 m a.s.l.) – towers up in its very center. To the north of it is situated the Sofia lowland, to the west – the Pernik lowland and to the south – the northwestern periphery of the Samokov Plain ("Palakariyata"). Vitosha Mountain has orographic links to Lyulin Mountain via the Vladaya saddle (860 m.), to the Verila Mountain - via the Buka Preslap saddle (1090 m.) and to the Plana Mountain – via the Yarema roof (1195 m.). Within the these boundaries the mountain occupies an area of 278 km^2 (Nikolov, Yordanova, 2002).

Vitosha is built of powerful sienite (monzonite) pluton. Its core consists of Upper Cretaceous volcanites – andesite, andesite breccia, diorite and other rocks. Tertiary conglomerates and sandstones are developed at some places in its northern and western periphery. Limestone and dolomites occur in the southern and southeastern periphery. On some places the solid rocks are permeated by veins of quartz and pegmatite (Bonchev, 1938).

Nine rather large rivers take their sources from this watershed: Tanchovitsa (Kladnitsa), Vladayska, Boyanska, Dragalevska, Yanchovska, Bistritsa, Zheleznishka (Selska), Struma, Matnitsa and Palakariya (Yossifov, 1983). There are no natural lakes in Vitosha Mountain, The famous Boyana Lake (area 2000 m^2) is man-made and was constructed as early as in 1906.

The continental nature of the climate is manifested in the significant temperature variations

between winter and summer and in the May-June precipitation maxima.

Three climatic belts are distinguished:

– The low-mountain forest belt (below 1400 m..), characterized by short winters (up to 4 months) and short-lasting snow cover (30-40 cm). The precipitation is mainly in the form of rain. The average 24-hour temperature exceeds 10°C, from the beginning of April.

– The middle-mountain forest belt (1400–1900 m.). It comprises a large portion of the mountain. It is characterized by a significant snow cover, winters there last for about 5 months. The precipitation rates are voluminous (above 1000 mm at *Aleko* Chalet and *Boeritsa* Chalet).

– The high-mountain forest belt with significant precipitation rates (Cherni Vrah Peak - 1100 mm annual average). The tops of Vitosha Mountain belong to the most humid locations in the country (Georgiev et al., 1971).

The mean annual air temperature at Cherni Vrah Peak is 0.2°C, at *Boeritsa* Chalet 4.2°C, at Selimitsa Chalet 7.1°C. The absolute minimum temperature was – 27°C, measured at Cherni Vrah Peak on 27 December 1941 (Yordanov, 1977). Very typical for the lowlands around Vitosha Mountain are

temperature inversions, with the lowest temperatures in the valleys instead on the ridges. Winter winds are strong. In recent decades devastating storms, which pulled down entire forest massifs, have emerged at certain locations.

The soil cover of the Vitosha-Sredna Gora province belongs to the Balkan-Mediterranean soil sub-district (Ninov, 1997), the majority of which covers the belt of *Distric*, CMd. Formed under the influence of the broadleaved and coniferous vegetation they are distributed over approximately 60% of the area, above all in the altitude belt of 1000–1600 m. The soils are predominantly clay-sand deep ones, fresh and average rich to rich. There are traces of erosion at certain places. Erosion is strong in sites along the steep slopes with southern exposure (Donov, 1993).

Chromic Luvisols rank on the second place in terms of distribution. They are typical for the lower parts of Vitosha Mountain and occupy 27% of the total area. They occur at the altitude between 600 and 900 m. Leached gleyic *Luvisols* subtypes, formed under the influence of the broadleaved forest vegetation, shrub formations and grass massifs predominate.

In the upper end of the middle-mountain and high-mountain belt occur Umbric Cambisols, Humic Cambisols, Gleysols on mountain meadows and peat-bogs, formed under the more severe conditions of the high-mountain climate of Vitosha Mountain.

In the low parts of the mountain, especially around the human settlements, where forests are subjected to excessive use, the soils are poor and gravely eroded. *Chromic*, L_lVx, *Vertisoils* and *Dystric* Pld. occupy smaller areas. (Ninov, 1997).

6.2. Forest vegetation

Vitosha Mountain belongs within the European phytogeographic district of broadleaved forest to the Illyrian (Balkan) province and its isolated and independent Vitosha District (Bondev, 1997).

The vegetation cover is formed by nemoral (broadleaved deciduous), boreal (coniferous) and Arctic-Alpine species, classified under three vegetation belts:

– Mesophylic deciduous forest with predomination of oak, hornbeam and beech;

– Coniferous forest;

– High-mountain (Alpine) vegetation;

The belt of mesophylic deciduous forests is subdivided into:

The oak-hornbeam sub-belt (650–800 m..). From the former centuries-old oak forests only individual specimen of secondary origin have remained (Georgiev, 2004).

The beech sub-belt (800–1600 m.) In the lower parts its structure is distorted by the increase of *Carpinus betulus, Populus tremula*, *Acer campestre,*, *Fraxinus ornus*, *Fraxinus excelsior*, *Tilia grandifolia* and a large number of shrub species.

The coniferous forests belt (from 1500–1600 to 1800–1900 m.) is represented entirely by *Picea abies* Karst. It is best developed in the watershed basin of the river Bistritsa and also along the upper stretches of the rivers Dragalevska and Boaynska. Small groups of *Picea abies* occur also on the south slopes of the village of Kladnitsa and the village of Chuypetlyovo. In Vitosha Mountain *Picea abies* forms the upper timber line, which is lower as a consequence of the devastation of forests (Gateva,

1985). Accompanying components of the *Picea abies* stands are *Pinus sylvestris*, *Abies alba*, *Pinus peuce* and *Salix caprea.*

The high-mountain vegetation belt is found above 1800 m., with some stands of *Picea abies, Pinus peuce* and *Pinus mugo*.

6.3. History of Vitosha National Park

The situation of this mountain (between the Balkan Mountain range and the Rila-Rhodopes massif, and in the vicinity of the capital of the country) and the diverse physical and geographic conditions have served as preconditions for the announcement of Vitosha Mountain as one of the first parks in Southeastern Europe as early as in 1934 with the objective to conserve its forests, pastures, rock complexes and peat fields. Presently from the entire territory (26,606 ha) of the Vitosha Nature Park 24,078 ha is covered with forest.

The broadleaved high-stem forests cover 1584 ha (10.9%). Other more common species besides *Fagus sylvatica* L. are *Carpinus betulus* L., *Betula pendula* Roth., *Quercus petraea* (Matt.) Liebl. and *Quercus cerris* L. Coniferous forests occupy 39.3%, including 23.3% natural stands. These dendrocoenoses are represented mainly by *Picea abies*. The *Pinus mugo* stands occur on spots of the total area of 3.5 ha in the area of Shtastlivetsa Chalet and on the mountaintops (Gateva, 1985). Some of them are of artificial origin.

Travel notes of the Turkish geographer and historian Evliya Chelebi from 1652, state that he had visited the Beliiefendi Field (Knyazhevo) and that it was a "….. very thick forest, which neither an arrow, nor a bullet could break through….".

Since then iron mining industry had had a devastating impact. According to Yordanov's estimates (1977) it required 40,000 solid cubic meters of timber per annum.

Mountain stock-rearing also contributed to the poor state of the forests in the higher parts of Vitosha Mountain. Immigrated gross sheep breeders ("Yuruks"), used to graze flocks of several thousand sheep, settled down there together with the Turks. This had led to forest fires and to cutting of forests for pastures on an area of about 45000 ha.

In the years before and after the Liberation (1878) the last seed production beech forests on the western slopes of Vitosha Mountain and the valley of the Vladayska rive were cleared for the purposes of construction of the railway to Pernik and Radomir.

After the announcement in 1934 of the Vitosha National Park the foundations were laid of a profound research and professional forestry activity for protection of the green wealth.

Despite the objection of the local population (the village of Bistritsa), who had the Vitosha forests as a legally permitted object for economic use, a decision was taken to set up the first forest reserve in Vitosha Mountain in the basin of the river Bistrishka and to place the forest under a strict protection regime.

6.4. Virgin forest

After 40 years of ban on grazing and felling and the limited access of people, the forest has profoundly changed (Yordanov, 1977). *Picea abies* trees, which are now above 100 years-old have grown to a height above 26–28 m and have a diameter of nearly 50 cm at breast height. In terms of forest tree stock the Bistritsa *Picea abies* forest, the most representative part of the park, can be compared with some famous *Picea abies* forests in Rila Mountain and the Rhodope Mountains and has regained its old glory (Table 1).

This natural wealth gave grounds in 1977, in the framework of the "Man and Biosphere" (MAB) Programme of UNESCO, to incorporate the reserve "Bistrishko Branishte" with a total area of 748.1 ha in the World Network of Biosphere reserves, which ranks it among the most valuable and important ecosystems on the planet.

The investigation revealed in the area of the "Bistrishko Braniishte" reserve, the presence of *Picea abies* virgin forests in the polygon of the "Piperkata" locality and in the polygon below the "Golyamata Gramada" locality. Their total area is 211.9 ha.

The *Picea abies* communities occur mainly in the altitude range of 1600 m and belong to the type "*Picea abies - Abies alba - Fagus sylvatica* forest with *Vaccinium myrtillus*". At the altitude of about 1800-1900 m the "*Picea abies* forest with mosses and *Vaccinium myrtillus"* type of forest occurs as well (Penev et al., 1969).

Steep gradients from 15 to 25° predominate (total area 76.1 ha). Sloping terrains represent some 85.8 ha and the very steep ones (25–30°) account for 61.2 ha. The predominant exposures are shady – 68.2 ha N and 45.5 ha NE, 33.0 ha E and 37.8 ha W. The average age of the *Picea abies* stands is 80–120 years (area 168.9 ha) and 120–150 years (43.1 ha).

The storm, which raged in the mountain in 2001, blew down about 60 ha (10%) of natural *Picea abies* forest in the reserve. This event has to be accepted as a natural process in virgin forests.

In 2001 a decision was passed not to haul and clean the fallen timber. There is a proposal to organize monitoring of the health status of the stands, the spread and effect of the Bark beetle (*Ips typographus*), and other ascending changes as storm impact and regeneration process. In 2003 drying up of the *Picea abies* in the area around the windbreaker spot appeared and an additional Bark beetle spot of about 30 ha was formed.

Figure 6.1. Investigated territories and identified virgin forests in the Vitosha Mountain

No.	Investigated territory	State forest enterprise	Protection status	Predominant tree species	Area of investigated territories, ha	Area of identified virgin forest, ha
1	Vitosha Mountain	Vitosha Nature Park	NP	*Picea abies*	211.9	211.9
				Total:	**211.9**	**211.9**

7. Virgin forests in Rila Mountain

7.1. Physical and geographic characteristics

Rila Mountain is situated in Southwest Bulgaria and is part of the large Rila-Rhodopes mountain area. It is the highest mountain in Southeast Europe – Peak Mussala towers at 2925 m a.s.l.

The mountain range is divided into three parts: Northwestern Rila with an area of 577.5 km^2, Eastern Rila – 897.3 km^2 and Southwestern Rila – 718.5 km^2. The total area of Rila Mountain is 2392.6 km^2 (Stoychev, Petrov, 1981).

A characteristic feature of the mountain is the clearly expressed block-indented morphological structure with sharply outlined fault slopes along the periphery and high ridges. Relic glacier forms of quaternary origin – circus lakes, trog valleys, riegels, moraines etc. are widely spread. More than 80% of the mountain area belongs to the middle, high and sub-Alpine forest vegetation belt (Yordanov et al., 2002).
Metamorphous (gneisses, amphibolites etc.) and solid rocks (South-Bulgarian granites) predominate.

The climate of Rila Mountain is a mountain version of the transitional continental climatic region along the northern slopes and bears signs of the mountain version of the continental-Mediterranean climatic region along the southern slopes (Tishkov, 1982). The mean annual temperature goes down from 13.2°C at an altitude of 300 m to –2.6°C at 2 900 m for the southern slopes and respectively from 11.6°C at 300 m to –2.6°C at 2 900 m for the northern slopes (Raev, 1983).

For Rila Mountain the vegetation period, defined as a number of days with temperature above 10°C, is as follows: for the southern slopes it diminishes from 224 days at 300 m to 26 days at 2300 m, and for the northern slopes – from 202 days at 300 m. to 22 days at 2300 m.

Rainfall rates vary in the reverse order; from 535 mm at 300 m to 1150 mm at 2900 m. along the south slopes and from 620 mm at 300 m. to 1150 mm at 2900 m. along the north slopes.

Mountain climates, defined after the Rubner method (1960), i.e. according to the number of days with a vegetation period above 10°C, are as follows:

- the warm mountain climate (with a vegetation period above 180 days) extends in Rila Mountain up to 500 m a.s.l. along the north slopes and up to 700 m along the south slopes;

- moderate mountain climate (vegetation period from 180 to 121 days) in the range from 500 to 1350 m a.s.l.(north) and 700-1450 m a.s.l. (south);

- cool mountain climate (61 – 120 days): respectively for 1350-2000 m a.s.l.(north) and 1450 – 2050 m a.s.l. (south);

- Alpine climate (vegetation period 0 days) – above 2500 m a.s.l. (Raev, 1983).

In Rila Mountain the "optimum zone" covers the range from 900±50 m to 1650±100 m a.s.l. (Raev, 1983). The bottom boundary of that zone is determined where the de Marton Index has a value more than 40. For the south slopes it is about 950 m a.s.l. and for the northern ones – 850 m a.s.l. For the upper boundary of that zone a 4.5°C isoterm was adopted – the altitude until which the most productive

tree species - *Abies alba* - is encountered (Radkov, 1970). It is 1700-1759 m a.s.l. along the south slopes and 1550 – 1600 m a.s.l. along the north slopes.

Rila Mountain is known for its significant water bearing capacity because of the mountain climate and poor water permeability of the underlying rock substrate. The average annual share of ground waters in the river runoff ranges from 30 to 60%. Concerning water, Rila Mountain is the richest part of Bulgaria. This is particularly valid for the high mountain belt of above 1600 m a.s.l. The hydrological saturation is explained by the considerable rainfalls and the ample water runoff. The hydrological saturation varies between 200 mm in the mountain skirts and 800 mm in the high-altitude parts of mountain, whereat it is higher on the northern slopes than on the southern ones. The runoff coefficient varies between 30% and 90%, and increases with the increase of the altitude. High water is typical for the spring-summer seasons and water deficit – for the autumn (Yordanova et al., 2002).

Under these specific geological, climatic and anthropogenic conditions the following soil types have been formed in Rila Mountain: *Dystric-Eutric Cambisols, Umbric Cambisols* and *Modic Cambisols*. Along the northern, more humid and shady slopes with gradient from 10 to 45^{o} *Dystric-Eutric Cambisols* are developed at an altitude from 1000 to 1800 m. In the southwestern and western parts of Rila Mountain *Dystric-Eutric Cambisols* are developed at 700 to 1600 m a.s.l. They are the product of the forest soil-building process with an element of mountain-soil-formation, mainly in coniferous forests, under the conditions of moderate cool and humid climate and good drainage capacity (Grozeva, 1997).

The humus-accumulating horizon is of low capacity and changes from 10 to 30 cm. It is deeper at shady exposures. The transitional horizon varies from 15 to 70 cm. The total depth of these soils is not very great – from 40 to 110 cm. They feature high porosity, high sand content and water permeability and good aeration, which makes them very suitable for forest vegetation (Naumov, Antonov, 1965). The humus content is high and the total quantity of nitrogen is moderate, the soil humidity is favorable and all this results in the good productive capacity of the *Dystric-Eutric Cambisols* in Rila Mountain. *Maroon* soils are encountered at an altitude below 700 m.

Umbric Cambisols are the product of the uniform *Picea abies* forests and it is namely in Rila Mountain that they have been described for a first time in Bulgaria (Antipov-Karataev, Gerasimov, 1948). Their distribution begins from 1500-1600 m a.s.l. and reaches up to 2000-2300 m a.s.l. (Grozeva, 1997). They are characterized by significant capacity of the forest cover of the “moder” type. The humus-accumulating horizon is powerful, 30-50 cm thick, black, crumbly, peaty. In certain cases it reaches 60-70 cm. The transition horizon is from 50 to 30 cm (Georgiev, 1976). The humus content is quite high. They are rich in total nitrogen. They possess good soil fertility.

The *Modic Cambisols* are formed at an altitude of 1800-1950 m and extend up to 2300-2600 m. They are developed under the high-mountain meadow vegetation and under *Pinus mugo* and *Juniperus* (Grozeva, 1997).

7.2. Forest vegetation in Rila Mountain

European vegetation province

The following types of vegetation are encountered in Rila Mountain: boreal-montane type of coniferous forest and Arctic-Alpine vegetation (Velchev, 2002). The coniferous forest vegetation predominates in Rila Mountain.

The *Pineta sylvestris* formation is widely spread in the mountain. It occupies the intermediate position between the mesophytic and the xerophytic type. It prefers slopes of various gradients and mainly sunny exposures. The geological substrata are mainly silicate and the soils are *Dystric-Eutric Cambisols* and *Umbric Cambisols*; medium rich to poor, with moderate to low moisture content. It usually occupies the range from 1000 to 1800 m a.s.l. along the southern slopes and from 900 to 1400 m a.s.l. along the northern exposures. There are a number of exceptions to that rule as well.

The *Piceeta abies* formation is also widely spread in Rila Mountain. It is a typical mesophytic type. It prefers north exposures, starting from 1300-1400 m and going up to 2000 m. Along the sunny exposures of Rila Mountain it starts at about 1600 m a.s.l. and goes up to the upper boundary of the forest (2000 m.). The geological substratum is mainly silicate rock. The soils are *Umbric Cambisols*, quite rich and humid during most of the vegetation period. This is a highly productive formation, which is of great importance for the forestry sector.

The *Abieta albae* formation has a more limited distribution in Rila Mountain; on the north slopes it is encountered at 1000-1400 m a.s.l. and on the south slopes at 1100-1500 m a.s.l., mainly in mixed forests with *Pinus sylvestris* or *Picea abies*.

The *Pineta peucis* formation is found mainly towards the upper boundary of the forest, between 1700 and 2000 m a.s.l. In ecological respect it falls between the formations of *Piceeta abies* and *Pineta sylvestris.* It prefers slopes of various gradients and manages to survive even at very steep and eroded terrains, however mainly on north exposure. It prefers silicate geological substrata. The soils are *Umbric Cambisols*, although it can also grow well on *Dystric-Eutric Cambisols*. It forms pure stands or a mix with *Pinus sylvestris* and *Picea abies.*. This is an endemic formation for the Balkan Peninsula. It is an extremely valuable formation for the upper timber line, including on eroded terrains.

In the Arctic-Alpine vegetation the *Pineta mugi* formation is of utmost importance for Rila Mountain. It occurs widespread in the belt from 1800-2000 to 2500 m a.s.l., especially along the north slopes, above the alpine timber line. The largest complexes of *Pineta mugi* in Bulgaria are found in Rila Mountain. The geological substrate is silicate and the soils are *Umbric Cambisols* with high moisture content. Near the alpine timber line there are single trees of *Picea abies, Pinus peucis* or *Pinus sylvestris*. This is a most valuable formation because of its soil-protecting and hydrological role (Raev, 1989).

Forest vegetation subdivision of Rila Mountain

According to the forest vegetation types of Bulgaria, described by Zakhariev et al. (1979), Rila Mountain has the following forest zonation:

- Lower mountain forest zone of *Quercus petraea, Fagus sylvatica* and *Abies alba* from 700 (600-800) to 1200 (1100-1300) m a.s.l. This belt occupies the mountain skirts and the steep mountain slopes. The mean annual temperature is between 3.9 to 8.7^{o}C. The vegetation period is between 128 and 170 days. The annual rainfall is from 714 to 939 mm with a maximum in June. The continuous snow cover is between 66 and 107 days. The soils are transitional between *Cambisols* and *Luvisols*. The forests are pure or mixed forests of *Quercus petraea and Fagus sylvatica*, as well as of *Pinus sylvestris* and *Pinus nigra.*

- Middle mountain forest zone of *Fagus sylvatica, Abies alba* and *Picea abies* from 1200 (1100-1300) to 1700 (1600-1800) m a.s.l. It occurs on vast steep slopes, as well as vast flat ridges. The mean annual temperature is between 3.7 and 5.5^{o}C. The vegetation period is from 87 to 127 days. The rainfall is from 974 to 1034 mm with a maximum in June. The continuous snow cover is some 124-136 days. The soils are typical *Dystric-Eutric Cambisols*. The forests are pure and mixed *Pinus sylvestris* forests along the sunny slopes and pure and mixed *Picea abies* and *Abies alba* forests along the shady slopes.

- Upper mountain forest zone of *Picea abies* from 1700 (1600-1800) to 2000 (1900-2100) m a.s.l. It covers wide and steep slopes or rounded up ridges. The mean annual temperature is between 3.1 and 4.3^{o}C. The rainfall is between 1014 and 1034 mm with a maximum in June. The continuous snow cover is between 168 and 178 days. The soils are *Umbric Cambisols.* The forests are pure or mixed of *Picea abies* and other tree species – *Pinus sylvestris* and *Pinus peuce.*

- High-mountain forest of *Abies alba* and *Pinus peuce* from 2000 (1900-2100) to 2200 (2100-2300) m a.s.l. This belt covers high ridges and steep slopes. The soils are *Umbric Cambisols*. The forests are composed by *Pinus peuce*, *Picea abies* or *Pinus sylvestris*, as well as *Pinus mugo.*

- Sub-Alpine zone of individual trees of *Pinus mugo* and others, from 2200 (2100-2300) to 2500 (2400-2600) m a.s.l. on the high ridges and peaks. The mean annual temperature is about 3.1^{o}C. The vegetation period is around 68 days. The rainfall is approximately 1050 mm. The continuous snow cover is about 200 days. The soils are *Umbric Cambisols*. The vegetation consists of individual specimens of *Picea abies, Pinus sylvestris*, *Pinus peuce* and above all *Pinus mugo*.

Relation between forest formations and climate

Using the classification of forest formations according to Velchev (2002) and the climate parameters depending on the altitude for Rila Mountain (Raev, 1982), we can obtain the climate-related characteristics of the major forest formations in Rila Mountain.

Phytoclimate of the sub-Alpine vegetation zone

The zone of sub-Alpine climate extends from 2050 to 2500 m a.s.l. along the south slopes and from 2000 to 2500 m a.s.l. for the north slopes of Rila Mountain. According to Velchev (2002) and Bondev (1991) this is the zone of *Pinus mugo* and *Juniperus,* surrounded by the sub-Alpine herbaceous vegetation. The climatic parameters are as follows:

- Mean annual temperature: from 3.1^{o}C to 0.3^{o}C;

- Vegetation period; from 66 to 0 days for the south slopes and from 62 to 0 days for the north slopes;

- Temperature total during the vegetation period: from 820 to 0^{o} for the south slopes and from 680 to 0^{o} for the north slopes;

- Rainfall: from 992 to 1090 mm for the south slopes and from 1095 to 1135 mm for the north slopes;

- De Marton Index; above 77 for the south slopes and above 87 for the north slopes (Raev, 1997).

Phytoclimate of the Picea abies* and *Pinus peuce forest zone

Conventionally, this zone covers the range from 1700 (1600-1800) to 2000 (1900-2100) m a.s.l. and according to Velchev et al. (1982) this is the upper part of the coniferous forests belt. Here we present some climate-related indicators for the development of *Picea abies* and *Pinus peuce*:

- Mean annual temperature: from 4.4°C to 3.0°C for the southern slopes and from 3.9°C to 2.6°C for the north slopes;

- Vegetation period; from 100 to 66 days for the south slopes and from 95 to 62 days for the north slopes;

- Temperature total during the vegetation period: from 1160 to 660° for the south slopes and from 1000 to 530° for the north slopes;

- Rainfall: from 930 to 992 mm for the south slopes and from 1035 to 1095 mm for the north slopes;

- De Marton Index; from 65 to 77 for the south slopes and from 74 to 87 for the north slopes.

Phytoclimate of Pinus sylvestris forest zone

The zone of *Pinus sylvestris* forests in Rila Mountain covers an interval from 1200 (1100-1300) to 1700 (1600-1800) m a.s.l. and forms the lower end of the belt of coniferous forests. The climatic parameters are as follows (Raev, 1997):

- Mean annual temperature: from 6.7°C to 3.9°C for the south slopes and from 6.1°C to 3.9°C for the north slopes;

- Vegetation period; from 138 to 100 days for the south slopes and from 135 to 95 days for the north slopes;

- Temperature total during the vegetation period: from 2000 to 1160° for the south slopes and from 1800 to 1000° for the north slopes;

- Rainfall: from 802 to 930 mm for the south slopes and from 815 to 1035 mm for the north slopes;

- De Marton Index; from 48 to 65 the south slopes and from 51 to 74 for the north slopes.

It is important to note that the main forest-forming species along the south slopes of Rila Mountain is *Pinus sylvestris*, while the participation of *Picea abies* is dominant along the north slopes. On both types of slopes participate also *Abies alba* and *Fagus sylvatica*, and in the upper part of the mountain – *Pinus peuce* as well. It is here that the most productive coniferous forests in Bulgaria occur.

7.3. Virgin forests in Rila mountain

From the total of 22 088.6 ha forest area studied in Rila Mountain, in 2004 a total of 20 394.2 ha of virgin forests have been identified, relatively evenly distributed among 10 state forestry enterprises, the

"Rila Monastery" Nature Park and the "Georgi Avramov" Experimental and Training Enterprise. Larger complexes of virgin forests are situated in the state forestry enterprises of Samokov, Borovets, Rila Monastery, Blagoevgrad and Kostenets. They are much less present in Dupnitsa, Belitsa, Simitli, Belovo and Yundola. The greatest number of preserved natural forests exists within the boundaries of the Rila National Park (16 486.5 ha), as well as in its five reserves: Parangalitsa, Central Rila Reserve, the Rila Monastery Forest, Ibar and Skakavitsa (2878.9 ha). There are 669.5 ha in "closed forest basins' and 96.3 ha in seed production stands.

Virgin forests in Rila Mountain grow mainly on granite products (53.7%), South-Bulgarian granite (21.9%) and gneiss (16.3%). Since they occur mainly at an altitude above 1400 m, *Umbric Cambisols* predominate (64.7%), while the participation of the Dystric-*Eutric Cambisols* is lesser (20.5%). The areas manifest high soil fertility.

Figure 7.1 Studied territories and identified virgin forests in Rila Mountain

Code No.	Studied area	State forestry enterprise	Protection status and accessibility	Dominant tree species	Investigated area (ha)	Area identified as virgin forest (ha)
1	Northern slopes	Dupnitsa	CB	*Picea abies, Abies alba*	219.4	121.5
2	of Rila Mountain		NlP	*Abies alba, Picea abies*	145.7	93.0
3			SPS	*Picea abies, Pinus sylvestris*	96.3	96.3
4		Samokov	R	*Picea abies, Pinus peuce*	403.0	403.0
5			R	*Picea abies, Pinus peuce*	396.7	353.8
6			CB	*Picea abies, Pinus peuce*	248.2	248.2
7		Borovets	CB	*Abies alba, Pinus sylvestris, Quercus petraea*	93.3	93.3
8			R	*Picea abies, Pinus peuce*	61.1	61.1
9			NlP, WSZ	*Picea abies, Abies alba*	65.1	65.1
10			CB	*Picea abies, Pinus mugo*	47.6	47.6
11		Kostenets	P	*Picea abies, Pinus sylvestris, Pinus peuce*	168.8	168.8
12			NlP	*Abies alba, Picea abies, Pinus sylvestris*	90.8	90.8
13			NlP	*Abies alba, Picea abies*	176.4	176.4
14			NlP	*Abies alba, Picea abies*	81.0	81.0
15		Belovo	CB	*Abies alba,Fagus sylvatica, Pinus sylvestris*	209.8	107.8
16		Yndola	CB	*Picea abies*	51.1	51.1
17	Southern slopes of Rila Mountain	Rila Monastery	R	*Fagus sylvatica, Quercus petraea, Carpinus betulus*	212.0	97.6
18			R	***Pinus mugo***	100.0	96.6
19		Rila Monastery	R	*Picea abies,Pinus peuce, Abies alba*	1150.0	846.1
20			R	*Pinus mugo*	860.0	617.7

21			NP	*Pinus mugo*	340.0	263.0
22		Blagoevgrad (Parangalnitsa))	BR	*Picea abies, Pinus peuce, Abies alba, Pinus sylvestris*	255.0	234.2
23		(Uoto)	NlP	*Fagus sylvatica*	199.2	199.2
24		(Chakalitsa)	NlP	*Picea abies, Pinus sylvestris, Abies alba,Pinus peuce*	160.0	151.7
25		(Giurganata)	NlP	*Picea abies,Pinus sylvestris, Abies alba*	65.0	61.7
26		Simitli	NlP	*Pinus sylvestris, Abies alba, Fagus sylvatica*	636.0	161.4
27		Belitsa	NlP	*Pinus mugo, Picea abies. Pinus peuce, Pinus sylvestris*	320.0	267.6
28		Yakoruda	NlP	*Pinus mugo*	1718.0	1619.5
29	On the entire territory of the National Park		NlP	*Pinus mugo*	13 519.1	13 519.1
	Total:				**22 088.6**	**20 394.2**

CB – Closed basin
NlP – National park
NP – Nature park
R – reserve
BR – biosphere reserve
NR – nature reserve
SPS – Seed production stand
PL – Protected locality
WSZ – Water supply zone
HL – Historical locality

Rila Mountain is the highest mountain in Bulgaria. This offers the forest belts the possibility to reach high altitude. From 2000 to 2200 m a.s.l. virgin forests are predominant, mainly *Pinus mugo*. Also in the belt of 2200-2400 m a.s.l. the share of these forests is high (29.7%). In the altitude belt of 1800-2000 m occur the forests of *Picea abies* and *Pinus peuce* (14.4%). All in all, 90.2% of the virgin forests in Rila Mountain are situated at an altitude above 1800 m.

North exposures (NW, N, NE) are predominant: 50.6% of the virgin forests. Ranking next are those with eastern exposure (14.1%) and western exposure (14.0%). The forests with other exposures have a lesser participation.

34.2% of the virgin forests in Rila Mountain are situated on steep terrains, i.e. terrains with a gradient between 21 and 30°. If we add the forests situated on very steep and ravine terrains (gradient above 31°), a total of 50.8% of the virgin forests are formed on very hard-to-access locations.

A very interesting point are the differences in share between the tree species in the virgin forests in Rila Mountain. In this aspect the participation of *Pinus mugo* stands out overwhelmingly with 82.8%. These valuable forest formations have survived thanks to the farseeing ban on their felling during the 1960's. Currently they form a vast *Pinus mugo* belt above 2000 m a.s.l. in Rila Mountain – undoubtedly the largest *Pinus mugo* belt in this country (including 16 877.8 ha virgin forests). Ranking next is the participation of Norway Spruce (*Picea abies*) – 6.0%, Macedonian Pine *Pinus peuce*) - 3.3%; Silver Fir (*Abies alba*) – 2.8%; Scots Pine (*Pinus sylvestris*) – 1.3%; Common beech (*Fagus sylvatica*) – 1.1% and some others. .

Aged below 100 years are approximately 45% of the virgin forests in Rila Mountain because of the relative young age of the majority of *Pinus mugo* formations. 34.8% of the virgin forests are between 100 and 150 years of age, 16.8% are aged between 150 and 200 years and only 1.2% are above 200 years of age.

7.4. Characteristic complexes of virgin forests in Rila Mountain

As a result of the work of two research groups in the course of two expeditions in the mountain in 2004 a total of 20 394.2 ha of virgin forests in Rila Mountain have been described and mapped. Characteristic of the virgin forest complexes in Rila Mountain are briefly described per polygon.

Polygon 1: SFE Dupnitsa. "Panichishte" Location. Closed basin, part of the buffer zone of Rila National Park. Area 121.5 ha. *Picea abies* – 80%, *Abies alba* – 20%. Type of forest: "*Picea abies* - *Abies alba* - *Fagus sylvatica* forest with *Vaccinium myrtillus*"

Polygon 2: SFE Dupnitsa. "Panichishte" Location. Closed basin, part of the Rila National Park. Area 93.0 ha. *Abies alba* – 70%, *Picea abies* – 20%, *Pinus peuce* – 10%, single trees of *Sorbus aucuparia*. Type of forest "Valley-type *Picea abies* - *Abies alba* forest"

Polygon 3: SFE Dupnitsa, "Ursuz Voda" Location. Seed productioon stand. Area 96.3 ha. *Picea abies* – 80%, *Pinus sylvestris* – 20%, single trees of *Abies alba*. Type of forest: "fresh *Pinus* L.- *Picea abies* forest with different grass species".

Polygon 4: SFE Samokov, around Beli Iskar Dam, Central Rila Reserve. Area 403.0 ha. *Picea abies* – 80%, *Pinus peuce* – 20%, single individuals of *Alnus viridis*. Type of forest: "*Picea abies* - *Abies alba – Pinus peucie* forest".

Polygon 5: SFE Samokov, Central Rila Reserve. Area 353.8 ha. *Picea abies* – 80%, *Pinus peuce* – 20%, single trees of *Sorbus aucuparia.* Type of forest: "*Picea abies - Abies alba - Fagus sylvatica* forest with green mosses and *Vaccinium myrtillus*".

Polygon 6: SFE Samokov, closed basin, "Karata" Locality. Area 248.2 ha. *Picea abies* – 100%, single trees of *Sorbus aucuparia, Salix caprea*. Type of forest: "*Picea abies* forest with green mosses and Vaccinium myrtillus".

Polygon 7: SFE Borovets, closed basin, "Hodjovitsa" Locality. Area 93.3 ha. *Abies alba* – 60%, *Pinus sylvestris* – 30%, *Picea abies* – 5%, *Fagus sylvatica* – 3%, Q*uercus petraea* – 2%. Type of forest: "valley-type *Abies alba* forest with fern species".

Polygon 8; SFE Borovets, 'Maritsa" Chalet, part of the Central Rila Reserve. Area 61.1 ha. *Picea abies* – 80%, *Pinus peuce* – 20%, single trees of *Salix caprea, Jniperus communis*. Type of forest: "*Picea abies – Pinus peuce* forest"

Polygon 9: SFE Borovets, "Maritsa" Lineman's Lodge, part of the Rila National Park, water supply zone. Area 65.1 ha. *Picea abies* – 70%, *Abies alba* – 18%, *Pinus sylvestris* – 10%, *Pinus peuce* – 2%, single trees of *Fagus sylvatica, Sorbus aucuparia.* Type of forest: "Valley-type *Picea abies - Abies alba* forest".

Polygon 10: SFE Borovets, "Maritsa" Lineman's Lodge, closed basin. Area 47.6 ha. *Picea abies* – 70%, *Pinus mugo* – 20%, *Pinus peuce* – 10%, single trees of *Salix caprea*. Type of forest "*Abies alba – Picea abies - Pinus peuce* forest".

Polygon 11: SFE Kostenets, "Ibar" Reserve, "Vartelezhkata" Locality. Area 168.8 ha. *Picea abies* – 70%, *Pinus sylvestris* – 20%, *Pinus peuce* – 20%, single trees of of *Sorbus aucuparia.* Type of forest: *"Picea abies* forest with green mosses and *Vaccinium myrtillus*".

Polygon 12: SFE Kostenets, water supply zone, part of the Rila National park, "Elenska Skala" Locality. Area 90.8 ha. *Abies alba* – 60%, *Picea abies* – 20%, *Pinus sylvestris* – 10%, *Pinus peuce* – 10%. Type of forest: "Valley-type *Picea abies - Abies alba* forest".

Polygon 13; SFE Kostenets, closed basin, part of the Rila National park, "Tsvetanov Ustrug" Locality. Area 176.4 ha. *Abies alba* – 80%, *Picea abies* – 20%, single trees of *Sorbus aucuparia, Alnus glutinosa*. Type of forest: "Valley-type *Picea abies - Abies alba* forest".

Polygon 14: SFE Kostenets, closed basin and water supply zone, part of the Rila National park, "Dvete Reki" Locality. Area 81.0 ha. *Abies alba* – 70%, *Picea abies* – 20%, *Fagus sylvatica* – 5%, *Acer pseudoplatanus* – 3%, *Tilia grandifolia* – 2%, single trees of *Fraxinus ornus, Corylus avellana, Ulmus minor.* Type of forest: "Valley-type *Abies alba* forest with fern species":

Polygon 15: SFE Belovo, "Gechevoto' Locality. Closed Basin. Area: 107.8 ha. *Abies alba* – 70%, *Fagus sylvatica* – 20%, *Pinus sylvestris* – 10%, single trees of *Corylus avellana, Rosa canina, Sambucus racemosa*. Type of forest: "Valley-type *Abies alba* forest with fern species":

Polygon 16: "G. St. Avramov" Experimental and Training Enterprise, "Yundola" Locality – "Mitnitsata". Closed basin. Area 51.1 ha. *Picea abies* – 100%, single trees of *Salix caprea.* Type of forest:"*Picea abies* forest with green mosses and *Vaccinium myrtillus*"

Polygon 17: Nature Park "Rila Monastery", "Rila Monastery Forest" Reserve. Area 97.6 ha. *Fagus sylvatica* – 75%, *Quercus petrea* – 15%, *Carpinus betulus* - 5%, *Populus tremula* – 5%, single trees of *Acer platanoides, A. pseudoplatanus*, *A. campestre*, *Quercus protoroburoides.* Types of forest: "*Fagus sylvatica* forest with *Luzula*", "*Picea abies - Abies alba - Fagus sylvatica* forest with *Luzula*", "Fresh *Abies alba-Picea abies-Pinus forest"*

Polygon 18; Nature Park "Rila Monastery", "Rila Monastery Forest" Reserve. Area 96.6 ha. *Pinus mugo* – 100%. Type of forest: "*Pinus mugo* forest with *Vaccinium myrtillus*".

Polygon 19: Nature Park "Rila Monastery", "Rila Monastery Forest" Reserve. Area: 846.1 ha. *Picea abies* – 90%, *Pinus peuce* – 5%, *Abies alba* – 4%, *Pinus mugo* – 1%, single trees of *Sorbus*

aucuparia and Salix caprea. Types of forest: "stony *Pinus peuce - Picea abies* forest", "*Pinus peuce* forest mixtoherbosum","sub-alpine *Pinus mugo* forest with *Pinus peuce* and *Picea abies"*.

Polygon 20: Nature Park "Rila Monastery", "Rila Monastery Forest" Reserve. Area: 617.7 ha. *Pinus mugo* – 100%. Type of forest: "*Pinus mugo* forest with *Vaccinium myrtillus*" etc.

Polygon 21: Nature Park "Rila Monastery", "Rila Monastery Forest" Reserve. Area: 263.0 ha. *Pinus mugo* – 100%. Type of forest "*Pinus mugo* forest with *Vaccinium myrtillus*".

Polygon 22: SFE Blagoevgrad. 'Parangalitsa" Biosphere Reserve. Area: 234.2 ha. *Abies alba* – 40%, *Picea abies* – 30%, *Pinus sylvesris* – 20%, *Fagus sylvatca* – 10%, single trees of *Sorbus torminalis*, *Acer pseudoplatanus*, *Populus tremula*, *Alnus viridis*, *Salix.* Types of forest: "*Abies alba* forest with *Oxalis acetosella*", "*Abies alba - Picea abies - Pinus peuce* forest", "high-mountain *Picea abies – Pinus peuce* forest", "sub-alpine *Pinus mugo* forest with *Pinus peuce* and *Picea abies"*.

Polygon 23: SFE Blagoevgrad. Rila National Park, "Uoto" Location. Area: 199.2 ha. *Fagus sylvatica* – 100%, single trees of *Carpinus betulus*, *Ostrya carpinifolia*, *Populus tremula*, *Acer pseudoplatanus*, *Acer*, *Quercus petraea*. Types of forests: "*Fagus sylvatica* forest with forest plant litter", "*Fagus sylvatica* forest with *Galium odoratum*", "*Fagus sylvatica* forest with *Ostrya carpinifolia*".

Polygon 24: SFE Blagoevgrad. Rila National Park, "Chakalitsa" Location. Area 151.7 ha. *Picea abies* – 50%, *Pinus sylvestris* – 40%, *Abies alba* – 5%, *Pinus peuce* – 4%, *Fagus sylvatica* – 1%, single trees of *Populus tremula, Sorbus aucuparia.* Types of forest: "*Picea abies – Abies alba – Pinus – Pinus peuce* forest", "*Pinus- Picea abies* forest with mixtoherbosum", "fresh *Pinus - Fagus sylvatica* forest", "fresh *Pinus -Picea abies* forest with different herbs".

Polygon 25; SFE Blagoevgrad. Rila National Park, "Giurganata" Location. Area 61.7 ha. *Picea abies* – 70%, *Pinus sylvestris* – 20%, *Abies alba* – 10%, single trees of *Abies alba, Pinus peuce, Salix, Juniperus.* Type of forest: "*Picea abies – Abies alba – Pinus peuce* forest".

Polygon 26: SFE Simitli. Rila National Park. Area 161.4 ha. *Pinus sylvestris* – 40%, *Abies alba* – 30%, *Fagus sylvatica* – 20%, single trees of *Picea abeis, Populus tremula*, *Salix, Sorbus aucuparia.* Types of forests: " *Fagus* with forest plant litter (subnudum)", *Fagus – Betula* forest on rocky soils", "*Picea abies – Abies alba – Fagus* forest with *Vaccinium myrtillus*", "fresh *Abies alba - Picea abies – Vaccinium myrtillus* forest".

Polygon 27: SFE Belitsa. Rila National Park. Area 267.6 ha.: *Pinus mugo* – 30%, *Picea abies* – 30%, *Pinus peuce* – 15%, *Pinus sylvestris* – 15%, *Abies alba* – 10%, single trees of *Fagus sylvatica.* Type of forests: "*Pinus mugo* forest with *Vaccinium myrtillus*", "high-mountain *Picea abies - Pinus peuce* forest", "*Picea abies - Abies alba – Pinus - Pinus peuce* forest", "*Abies alba - Picea abies - Pinus peuce* forest".

Polygon 28: SFE Yakoruda. Rila National Park. Area 1619.5 ha. *Pinus mugo* – 100%. Type of forest; "*Pinus mugo* forest with *Vaccinium myrtillus*", "*Pinus mugo* forest with *Nardus stricta*".

Polygon 29: Rila National Park. Area 13519.1 ha. *Pinus mugo* – 100%: Type of forest '*Pinus mugo* forest with *Vaccinium myrtillus*" etc.

8. Virgin forests in Pirin Mountain

8.1. Physical and geographic characteristic

This mountain is part of the Rila-Rhodopes mountain massif, composed of the Rila-Pirin mountain group and the Rhodopes Mountain. Pirin Mountain is situated between the valleys of the river Struma and the river Mesta and is separated from Slavyanka Mountain through the Paril saddle (1170 m a.s.l.) and from Rila Mountain – through Predela (1140 m a.s.l.). The total area of the mountain is 2585 km^2.

In morphological respect Pirin Mountain is divided into three parts:

- Northern Pirin – between the saddles Predel and Todorova Polyana. This part is the highest, with typical alpine characteristics. The highest peak in the mountain, Vikhren Peak (2914 m a.s.l.) is situated there.

- Central Pirin - between the saddles Todorova Polyana and Popski Preslop, with the highest point Orelyak Peak (2099 m.).

- Southern Pirin - between the saddles Popski Preslop and Paril, the lowest part of the mountain with the highest point Sveshtnik Peak (1973 m a.s.l.).

High ridges and deep river valleys, forming a typical alpine landscape are characteristic for the local relief. The most common exposures are northeastern and southwestern with slight predominance of the northern components. Nearly 79% of the total area is characterized by steep (21^o to 30^o) and very steep (above 31^o) gradients. The present relief is shaped mainly during the Pleistocene, when the circus lakes Kutelo, Banski Sukhodol and Golemia Kazan have emerged.

In geological respect the tectonic structure of Pirin Mountain is hosrt with a granite core and a cover of metamorphous rocks of the Proterozoic age. Gneisses, amphibolites, schists, quartzite, limestone and marbles are common.

In climatic respect Pirin Mountain is situated in the continental-Mediterranean region and the climate is generally mountainous with influx of Mediterranean influence along the valleys of the rivers Struma and Mesta.

The average monthly air temperatures during the coldest month – January – are below 0^oC. The maximum average monthly temperatures during the hottest month – July – are about 20^oC for the middle mountain belt and about 15^oC for the high mountain belt. Air temperature above 5^oC is typical for 242 days above 1000 m and for 166 days at the altitude of 2000 m

The rivers in Pirin Mountain are either tributaries of the river Struma – Sandanska Bistritsa, Pirinska Bistritsa, Vlakhinska and Melnishka rivers – or tributaries of the river Mesta – Damyanitsa, Kamenitsa, Retizhe, Banderishka, Bela and Dobrinishka rivers. There are 176 lakes in Pirin Mountain, the majority of which are glacier circus lakes.

The annual precipitation total varies from 600-700 mm in the lower parts to 1000-1200 mm in the high altitude zone. The precipitation maximum is in spring-summer and the minimum – in the summer-autumn. High water in Southern Pirin is typical for winter, beginning in January. The snow cover in the lower parts of Pirin Mountain is retained for maximum 30 days and in the higher parts – up to 150-160 days. The surface runoff there exceeds 500 mm. The air humidity reaches its maximum values of 80% to 85% in December and the minimum values (60% - 75%) have been recorded in August.

Powerful Karst springs are formed in the carbonate parts of the mountain and thermal waters emerge on the surface along the joint valleys (the village of Banya, Razlog District; Musomishta, Dobrinishte, Ognyanovo). The peat deposits of Pirin Mountain accumulate large quantities of pure waters, which feed brooks and rivers.

Chromic Cambisols (depth profile up to 60-70 cm) are typical for the bottom forest tree vegetation belt. At various locations they are strongly eroded. The local vegetation comprises Quercus coccifera, Quercus pubescens, Quercus frainetto, Quercus petraea, Juniperus excelsa and other species.

Distric - Eutric Cambisols are most common for the middle mountain belt of beech and coniferous forests at the altitude from 800 to 1800 m a.s.l. (7.7 %). They are the product of weathering of silicate rocks and develop humus components in the 10-20 cm thick surface layer, manifesting acidifying reaction (Ninov, 2002).

Humic Cambisols are spread in the high mountain belt of Pinus sylvestris Pinus peuce and Pinus mugo from 1500-1700 to 2500 m (44.3 %) on granite substratum. They possess a better-developed humus horizon – about 40-60 cm.

Umbrosols are encountered on a soil-forming granite rock in the Alpine part above 2500 m and partially in the sub-Alpine part (22.1 %). .

Rendzinas (5.9 %) are developed on carbonate terrains, on which Pinus nigra, Pinus heldreichii, Pinus mugo and Juniperus communis grow. .

The altitude of Pirin Mountain is on the average 1033 m within the boundaries from 300 m to 2915 m. Two of the peaks have an altitude above 2900 m (Vikhren Preak - 2915 m. and Kutelo Peak - 2908 m.), seven are above 2800 m high (Banski Sukhodol - 2884 m., Polezhan Peak - 2851 m., Malak Polezhan Peak - 2822 m., Kamenitsa Peak - 2822 m and Bayuvi Dupki Peak - 2820 m.), thirteen are above 2700 m high (Kaikakchal Peak- 2763 m), Yalovarnika Peak - 2763 m.,, Gazey Peak - 2761 m., Todorin Vrah Peak - 2746 m., Kamenititsa Peak - 2742 m., Banderishki Chukar Peak - 2737 m., Djengal Peak - 2730 m., Momin Dvor Peak - 2725 m Bashliyski Chukar Peak - 2720 m Kota Peak - 2712 m, Chengelchal Peak - 2709 m., Malak Todorin Vrah Peak - 2709 m. and Djano Peak - 2707 m

The high mountain forest vegetation belt covers about 32% of the area of the mountain.

8.2. Forest vegetation

Geobotanical regional division

From the point of view of the three vegetation districts identified in our country (European broadleaved forest district, the Euro-Asian steppe and afforested steppe district, and Mediterranean sclerophyllic forest vegetation district), the five vegetation geographic provinces (Euxinean, Illyrian, Macedonian-Thracian, Low-Danubean and Eastern Mediterranean), 28 counties and 80 geobotanical regions, Pirin Mountain falls under the following subdivisions (Bondev, 2002):

1. European broadleaved forest district

1.1. Illyrian (Balkan) province

1.1.1. Pirin county

Quercus petraea stands occur in the lower parts of the mountain, Pinus nigra settles on rocky terrains and in the valleys grow mixed broadleaved plantations in associations with Ostrya carpinifolia. Higher up are situated the beech forests, especially in the southern part of Pirin Mountain and partially near the Predela. The coniferous belt is composed of formations of Pinus nigra, Pinus sylvestris, Picea abies, Pinus peuce and Pinus heldreichii. Formations of Pinus mugo and Juniperus communis, as well as herbaceous formations of Nardus stricta and different fescue species are spread in the sub-Alpine belt. The Alpine belt contains formations of dwarf shrubs of Salix herbacea and Dryas octopetala, as well as herbal formations of Festuca riloensis, Carex curvula, Juncus trifidus, Sesleria korabensis, Agrostis rupestris etc. There are 84 species, which are Balkan endemics and 32 species of Bulgarian endemics. Typical for Pirin Mountain are the following plant species: Thymus perinicus, Alchemilla pirinica, Draba scardica, Papaver degenii, Brassica jordanoffii, Tulipa pirinica, Poa pirinica and some others.

Two regions are clearly distinguished in this district:

- Northern Pirin region, which possesses rich Arctic-Alpine, boreal and sub-boreal flora. Among the tree species characteristic for it are the Balkan endemic Pinus peuce Grisb. and the Balkan sub-endemic and relic species Pinus heldreihii Christ.

- The Central and Southern Pirin region, in which there is no Alpine vegetation and the sub-Alpine vegetation is underdeveloped.

2. Mediterranean sclerophyllous forest vegetation district

2.1. Eastern Mediterranean province

2.1.1. Middle-Struma district – It is situated in the lower parts of Pirin Mountain and comprises xerothermic forest vegetation, dominated by Quercus pubescens and Carpinus orientalis. There is allso shrubby communities of Paliurus spina-christii and Juniperuis oxycedrus. Typical Mediterranean species are Juniperus oxycedrus, Juniperus excelsa, Quercus coccifera, Platanus orientalis, Phyllirea latifolia, Silene graeca, Silene cretica, Sideritus lanata, Papaver apulum etc.

Forest vegetation regioning of Pirin Mountain

According to the former Ministry of Forests and Forest Industries (1976, 1983) and Zakhariev et al. (1979) Pirin Mountain is situated in the Southern border forest vegetation district. The Pirin Mountain sub-region covers the following forest vegetation belts and sub-belts.

I Low plainy and hilly and foothill belt of oak forests (from 0 to 800 m l.)

I.1. Sub-belt of forests on flood terraces and river valleys (floodplain and riverine forests) – from 0 to 800 (700-900) m.; mean annual temperature 10.7-14.0^{o}C; precipitation rate 500-730 mm/year

I.2. Sub-belt of xerothermic and deciduous oak forests – respectively from 0-200 (100-300) to 600 (500-700) m.s .; mean annual temperature 13.6-14.0^{o}C (11.7-13.6^{o}C); precipitation rate 500-550 mm/year (550-670) mm/year

I.3. Sub-belt of mixed broadleaved forests – from 600 (500-700) to 800 (700-900) m.; mean annual temperature 10.7-11.7^{o}C; precipitation rate 670-730 mm/year

II. Middle mountain forest vegetation belt of beech and coniferous forests (from 800 to 2200 m.)

II.1. Low mountain sub-belt of Quercus petraea, Fagus sylvatica and Abies alba forests – from 800 (700-900) to 1500 (1400-1600) m.; mean annual temperature 6.5-10.7^{o}C; precipitation rate 730-930 mm/year.

II.2. Middle-mountain sub-belt of the forests dominated by Fagus sylvatica L., Abies alba Mill. and Picea abies (L.) Karst. – from 1500 (1400-1600) to 1900 (1800-2000) m l., mean annual temperature 5.0-6.5^{o}C and precipitation rate 930-1040 mm/year.

II.3. Upper mountain sub-belt of Picea abies forests – from 1900 (1800-2000) to 2200 (2100-2300) m..; mean annual temperature 4.6-5.0^{o}C; precipitation rate 1040-1130 mm/year

III. High mountain belt (above 2200 m.)

III.1. High mountain sub-belt of Picea abies and Pinus peuce forests – from 2200 (2100-2300) to 2500 (2400-2600) m mean annual temperature 3.7-4.6^{o}C; precipitation rate 1130-1200 mm/year

III.2. Sub-Alpine sub-belt of single trees, Pinus mugo and shrub formations – from 2500 (2400-2600) to 2700 (2600-2800) m.; mean annual temperature 3.3-3.7^{o}C; precipitation rate 1200-1270 mm/year

III.3. Sub-belt of Alpine pastures – above 2700 (2600-2800) m.; mean annual temperature below 3.3^{o}C; precipitation rate – above 1270 mm/year.

Virgin forests in Pirin Mountain

They have been identified on the basis of the approved methodology (Rosnev et al., 2003) and data collected from literary sources, satellite images, forest management projects, surveys among forestry engineering staff with many years-of-service and mainly as a result of field studies by targeted expeditions, which ensured the most reliable results.

Table 8.1. Studied territories and virgin forests identified in Pirin Mountain

	Studied territory	State forest enterprise	Protection status	Predominant tree species	Area of the studied territory [ha]	Area of the identified virgin forest [ha]
1	Northern Pirin Mountain, the northern slopes of Central and Southern Pirin Mountain	Razlog (Bayuvi Dupki)	BR	*Pinus mugo. Pinus peuce. Pinus heldreichii. Fagus sylvatica*	3400.0	1850,6
2		Bansko-Dobrinishte (Vikhren, Bezbog))	NlP+R	*Pinus mugo. Pinus peuce. Picea abies. Pinus heldreichii*	8460.0	5692,6
3		Gotse Delchev	NlP, WSZ	Pinus mugo. Pinus peuce. Fagus sylvatica	1620.0	624,8
4			CB	Pinus sylvestris. Picea abies. Pinus peuce	780.0	459,8
5			R	Fagus sylvatica	800.0	543,2
6		Dobrinishte	CB	Pinus nigra. Fagus sylvatica	50.0	28,5
7	Western part of Pirin Mountain	Katuntsi	CB	Fagus sylvatica. Pinus sylvestris	10887.0	8193,4
8			CB, NlP	Pinus peuce. Fagus sylvatica	3800.0	3693,0
9		Kresna	NlP	Pinus peuce. Pinus sylvestris. Abies alba	4275.4	1587,8
10		Sandanski	NlP	Pinus peuce. Pinus mugo. Picea abies	5708.0	3943,7
11		Simitli	CB	Pinus peuce. Fagus sylvatica. Pinus sylvestris	330.0	289,2
				Total:	40110.4	26 906,6

* R Reserve
** BR Closed basin
*** NlP National Park
**** WSZ Water Supply Zone
***** CB Closed basin

The vascular flora in Pirin National park counts approximately 1300 species, belonging to 480 genera of 94 families, including 65 tree and shrub species.

The number of endemic plant species in the park is 57, including 18 local, 15 Bulgarian and 24 Balkan ones. Glacial vegetation relicts are 20 and the number of protected plant species is 54.

Polygon 1: "Bayovi Dupki" Park Area. Virgin forests area 2484.8 ha, composed of: Pinus mugo - 37%, Pinus peuce - 19 %, Pinus heldreichii - 11%, Fagus sylvatica - 11%, Pinus nigra - 8%, Abies alba - 6%, Pinus sylvestris - 4%, Picea abies - 4%.

Polygon 2: "Vihren" park area and "Bezbog" park area. Virgin forests area 5680.8 ha, composed of the tree species: Pinus mugo - 33%, Pinus peuce - 22%, Picea abies - 14%, Pinus heldreichii - 11%, Abies alba - 8%, Pinus sylvestris - 8%, Pinus nigra - 4% and Fagus sylvatica – single trees. The area of virgin forests on this polygon has been reduced by 80 ha (64 ha – for the existing skiing tracks and 16 ha – for the available skiing facilities). In the event of the planned implementation of the project Skiing Centre Bansko the area of the virgin forests will be reduced by additional 70-80 ha and in the event of windfalls, snowfalls and avalanches – this surface will be multiplied.

Polygon 3: Part of "Trite Reki" park area, SFE Kornitsa and SFE Breznitsa. Virgin forests area 1047.1 ha, composed of: Pinus mugo - 45%, Pinus peuce - 43%, Fagus sylvatica - 9%, Pinus sylvestris - 2%, Picea abies - 1%, Abies alba, Sorbus aucuparia and Salix caprea – isolated individuals.

Polygon 4: SFE Gotse Delchev. Virgin forests area 459.8 ha, composed of: Pinus sylvestris - 35%, Picea abies - 29%, Pinus peuce - 28%, Abies alba - 6%, Fagus sylvatica - 2%, Sorbus aucuparia – isolated individuals.

Polygon 5: "Orelyak" reserve. Virgin forests area 543.2 ha, composed mainly of Fagus sylvatica - 100% and individual specimen of Abies alba, Carpinus betulus, Populus tremula, Acer pseudoplatanus, Acer platanoides. and Betula pendula – individual trees.

Polygon 6: SFE Dobrinishte. Closed basin of 28.5 ha near the St. Pantaleymon Monastery with the participation of Fagus sylvatica - 50%, Pinus nigra. - 50% and isolated individuals of Acer pseudoplatanus, Populus tremula and Sorbus aucuparia.

Polygon 7: SFE Katuntsi. Closed basin of 8847.0 ha, predominant are Fagus sylvatica and Pinus sylvestris.

Polygon 8: "Kamenitsa" park area. Virgin forests area 2751.7 ha, composed mainly of Pinus peuce and Fagus sylvatica.

Polygon 9: "Kamenitsa" park area. Virgin forests area 4193.6 ha, composed mainly of Pinus peuce, Pinus mugo and Picea abies.

Polygon 10; "Sinanitsa" park area. Virgin forests area 1558.0 ha, composed mainly of Pinus peuce, Pinus sylvestris.and Abies alba.

The main types of forest in Pirin Mountain are as follows (Penev et al., 1969):

- Pinus nigra forest on dry rendzines
- Pinus nigra - Picea abies forest with Abies alba
- Fresh Picea abies forest with Carpinus betulus
- Fagus sylvatica + Quercus petraea + Carpinus betulus forest with Luzula
- Fagus sylvatica forest with Ostrya carpinifolia
- Fagus sylvatica forest with Galium odoratum

- Fagus sylvatica forest with Luzula
- fresh Fagus sylvatica forest with Vaccinium myrtillus
- fresh Pinus -Picea abies forest with different herbs
- fresh Pinus -Picea abies forest
- Pinus forest with Quercus petraea on Cambisols
- Stony Pinus forest
- Valley Picea abies - Abies alba forest
- Fresh Abies alba – Picea abies – Pinus forest
- Picea abies forest with mosses and Vaccinium myrtillus
- Picea abies - Abies alba - Pinus peuce forest
- Picea abies – Pinus heldreichii forest
- Fresh to humid Pinus peuce - Abies alba forest
- Pinus peuce - Pinus sylvestris forest with Vaccinium myrtillus
- Pinus peuce forest with mixtoherbosum
- Sub-Alpine very stony Pinus peuce forest
- Pinus nigra - Pinus heldreichii forest
- Fresh Pinus heldreichii forest with Luzula
- Pinus heldreichii forest with Thymus
- Pinus heldreichii forest on rocky places
- Sub-Alpine Pinus mugo forest with Pinus peuce and Pices abeis
- Sub-Alpine Pinus mugo forest with Pinus peuce
- Pinus mugo forest with Vaccinium myrtillus

The distribution of virgin forests in the Pirin National Park by types of tree species is as follows: mixed coniferous forests (64.4 %), Pinus peuce and Pinus heldreichii forests (16.6 %), Pinus sylvestris forests (9.5 %), Fagus sylvatica forests (4.0 %), Picea abies forests (2.1 %), Pinus nigra forests (1.2 %), mixed coniferous-broadleaved forests (1.1 %), Abies alba (1.0 %) and mixed broadleaved forests (0.1 %)..

The altitudinal distribution varies from predominance in the middle mountain belt (up to 83.9%), to 28.1% in the upper mountain sub-belt (). In the high mountain belt it is 9.8%, while in the low altitude plainy and hilly and foothill belt it is only 6.3%.

In terms of exposure these forests are distributed as follows: E – 16.0 %, W – 13.6 %, N – 18.3 %, S – 6.3 %, NE – 15.6 %, NW – 6.9 %, SE – 5.1 % and SW – 8.2 %, i.e. exposures with a northern component predominate (65.6 %), while those with southern exposure (34.4 %) have suffered more from anthropogenic pressure.

With respect to the distribution of virgin forests in the Pirin National Park by gradient, sloping terrains (0-10^{o}) account for 0.2 %, inclined terrains (from 11^{o} to 20^{o}) – 5.8 %, steep terrains (21^{o}-30^{o}) – 44.4 %, very steep terrains (31^{o}-40^{o}) – 47.8 % and ravines (above 40^{o}) – 1.8 %.

In terms of legal status these forests are mainly within the boundaries of the national park (39.9%) and in closed basins (35.8%), followed by those in reserves (15.6%) and biosphere reserves (6.3%). The share of those in the forest stock is the smallest (FS) – 2.4%.

In terms of age virgin forests aged below 120 predominate (84.7%), those in the group of 120 to 200 years of age account for 14.4% and only 0.9% are aged above 200 years.

Typical complexes of virgin forests in Pirin Mountain are those included in the ten polygons, whereas those in polygons I, II, II, V, IX and X enjoy more secure protection thanks to their belonging to the national park and the reserve, while those in IV, VI, VII and VIII are situated in close basins, which might become the object of commercial activity and hence be liquidated as such. This circumstance calls for specific measures for their conservation.

9. Virgin forests in Slavyanka Mountain

9.1. Geographic characteristics of the region

The most southern Bulgarian mountain - Slavyanka Mountain - is part of the Rila-Rhodopes massif. The state frontier between Bulgaria and Greece runs along its ridge. To the north lies Pirin Mountain, from which it is separated by the Paril saddle (1170 m a.s.l.), to the east it is connected to Stargach Mountain, to the west – to Sengelska Mountain and to the south to Sharliya Mountain in Greece. Slavyanka Mountain is situated in east-west direction and is some 20 km long. Its highest peaks are Gotsev Peak (2212 m.), Shabran (2196 m.) and Golyam Tsarev Vrah (2183 m.).

A characteristic feature of Slavyanka Mountain is its form of a stack with steep, at places hard-to-access, almost vertical, slopes. There are numerous Karst formations of different types, such as caves, pot-holes, pits, and two circus lakes (Suhoto Ezero - 2027 m.). The biggest caves in the mountain are "Stoykova Dupka" and "Oltarya". The Karst nature of the mountain is one of the reasons for its relatively grave dehydration.

Slavyanka Mountain is of horst origin. The main geological formations are proterozoic limestone and marbles, which have undergone severe metamorphosis and are permeated by thigh structure with a granite core deep underneath. The low parts are built up of granite, sandstones and conglomerates.

On Slanyanka Mountain the river Matnitsa has its source. This is a tributary of the river Mesta. The river watershed is relatively large and covers the area of seven villages. The name of the river is connected with the relatively high volume of sediment matter carried downstream as a consequence of the strongly eroded terrain of the watershed. The water runoff is formed to 25-30% by rainfall, 20-25% by the snowfall and the rest is the result of underground feeders. In the mountain skirts there are several Karst springs, some of them with a discharge rate above 1000 l/s (Nikolov, Yordanova, 2002).

The precipitation maximum is during the autumn-winter season. The annual precipitation rate is about 800 mm and in the parts at the highest altitude it is even higher by some 100 mm.

The climate is transient Mediterranean mountane with a determinant azonal factor – altitude and exposure. The climatic indicators during the cool seasons are strongly affected by foehn. The temperature total during the active vegetation period on the northern slopes in the low parts may be as much as 2000-2200^{o}C. The mean annual temperature in the upper part of the mountain is about 6^{o}C and in the low end – 14^{o}C (Nedyalkov, Nikolov, 1986). The vegetation period – the period with stable temperatures above 10^{o}C - is 130 days in the high-altitude parts of Slavyanka Mountain and 200-220 days in the low-altitude parts.

Dystric-Eutric Cambisols and *Umbric Cambisols* predominate in the high-altitude parts of the mountain, while *Chromic Luvisols* and *Rendzinas* are more common at the lower parts. The latter are shallow to medium-deep, stony to skeletal, rich in humus and total nitrogen. They are dry, shallow and warm.

9.2. Forest vegetation in Slavyanka Mountain

Biogeographic division

According to the biogeographic division of Bulgaria, the vegetation in Slavyanka Mountain is part of the European broadleaved district, Macedonia-Thracian Province, Slavyanka Mountain district (Bondev, 1982; 2002).

38 Balkan endemics (*Achillea depressa, Campanula scutellata, Centaurea parilica, Corothamnus rectipillosus, C. agnipilus, Crepis schachtii, Crocus olivieri, Fritillaria drenovskyi,Genista rumelica, Haplophyllum balcanicum, Herniaria olympica, Iris suaveolens, Lathraea rhodopaea, Linum elegans, Minuartia velutina, Polygala rhodopaea, P. carniolica, Pulsatilla slavjankae, Rosa parilica, Sedum zollikoferi, Senecio macedonica, Sideritis scardica, Silene gigantea, Trachelium rumelianum, Tulipa rhodopaea, Viola delphinantha, V. pirinensis, V. orphanidis)* and 6 Bulgarian endemics (*Centaurea mannagettae, Chondrilla urumovii, Colchicum doerfleri, Galium rhodopaeum, Festucopsis sancta* and *Rosa bulgarica* have been registered on the area of the mountain (Bondev, 2002).

Forests of relict species are characteristic for this biogeographic district: *Pinus heldreichii* Christ., *Ostrya carpinifolia* Scop. and *Castanea sativa* Mill.

The sub-Alpine belt is formed of *Pinus peuce* Gris. and *Pinus heldreichii* Christ., *Pinus nigra* Arn. and to a limited extent by *Abies alba* Mill. and *Pinus sylvestris* L. Small quantities of *Fagus silvatica* L. may also be found in this zone. The lower parts are occupied by *Quercus petraea* (Matt.) Liebl., sensu lato, represented by *Q. dalechampii* Ten., *Ostrya carpinifolia* Scop. and *Castanea sativa* Mill.

Related to its relatively small area Slavyanka Mountain possesses a rich variety of plant species (Velchev, 2002). Species of the nemoral, boreal-montane and Mediterranean type have been found.

The nemoral type of broadleaved deciduous forest is represented by the formations of *Querceta dalechampii*, *Fageta silvaticae*, *Castaneeta sativae* etc. Due to the Karst nature of the terrain and the general water shortage in the mountain (less precipitation and deep ground waters) the participation of *Fagus sylvatica* is limited, although as a result of the specific local climatic conditions its distribution goes up to 1800 m.

In Slavyanka Mountain the boreal-montane and Mediterranean formations are the most widespread. This type of vegetation consists of formations of *Pineta heldreichii* and *Pineta nigrae. Pinus heldreichii* occurs only here and in the Northern Pirin Mountain. The stands in Slavyanka Mountain are mature, aged between 80 and 140 years, and at certain places even above 220 years of age. There are some isolated trees aged above 400 years. Other representatives of the Mediterranean type are the limited communities of *Pineta nigrae-pallasianae* (Velchev, 2002).

Three formations of *Pineta peucis*, *Pineta sylvestris* and *Abieta albae* are representatives of the boreal-mountainous type. What is typical for these three formations is that they outline the upper timber line of the forest and are developed on silicate-based soils. While *Pinus silvestris* is encountered on sunny exposures, the other two types are more common on exposures with a northern component. *Pinus peuce* has a limited distribution, above all in the zone above 1800 m. The share of *Abies alba* is also quite small. It is concentrated primarily on rich soils near the avalanche gorges, forming typical narrow strip-like stands (Kaludin et al., 1985).

The plant species composition is strongly influenced by the Mediterranean climate. In the high mountain belt, for instance, only 19% of the species are representatives of the Arctic-Alpine and Nordic flora.

Forest vegetation regional distribution in Slavyanka Mountain

According to the biogeographic classification of Zakhariev et al. (1979), the virgin forests in Slavyanka Mountain are part of the Southern border forest vegetation district, Pirin sub-district, and belong to the middle mountain forest vegetation belt of beech and coniferous forests (800 – 2200 m.). Two sub-belts have been identified within this belt:

- Low-mountain sub-belt of *Quercus petraea, Fagus sylvatica* and *Abies alba* forests, 800 to 1500 m. The mean annual temperature may reach up to 8 ^{O}C and the length of the vegetation period is from 136 to 170 days. The snow cover lasts for about 70 days. The annual precipitation rate is up to 883 mm. Forests of *Pinus nigra* and to a lesser extent of *Fagus sylvatica, Ostrya carpinifolia* predominate.

- Middle mountain sub-belt of *Fagus sylvatica* and *Abies alba* forests, 1500 to 1900 m.

Relatively lower mean annual temperatures (about 4^{O}C) and vegetation period (78 days). The local forest stands consist mainly of *Pinus heldreichii* and to a lesser extent of *Pinus peuce*, *Pinus sylvestris*, *Fagus sylvatica*, *Abies alba* and other specices.

The sub-belt above 1900 m is woodless, occupied by herbaceous communities, some of which comprise the above mentioned endemics.

9.3. Virgin forests in Slavyanka Mountain

The identified virgin forests in Slavyanka Mountain comprise the area of the reserve of the same name and the adjacent buffer zone. 'Slavyanka" reserve was declared in 1951. Its area is 523.9 ha. It has been expanded on several occasions and currently amounts to 1628 ha with 701.3 ha buffer zone. It is one of the total of 17 Bulgarian biosphere reserves, included in the UNESCO list. The identified virgin forests extend over an area of 2324. 3 ha, including 70 % possessing the status of reserve and 30 % situated in the framework of the buffer zone.

In vertical respect the virgin forests are situate in the zone above 800 m on exposures having a northern component (N, NE and NW). The southern part of the mountain is situated on the territory of Greece.

Figure 9.1. Studied territories and identified virgin forests in Slavyanka Mountain

Item	Code No.	Studied territory	State forest enterprise	Protection status	Predominant tree species	Area of the studied territory [ha]	Area of the identified virgin forest [ha]
1	301	Slavyanka Mountain	Katuntsi	R	*Pinus nigra*	2324.3	2324.3

The major portion of the stands occurs on steep terrains (gradient range 32^{O} – 38^{O}).

In terms of tree species the participation of *Pinus nigra* is the highest (80 %), followed by *Pinus heldreichii* and *Pinus sylvestris*. The share of *Fagus sylvatica, Pinus peuce, Quercus petraea* and *Ostrya carpinifolia* is negligible.

Apart from the rich plant species diversity this area is unique also in terms of the ample presence of animal species. Besides the more than 1200 insects, some of the locally recorded fauna species are the turtles *Testudo graeca* and *T. hersmanii*, the reptiles *Lacerta erchardii*, *Telescopus fallax*, the mammal *Microtus nivalis*, the bird *Parus ater* and a number of other representatives of the Bulgarian fauna.

Characteristic virgin forest complexes in Slavyanka Mountain

Polygon 1: SFE Katuntsi. "Slavyanka" reserve and buffer zone. Area: 2324. 3 ha. Pinus nigra - 80 %, Pinus heldreichii – 10 %, Pinus silvestris – 10 %, single trees of Fagus sylvatica, Pinus peuce, Abies alba, Quercus petraea, Ostrya carpinifolia. Type of forest: "Fresh to dry Pinus forest with Vaccinium myrtillus"

10. Virgin forests in the Belasitsa Mountains

10.1. Physical and geographic characteristics of the region

Belasitsa Mountain is situated in the southwestern part of Bulgaria, between the valley of the river Strumeshnitsa and Syarsko field. The state frontier between the Republic of Bulgaria and Republic of Greece runs along the central ridge up to Kongura Peak (1951.3 m a.s.l.), then goes down in northeastern direction to an altitude of 1662.6 m along one of the smaller ridges. The narrow and covered with pastures mountaintop is the highest at Radomir Peak (2029 m a.s.l.) and in the eastern part ends abruptly above the Rupel Gorge on the river Struma. In this section the mountain is moderately inclined and has a hilly fore-mountain character, while to the west of the city of Petrich it is very steep, with many ravines, deeply indented rivers and valleys, which form sediment cones in the so-called "mountain-skirt step" – Podgorie (Galabov, 1982).

The Belasitsa Mountains are formed as a result of orographic processes that have emerged during the Palaeozoic age. The present-day forms of the mountains are the result mainly of Tertiary and Quaternary shifts, which have been at work across the denudated and fault-type region folded in geologic times.

The oldest and most common rocks in the region are gneisses, which occupy about 88.5% of the territory. At certain isolated locations one may come across spots of granite (5.4%), serpentines (2.1%) and amphibolite (0.2%). The rocks in almost the entire region are gravely weathered, cracked and fragmented (Forest Management Plan, 1998).

The climate in the region is continental-Mediterranean and is characterized by mild, even warm winters, however with frequent and often ample rainfalls and hot and dry summers. The mean annual air temperature is within the range of 12.5 – 14.0^{o}C (average value at Petrich meteorological station 13.9^{o}C) and is the highest countrywide. With the increase of the altitude it diminishes to about 3.0^{o}C. The mean January temperature varies from 1.0^{o}C in the low parts to –6.0^{o}C in the high mountain areas. The mean July temperature is respectively 21.0^{o}C and 11.0^{o}C. A characteristic peculiarity of this part of the country is the highest temperature total during the period of vegetation (4400^{o}C) and the longest active vegetation period (about 230 days), recorded at the Sandanski and Petrich stations. The steady retention of the temperatures above 10.0^{o}C begins during the period 4 April – 3 May. Due to the early ascend of spring the vegetation in the region is ahead of that in the rest of the country and hence late spring frosts represent for the already advancing vegetation a limiting factor (Velev, 2002).

The average annual precipitation total is 676 mm, varying depending on the altitude from 600-700 mm in the low parts of the mountain to about 900 mm in the high ones. Its distribution by months and seasons is characterized by autumn-winter maximum and summer minimum. Rainfall above 800 mm has nevertheless also been recorded at a lower altitude (Klyuch station – 450 m a.s.l.). This is due to the fact that the higher precipitation rates are stronger influenced by the exposure of the slopes and the location of the mountain ridges with respect to the pathways of Mediterranean cyclones than by the altitude (Koleva, Peneva, 1990).

A characteristic feature of the climate in this region is a drought period during the summer months, particularly strongly manifested in the period July-September. The warm and dry climate causes an upward shifting of the forest boundaries and of the occurence of all the tree species in comparison to the in the inland (Stanev et al., 1991).

In the Belasitsa Mountains the sources are found of the rivers Gabrenska, Kamenska, Kolarovska, Ivanik, Petrichka etc., all of which are right hand tributaries of the river Strumeshnitsa. All water courses in the region are characterized by inconstant water discharge rate, whose maximum is in spring (March-April) and the minimum is in summer (July-August). At certain periods of the year some of them dry up (Nikolov, Yodranova, 2002).

The soil types demonstrate clear belts depending on the altitude - *Chromic Luvisols* are common in the mountain skirts and the low parts of the mountain and *Dystric-Eutric Cambisols* - in the higher parts. *Luvisols* are found on different exposures up to about 800 m a.s.l. and are represented by one sole subtype - *Chromic Luvisols*. In terms of mechanical composition they are most often clay-sand to slightly sand-clay soils. In the altitude range from 800 m to the mountaintops *Dystric-Eutric Cambisols* predominate. They are characterized by slight to medium sand-clay composition, high skeleton content and good aeration. Their humus horizon is poor, and B-horizon is not compressed and is relatively deeper from the rest of the horizons. All the three subtypes of *Dystric-Eutric Cambisols* have been found in the region - *Umbric Cambisols,* light and of transitional character, whose distribution depends on the altitude, the exposure, the slope and the forest vegetation (Antipov-Karataev et al., 1960; Ninov, 1982).

10.2. Forest vegetation in the Belasitsa Mountains

European vegetation province

According to the geobotanical subdivision of Bulgaria the Belasitsa Mountains belong to the European broadleaved district, the Macedonian-Thracian province, the Belasitsa district (Bondev, 2002). The following types of vegetation are found in the area: nemoral (broadleaved deciduous forests of Central European types) and the Mediterranean one.

The most typical representatives of the nemoral type in the Belasitsa Mountains are *Fagus sylvatica* L., *Castanea sativa* Mill. and *Quercus petraea* (Matt.) Liebl., and of the Mediterranean type – *Platanus orientalis* and *Juniperus oxycedrus*

The *Fageta sylvaticae* is the most widespread formation in the Belasitsa Mountains. It is a typical mesophyte l type and is encountered more frequently on north or near northern exposures at different gradients and geological substratum. The soils are *Dystric-Eutric Cambisols*, well developed, of average richness and moderate moisture content. The presence of this forest formation is a very important factor for climate, soil and hydrology. However, under anthropogenic pressure its area has been strongly reduced.

Ranking the second in terms of distribution is the *Castaneeta sativae* formation. It is also a mesophyte type and occupies slopes of different gradients mainly on north or near to north exposures. The geological substratum is exclusively silicate. The soils are *Lavisols, LV* and *Dystric Cambisols*. They are well developed, rich, with moderate and steady moisture during the vegetation period. The presence of *Castanea sativa* communities is an important factor for soil and hydrology, It is however strongly affected by anthropogenic pressure.

The *Junipereta oxicedri* formation is spread everywhere in the region up to about 600-700 m a.s.l. It is a xerophyte type. It is encountered on inclined terrains of mainly south or near to south exposure. The geological substratum is diverse, but at the higher altitude it is exclusively carbonate. The soils are *Chromic Luvisols* and *Rendzic Leptosols, LPX*; usually shallow and often eroded and poor. Under the influence of anthropogenic factors these communities have usually changed into low and degraded shrubby communities.

The sub-Alpine vegetation is composed above all of secondary shrubs of *Juniperus sibirica*, *Vaccinium* spp. etc., as well as herbaceous vegetation of *Agrostis capillaries*, *Nardus stricta* and others. In the past the sub-Alpine belt used to be covered with *Pinus mugo*. In the dingles towards the upper timber line of the forest the beech forests are mixed with *Abies borisii-regis* and at some locations there are pure *Abieta albae* forest stands. A total of 30 diagnostic species and 13 Illyrian floristic elements, including 11 Balkan endemics, have been identified, The Macedonian-Thracian floristic element has a total of 13 species, including 12 Balkan endemics and 1 Bulgarian endemic - *Rosa bulgarica* (Velchev, 2002).

Forest vegetation subdivision of Belasitsa Mountain

According to the classification of Zakhariev et al. (1979) concerning the regional subdivison of forest vegetation in Bulgaria, Belasitsa Mountain falls on the territory of the Southern border district, Pirin sub-district. Virgin forests occupy three zones,:

- The flat to hilly zone of deciduous and xero-thermophyllous forests between 0 to 200 (100-300) m a.s.l. and 600 (500-700) m a.s.l. The mean annual temperature at the locations below 300 m is between 12.5°C and 13.9°C; above 300 m– between 11.2°C and 12.2°C. The average number of days with temperature above 10.0°C is between 220 and 246 in the first zone and between 206 and 215 days in the second zone. The mean January temperature is above 0°C – between 1.2°C and 1.4°C. The average annual precipitation is in the range of 514 to 880 mm, between 722 and 1100 mm at the locations of higher altitude, respectively, with maximum in October, November and December for the lower locations, at certain places also in June, and minimum in July, August and September for the entire sub-belt. The length of the vegetation period for the lower-altitude areas is between 7 ½ and 8 months and for the higher ones – between 6 ½ and 7 ½ months. .

- The Foothill zone of mixed broadleaved forests from 600 (500-700) to 800 (700-900) m a.s.l. The mean annual temperature is about 11.5° C, the average number of days with temperature above 10° C is about 210, the mean January temperature is about 0.0°C. The average annual precipitation varies between 646 and 835 mm with maxima in November or June and minima in September. The length of the vegetation period is about 7 months.

- The Lower mountain vegetation zone of *Quercus petraea, Fagus sylvatica* and *Abies alba* forests from 800 (700-900) to1500 (1400-1600) m a.s.l. The mean annual temperature is in the range between 6.8°C and 8.0° C, the average number of days with temperature above 10.0°C is between 136 and 170, the mean January temperature is below 0°C – between –1.4°C and –2.9°C.. The average annual precipitation varies from 714 to 883 mm with maxima in June or December and minima in August or September. The vegetation period is between 4 ½ and 5 ½ months.

10.3. Virgin forests in the Belasitsa Mountains

Through the preliminary study of the available documentation, contained in forest management projects and cartographic materials, a virgin forest of 1293.9 ha had been identified. It is situated in the "Kongura" reserve on the territory of SFE Petrich. Type of forest: "*Fagus sylvatica* with *Vaccinium myrtillus"*.

Figure 10.1 Studied territories and identified virgin forests in the Belasitsa Mountains

	Code No.	Studied territory	State forest enterprise	Protection status	Predominant tree species	Investigated area[ha]	Area identified as virgin forest [ha]
1		Belasitsa Mountain	Perich	R	*Fagus sylvatica, Castanea sativa*	4314.1	1588.7

The distribution of virgin forests by altitude shows that 59.5% of the total is situated in the altitude range of 800 – 1200 m a.s.l. Virgin forests on north (21.4%) or near northern exposures (35.5%) predominate. They are situated most often on steep (21 - 30^{o}) (57.7%) and very steep (above 30^{o}) terrains (18.3%), which are a specific peculiarity for the Belasitsa Mountains. Dominant participation on the area of the reserve had been noted for the *Fagus sylvatica* forests (69.9%), followed by *Castanea sativa* forests (14.4%) and *Quercus petraea* forests (5.6%). As single specimen in the composition of the beech or mixed beech-and-chestnut stands one may come across *Carpinus orientalis* and *Quercus frainetto*.

The average age of the stands in the region is high. More than one half of them (54.3%) belong to the age group of 150-200 years old, while 7.3% and 6.3% belong to the groups of 80-120 years old and 120-150 years old, respectively. Single individuals of beech and chestnut trees reach the age of 200 years and the maximum age recorded for local tree in the course of the study was 220 years.

Characteristic virgin forest complexes in the Belasitsa Mountains

Polygon 1: SFE Petrich (departments Nos. 149-173). "Kongura" reserve. Area: 1293.9 ha. Tree species: *Fagus sylvatica* L. – 100%. Type of forest: "*Fagus sylvatica* with *Vaccinium myrtillus"*.

11. Virgin forests in Ograzhden Mountain

11.1 Geographic characteristics of the area

Ograzhden Mountain is a part of the Osogovo-Belastitsa mountain range. The mountain extends in west-east direction and the larger portion of it is situated on the territory of the Republic of Macedonia. The highest peak on the territory of our country is Bilska Chuka (Golak) (1644 m.). The other high peak, situated in the center of the Bulgarian section of the mountain, is Markovi Kladentsi (1523 m.). The mountain ridge is mildly undulated – remains from a denudation surface of an altitude of 1100-1200 m., above which the higher peaks tower up. The slopes are steep and deeply indented by numerous rivers and valleys (Nikolov, Yordanova, 2002).

The Bulgarian portion of Ograzhden Mountain has the form of an irregular rectangle 22 km E-W and about 18 km N-S.

Ograzhden Mountain is built of metamorphous rocks – gneiss, crystalline schist, amphibole schist. The metamorphous nature of the rocks and especially the existence of different types of schist and gneiss predetermine an active weathering process – a particularly favorable precondition for formation of rapidly eroding soils. Steep terrains predominate (68.9%), 50.5% of them have southern exposure (Marinov, 1985).

The rivers taking their sources from the mountain are short, shallow and running in deeply indented valleys. The main roof is situated between the Markovi Kladentsi Peak to southeast and the Bilska Chuka Peak to northwest. There the rivers begin their course to the river Lebnitsa to the north, the river Strumeshnitsa to the south and the river Struma to the east. The longest rivers are Ribnik, discharging in the river Struma, the rivers Gradeshnitsa and Mendovska, discharging respectively in the river Strumeshnitsa. The rivers are characterized by mainly spring high water, although a well-manifested secondary high water in the autumn-winter is observed as well.

Ograzhden Mountain is a medium-high mountain and its situation in the continental-Mediterranean region determines generally a warmer and dry climate with definite Mediterranean influence. The mean annual temperatures vary between 12.5^{o}C and 13.5^{o}C at an altitude of up to 300 m , between 8.5^{o}C and 12.5^{o}C at an altitude of 300-1000 m and between 2^{o}C and 8.5^{o}C for the higher locations. The longest vegetation period countrywide (230 days) has been recorded at the Sandanski and Petrich ecological stations (Kyuchukova, 1985). The precipitation total is respectively 500-600 mm 600-700 mm and 800-900 mm with two maxima – in February and August (Koleva, Peneva, 1990). The drought index is 1.1. This defines Ograzhden Mountain as a very dry to moderately dry mountain, characterized by the longest drought period in this country (Nenov, Teokharov, 1983).

Western and in rare cases northwestern winds predominate (Kyuchukova, 1982).

At the altitude up to 700 m in Ograzhden Mountain the predominant soil types are heavely eroded *Chromic Luvisols* and Pseudo-*Chromic Luvisols* (Ninov, Teokharov, 1983). They are poorly developed, of the *Umbric Leptosols* type. One of the characteristic peculiarities of these soils is the extraordinary predominance of the sand fraction and the low content of physical clay along the entire soil profile. On northern exposures up to 800-900 m. *Chromic Luvisols* changing into *Distric-Eutric Cambisols* occur. *Distric-Eutric Cambisols* are distributed also at the altitude from 900 to 1000 m, whereas below the lower limit they are light and in the higher parts - dark.

Soil erosion is spread almost all around and is very strong. It has specific impact on soil depth. Very shallow and shallow soils predominate – 21.2% and 62.1% respectively, and deep soils account for only 16.5% of the total (Marinov et al., 1985).

It is worth noting that Ograzhden Mountain is one of the mountains most affected by forest fires, illegal cuttings, excessive grazing, water and wind erosion.

11.2. Forest vegetation in Ograzhden Mountain

Biogeographic division

According to the biogeographic regioning of Bulgaria Ograzhden Mountain is referred to the European broadleaved region, Illyrian (Balkan) province, Western Balkan border mountainous county, Ograzhden area (Bondev, 2002). Both the nemoral and the Mediterranean types of vegetation are represented locally.

The nemoral type of the broadleaved deciduous forest is represented by the formations of *Fagus sylvatica*, *Q. petraea* and *Q. pubescens* (Velchev, 2002).

The region is small in size. In the forests predominate *Fagus sylvatica*, *Q. petraea* and to a lesser extent *Quercus frainetto*. At certain locations xerothermic forests of *Q. pubescens* are also found, the majority of which have degraded and on their place secondary communities have been formed - *Paliurus aculeatus* shrub communities and herbal xerothermic communities. Characteristic and outstanding specifically for Ograzhden Mountain are the still survived individuals of *Quercus coccifera*, *Juniperus excelsa* and *Castanea sativa*, which is a relic species. *Platanus orientalis* occurs along the river valleys.

Regions of forest vegetation

According to the classification of Zakhariev et al. (1979) Orgazhden Mountain is a part of the Southern border forest vegetation region, Pirin Mountain subregion and belongs to the Middle mountain forest vegetation belt of Fagus silvatica and coniferous forests (800 – 2200[1] m.). Two sub-belts have been identified:

- the sub-belt of low-mountain forests of *Q. petraea*, *Fagus sylvatica* and *Abies alba*, which is situated at the altitude from 800 to 1500 m a.s.l. the mean annual temperature reaches up to 8 ^{O}C and the vegetation period lasts from 136 to 170 days. The total annual precipitation is up to 883 mm. The primary forests have been almost totally destroyed and only random degraded formations of *Quercus frainetto, Quercus pubescens, Carpinus orientalis, Quercus coccifera* may still be detected. The Sweet chestnut (*Castanea sativa*) still exists only along the valleys of the rivers Gradeshnitsa and Ribnika.
- the sub-belt of middle mountainous forests of *Fagus sylvatica* and *Abies alba*, situated at 1500-1644 m. It is characterized by significantly lower mean annual temperatures (about 4^{O}C) and a vegetation period of 78 days. The plantations are mainly of *Fagus sylvatica*, *Quercus petraea* and *Carpinus orientalis*.

Large parts of the mountain have been deforested in the past. Currently plantations of Scots Pine, Black Pine, and to a lesser extent other species have been planted on a large area.

[1] The scope of the Middle mountain belt of *Fagus silvatica* L. and coniferous forests has been indicated by Zhakhariev et al., however it should be taken into account that the maximum altitude of the mountain on the territory of Bulgaria is 1644 m a.s.l. (Bilska Chuka Peak).

11.3. Virgin forests in Ograzhden Mountain

As a result of the work of researchers from the third working group from the Forest Research Institute at BAS in 2004 a plot of virgin forest of an area of 294.8 ha has been identified in a closed basin on the territory of Parvomay State Forestry Enterprise. The forest was identified through preliminary study of the total of available documentation, contained in forest management plans, maps and through surveys among colleagues.

Table 11. 1 Studied territories and identified virgin forests in Ograzhden mountain

	Code No.	Studied territory	State Forestry Enterprise	Protec -tion status	Predominant tree species	Area of the studied territory (ha)	Area of the identified virgin forest (ha)
1	304	Ograzhden	Parvomay	CB	*Fagus sylvatica*	583.2	294.8

In vertical respect the virgin forest is situated in the altitude range of 950 – 1400 m. on both shady expositions (N, NE, NW) (64% of the total area) and on hot sunny components (SW, W) – 0-25%. Virgin forests on steep slopes (11- 20^{o}) predominate – 53%. As much as 28% of the virgin forests have been identified on steep terrains (21 - 30^{o}). Very steep and ravine terrains are not typical for that mountain and the conservation of the individual virgin forests is due to a large extent to the proximity of the frontier with Macedonia.

The virgin forests of Orgazhden Mountain are composed of *Fagus sylvatica* – 100%, although individual trees of *Carpinus betulus* and *Quercus petraea* are encountered as well.

Nearly 63% of the virgin forest is aged below 120 years and about 27% belongs to the age range of 120 – 150 years.

The soil types are *Distric-Eutric Cambisols* of transitional sub-type.

Typical virgin forest complexes in Ograzhden Mountain

Polygon 1: SFE Parvomay, "Hadjiytsa" Locality. The listed sections represent a closed basin in immediate vicinity to the frontier with Macedonia – FYROM. They occupy a total area of 294.8 ha Type of forest: "*Fagus sylvatica* forest with *Luzula"* with 100% participation of *Fagus sylvatica*.

12. Virgin forests in Osogovo Mountain

12.1. Geographic characteristics of the region

Osogovo Mountain occupies the farthest northern end of the Osogovo-Belasitsa mountain range. It extends mainly in southwest-northeast direction at a length of 65 km (25 km on the territory of Bulgaria). Its width is about 25 km. The highest point, Ruen Peak (2251 m.), is the orographic and hydrographic center. It is situated at the point where two ridges meet at right angles. .

The relief of Osogovo Mountain is formed during the Neocene and the Quaternery period. The consecutive stages in the building of the mountain are fixed in several step-shaped denudation surfaces. It represents a well-outlined mountain stack of metamorphous rocks - crystalline schists, gneisses, amphibolites etc. On the north side, the Kyustendil mineral springs break through. In the middle of the mountain a core of south-Bulgarian granite is found. A characteristic feature of the rocks in this region is that they are strongly weathered and cracked, producing soils that are good for the growth of forest (Nikolov, Yordanova, 2002).

The Osogovo Mountain falls under the transient-continental climate sub-region of the European continental climatic region (Velev, 2002). The climate reflects the moderating influence of the Balkan mountain range, which acts as a barrier to the influx of cold continental air masses from the north. From the south Mediterranean air currents penetrate along the river Struma valley. For this reason the mean January temperature in the region is considerably higher and the number of days with snow cover is smaller compared to Northern Bulgaria.

The areas at an altitude of 600-1000 m fall under the low mountain climate belt, which is characterized by relatively mild winters and cool summers. The mean January temperature is around -1.0^{o}C to –2.0^{o}C, and the mean June temperature in the high altitudes is 18.0^{o}C. The mean annual air temperature is in the range of 8.0 to 10.5^{o}C and late spring and early autumn frosts are rare. The mean annual precipitation total in the lower parts is about 640 mm and in the higher ones – 710 mm with maximums in June and October and minimums in March and August. With the increase in the altitude above 1500 m. the mean annual temperatures decreases to about 2.0^{o}C. The absolute minimum temperatures are in the range of –18.0^{o}C to –20.0^{o}C. The average precipitation total is from 700 to 960 mm. The highest amount of rainfall has been recorded during the months of May and June (Koleva, Peneva, 1990). A typical element of the climatic conditions in the higher exposed parts of the mountain is that of frequent occurrence of strong winds, which can cause the formation of wind throws.

The bigger rivers taking their sources from Osogovo Mountain are the river Eleshnitsa, the river Novoselska Reka and the river Banshtitsa. Despite the inconstant water supply from the tributaries, they never dry up the year round. Some watersheds in this region have been declared water supply zones (Nikolov, Yordanova, 2002).

The variety of relief, climate, vegetation and basic rock predetermine the formation of the following types of soils: *Chromic Luvisols* and *Dystric-Eutric Cambisols* with their subtypes - light, transitional and dark – and *Humic Cambisols*. *Chromic Luvisols* occur at an altitude up to about 700 m. It are most often clay-loam to slightly clay-loan soils. *Dystric-Eutric Cambisols* occur in the altitude range from 700 to 2000 m. They are characterized a by poor humus horizon and a deep, packed B-horizon. They are light to medium loam-clay soils with good aeration and rich skeleton content. *Umbric Cambisols* occur most frequently on shady

exposures. They possess high deposits of nutrients and a significant active moisture content. *Dystric-Eutric Cambisols* are typical for sunny or dry slopes. They are relatively shallow, with a reduced humus horizon and a very rich skeleton content. *Humic-Cambisols* are less common, to be encountered mainly at an altitude above 2000 m a.s.l. They are characterized by a considerably deep (30-50 cm) humus accumulating horizon and high content of humus and total nitrogen (Ninov, 1982; Donov, 1993)..

12.2. Forest vegetation

European vegetation province

The Osogovo Mountain falls under the European broadleaved region, Illyrian (Balkan) province, Western Bulgaria border mountain district (Galabov, 1982; Bondev, 2002). The following types of vegetation have been identified in the mountain: nemoral (of broadleaved summer-green forests of the central European type) and boreal-mountane and Arctic-Alpine.

Fagus sylvatica and *Quercus petraea* forests predominate, at places mixed with *Carpinus betulus*. In the northern end of the region there are preserved *Picea abies* forests and in the central and southern ends – remnants of *Pinus sylvestris* and *Pinus nigra* forests. In the highest parts of the mountain Alpine floristic elements occur, which form small-size phytocoenoses. In the sub-Alpine belt shrubs of *Juniperus sibirica* and *Juniperus pygmea* predominate.Xerothermic formations of *Quercus frainetto* and *Quercus cerris* and (much rarer) of *Quercus pubescens* are preserved in the lower parts. At many locations, however, these formation have been changed under human influence into *Carpinus orientalis* forest. In the northwestern part of the region one may come across trees of the relic type *Ostrya carpinifolia* (Velchev, 2002). .

Regional subdivision

The Osogovo Mountain is situated on the territory of the Thracian forest vegetation district, Ossogovia Subdistrict, Zakhariev et al. (1979).

The vertical forests belts are:

- Low mountain forest of *Quercus petraea*, *Fagus sylvatica* and *Abies alba* from 700 (600-800) to 1200 (1100-1300) m. The mean annual temperature ranges between 3.9^{o}C and 8.7^{o}C, the average number of days with temperature above 10^{o}C varies between 128 and 170, the mean January temperature is below 0^{o}C – between –0.4^{o}C and –5.5^{o}C. The average annual precipitation rate varies between 714 and 939 mm with maximum most frequently in June and more rarely in December and minimum in August or September. The length of the vegetation period is between 4.5 and 5.5.months.
- Middle mountain forest of *Fagus sylvatica*, *Abies alba* and *Pinus sylvestris* from 1200 (1100-1300) to 1700 (1600-1800) m. The mean annual temperature ranges between 3.7^{o}C and 5.5^{o}C, the average number of days with temperature above 10^{o}C is between 87 and 127, the mean January temperature is below 0^{o}C – between –4.4^{o}C and –6.0^{o}C.. The average precipitation varies from 947 to 1034 mm with maximum in May or June and minimum in August or September. The length of the vegetation period is between 3 and 4 months.
- Upper mountain forest of *Pinus sylvestris* from 1700 (1600-1800) to 2000 (1900-2100) m. The mean annual temperature is in the range between 3.1^{o}C and 4.3^{o}C, the average number of days with temperatures above 10^{o}C is between 68 and 102, the mean January temperatures is below 0^{o}C – between –4.7^{o}C and –5.5^{o}C. The average annual precipitation total varies between 1014 mm and 1034 mm with maximum in June and minimum in February or September. The length of the vegetation period is between 2.5 and 3.5 months.

Virgin forests

A virgin forest location of 190.8 ha total area has been identified in the "Tsarna Reka" reserve on the territory of SGBS Osogovo. Type of forest: "*Fagus sylvatica* forest with *Luzula* ".

Figure 12.1 Investigated territory and virgin forests identified in Osogovo Mountain

	Investigate dterritory	State Game Breeding Station	Type of forest	Predominant tree species	Area of the investiga ted territory, ha	Area of the identified virgin forest, ha
1	Osogovo Mountain	Tsarna Reka	R	*Fagus sylvatica,*	190.8	190.8

The reserve is situated in the altitude range 1350-1750 m. A large portion of the terrains are steep (37.9%) and very steep (19.8%). The southern exposures and those containing a southern component (40.2%) have a slight predominance over the northern and containing a northern component ones (34.0%). The type of soils in the studied area is *Dystric-Eutric Cambisols*. Trees aged 80 to 120 years predominate (48.5%), while the share of those aged 120 to 150 years is also big - 35.2%. The average age of the tree stand is 115 years, the average tree height is 24.0 m and the average diameter - 20.9 cm.

One virgin forest has been identified also in Vlahina Mountain (adjacent to Osogovo Mountain). The total area of the virgin forest is 89.6 ha. It is situated in the "Gabra" reserve and falls within the boundaries of the SFE Nevestino. Type of forest: "*Pinus nigra - Fagus sylvatica*".

Figure 12.2 Investigated territory and virgin forests identified in Vlahina Mountain

	Investiga ted territory	State Forest Enterprise	Type of forest	Predominant tree species	Area of the investiga ted territory, ha	Area of the identified virgin forest, ha
1	Vlahina Mountain	Nevestino	R	*Pinus nigra*	89.6	89.6

The identified virgin forest is situated in the altitude range of 900 – 1100 m. The exposure of the plot is generally northern and in rare exceptions southwestern and western. The gradient is high – 18-31^{o}. The virgin forest represents natural stand of *Pinus nigra* (50%) with admixture of *Fagus sylvatica* (22.5%), *Quercus petraea* (10%), *Acer campestre* (7.5%), *Quercus cerris* (5%) and *Sorbus torminalis* (5%). The average age of the forest stand is 115 years. The height of some trees reaches up to 30-35 m. It is characteristic for the *Pinus nigra* in "Gabra" is that it reaches its maximum size and possesses a particularly good-quality stem – high stocking rate, self-pruning and relatively narrow crown.

Characteristic virgin forest complexes in Osogovo Mountain and Vlahina Mountain

Polygon 1: SGBS Osogovo. "Tsarna Reka" reserve. Area: 190.8 ha. Tree species: *Fagus sylvatica* – 100%. Type of forest "*Fagus sylvatica*.with *Luzula"*

Polygon 2: SFE Nevestino. “Gabra” reserve. Area: 89.6 ha. Tree species: *Pinus nigra* – 50%, *Fagus sylvatica* – 22.5%, *Quercus petraea*.– 10%, *Acer campestre* – 7.5%, *Quercus cerris* – 5%, *Sorbus torminalis* – 5%. Type of forest “*Pinus nigra - Fagus sylvatica”*.

13. Virgin forests in the Eastern Rhodope Mountains

13.1. Physical and geographic characteristics

The Eastern Rhodope Mountains fall under the Eastern Rhodopes-Strandzha district of the Macedonian-Thracian province (Geography of Bulgaria, 2002). The separation of the Eastern from the Western Rhodopes is based on the differences in climate and hydrology, the Mediterranean influence, the winter precipitation maximum and the runoff (Galabov, 1966).

The two parts of Rhodope Mountains show also great differences in altitude, horizontal and vertical orographic patterns, soil cover, flora and fauna.

The Eastern Rhodope are separated from the Western Rhodope Mountains at the "Trite Kamaka (The three stones)" saddle. An undulating relief on the average altitude of 330 m predominates. The ridge "*Snezhnik"* along the national frontier goes up to 1200–1400 m and includes the southernmost point in Bulgaria – the Veykata Peak (1463 m.). Eastward the mountain ridge ends at the Makaza saddle (690 m.). To the north of it, between the rivers Varbitsa and Krumovitsa, is situated Stramni Rid with its highest peak Yurkeden (960 m a.s.l.) (Nikolov, Yordanova, 2002). н.в.).

The district represents ancient land with volcanic activity during the Paleocene age. South Bulgarian granites occur locally in the cores of the eroded and indented block anticlinal formations. Metamorphous formations (crystalline schists, gneisses and marbles) predominate in the periphery and riolites and trass – at the locations of former active volcanic activity. Erosion used to be very grave in the past (Bonchev, 1938).

The climate of the Eastern Rhodope Mountains is continental-Mediterranean. The mean annual temperature varies from 8 to 13.5°C. The area is characterized by relatively mild winters and hot summers. The period of moisture shortage is 72–80 days and the dry period lasts for 93 - 145 days. The vegetation period lasts for about 7 months. The annual precipitation total varies from 585 mm to 900 mm. The runoff maximum is in the winter (November-January) and the minimum – in the summer-autumn period (July-September). Snow accounts only for 5–6% of the annual precipitation total and is therefore the lowest nationwide (Climate Yearbook, 1990).

During the cold months of the year southwestern and southern winds with foehn effect are typical for the northern slopes of Maglenik and Gyumyudzhinski Snezhnik in the Eastern Rhodopes Mountain.

The major part of the Eastern Rhodope Mountains falls under the zone of *Chromic Luvisols*. Leached gleyic *Luvisols* are the most widespread. *Dystric Cambisols* predominate in the low mountain belt. As a consequence of the higher precipitation rates in southwestern direction there is a tendency towards formation of *Dystric Cambisols* at the lower altitudes. Soils formed on andesite and andesite-riolite tufa-breccia, tuffites and limestones occur frequently as well. They are subject to strong erosion processes, leading to degrading of the soil cover (Bachvarov, Petkov, 1985).

13.2. Forest vegetation

The majority of the Eastern Rhodope Mountains falls under the Thracian province of European broadleaved forest district. Oak forests predominate - *Quercus cerris*, *Quercus*

frainetto, Quercus petraea. On the ridges Gyumyurdzhinski Snezhnik and Maglenik *Fagus sylvatica* forests predominate. In the western part of Zhalti Dyal there are forests of *Betula pendula* as well. Many of the forests are exhausted and gradually more resistant species begin to penetrate, forming secondary forests of *Carpinus orientalis* and shrubby formations of *Paliurus spina-christi* and *Juniperus oxycedrus* (Bondev, 1997).

Oak forests in the Eastern Rhodope Mountains occupy approximately 40-45% of the afforested area (Petkov, Bachvarov, 1989) and outline the following characteristic belts:

– The low-mountain Oak forests, covering the upper parts of the low-mountain forest zone at the altitude from 600 to 900 m, and in the regions of the Gyumyurdzhinski Snezhnik and Maglenizhki ridge – from 400 to 700 m;

– The hilly oak forests, comprising *Quercus petraea* and *Quercus frainetto* forests at the altitude of 400–600 m on slopes with eastern exposure;

– The low-hilly and plain forests, distributed on stony soils to an altitude up to approximately 500 m.

Beech forests in the Eastern Rhodopes occur mainly on the shady slopes of Gyumyurdzhinski Snezhnik and Maglenizhki ridge.

Pinus nigra had in the past locally a broader distribution . It used to participate in the composition of the mixed Oak and Oak-pine forest stands(Stefanov,1927) At a later point of time *Pinus nigra* has suffered from mass felling interventions and its natural distribution currently occurs only in protected localities and reserves.

Virgin forests

The broadleaved virgin forests in the higher parts of the mountain occur in closed basins of high-stem beech forests on the territory of SFEs Zlatograd, Kiirkovo, Smilyan on a total area of 370 ha. They have been localized on the northern exposures of the mountain ridges Gyumyurdzhinski Snezhnik and Maglenizhki ridge above 900 m a.s.l. The characteristic type is the *Fagus sylvatica* forest with *Rubus fruticosus* (Penev et al., 1969). The predominant type of soils is dark D-2 (104) with high productive capacity (II, II/III). They occupy terrains with 30–35° inclination on gneiss substratum. The forest stands are usually composed of beech, of uniform age (100-120 years), single-storey and highly productive. There are single trees of *Fraxinus excelsior*, *Acer platanoides,.Abies alba, Populus tremula* and *Tilia cordata*. Two polygons have been set up of this type of forest (Nos. 27 and 28).

Polygon 26: Fresh *Pinus -Picea abies* forest (Penev et al., 1969). It is situated near the national border (SFE Smilyan), in the closed basin "Ruchansko". Area of virgin forest: 23.2 ha. The main tree species is *Pinus sylvestris* (90%). There are single trees of *Fagus sylvatica.*

Polygon 27: It is situated in the middle-mountain belt of beech and coniferous forests on the territory of SFE Zlatogorad. Virgin forest 130.3 ha. This is a closed basin in the "Kartalova Livada" locality. The main tree species are *Fagus sylvatica* (90%) and *Quercus petraea* (10%). Single presence of understorey of *Fraxinus ornus* and *Populus tremula*. The state of the tree stands is good and no pathogene fungi and diseases have been identified.

Polygon 28: It is situated in a closed basin in Gyumyurdzhinski Snezhnik in the SFE Kirkovo in the "Tekiya Cham" locality. Virgin forest 113.6 ha. The major edificatory is *Fagus sylvatica* and in the understorey occur *Acer platanoides* (20%), *Acer heldreiichii* (15%), *Tilia cordata* (3%) and *Acer campestre.* There are also single trees of *Abies alba* in a good health status.

Polygon 29: To the east of the village of Raven (SFE Momchilgrad) is situated the managed reserve "Borovo". This is the most eastern natural forest stand of *Pinus nigra* in our country at the altitude of 350 m. Virgin forest 20.1 ha. The main species with 100% participation is *Quercus petraea.* There are single trees of *Carpinus betulus*. Despite the viciniity of human settlements, the status of managed reserve provides sufficient guarantee for conservation of this unique *Pinus nigra* stand for the future.

Polygon 30: It is in the managed reserve "Chamluka", SGBS Zhenda. It is a protected natural *Pinus nigra* forest stand aged 100 years and in good state. Virgin forest 39.9 ha. A natural *Pinus nigra* understorey has emerged on the open spaces. Stable understorey of *Quercus petraea, Fagus sylvatica* and *Carpinus betulus* occurs frequently as well. It can successfully be used as a gene-bank and seed production.

Polygon 31. The "Chinarski Dol" protected locality is situated in the Thracian forest vegetation district, Haskovo hilly land of the Eastern Rhodopes, not far from the village of Topolovo. Virgin forest 27.7 ha. *Platanus orientali* forest on the riverine terrace at an altitude of 300-310 m on leached gleyic *Luvisols* over sandstone substratum. The average age of the tree stand is 80-200 years. There are single specimens of 630 cm trunk perimeter. The location of the forest in close vicinity to sports angling reservoir and settlements create the risk of partial violation of the wholeness of the *Platanus orientalis* forest. Stricter control and indicative boards would greatly contribute to better conservation of this unique nature phenomenon.

14. Virgin forests in Western Rhodope Mountains

14.1. Physical and geographic characteristics

Western Rhodope Mountains are situated to the east of the Rila-Pirin mountains group of the Macedonian-Thracian massif. The western boundary runs along the river Mesta, via the Avramova saddle and the river Yadenitsa, the eastern boundary runs along the rivers Borovitsa and Varbitsa. To the north the Western Rhodope Mountains borders on the Upper Thracian Lowlands and to the south – to Aegean Thracia. The Western Rhodopes occupy a total area of 8732 km^2 and represent a system of mountain hills and ridges cut by deep valleys. The river Vucha divides the Western Rhodopes into two parts: the western part, which extends over a larger area and is higher eastern part, which is often assumed as the Central Rhodope Mountains. The western part is subdivided in several parts: Dabrash, Veliyshki part, Syutka, Videnishka Mountains and Batashka Mountains with the ridges of respectively Karkaria and Alabak. In the eastern part are situated Chernatitza with the ridges Varkhovrakh, Srednia, Ravnishte and Byala Cherkva, Perelik with the ridges Mursalitsa and Kaynadin, Prespa with the ridges Chernovrakh, Radyuva Mountain and Dobrostan and Aredniski with the ridges Zhalti Dyal and Gyumyurdjiyski Snezhnik.

The highest peaks in the Western Rhodope Mountains are the following ones: Golyam Perelik (2191 m), Golyama Syutka (2186 m), Golyam Persenk (2091 m), Batashki Snezhnik (2082 m), Prespa (2000 m), Karkaria (1975 m) and Beslet (1938 m).

The complex indentation of the Western Rhodopes Mountain causes different exposures apart in contrast to rounded hilltops and lowland fields. The vertical indentation reaches values from 500 to 700 m/km^2 and the steepest slopes are in the gorges of the rivers Trigradska, Muglenska, Vucha, Chepinska, etc.

The inclination in the forests of this mountain is as follows: flat areas (0^0-4^0) - 0.6 %; sloping (5^0-10^0) - 3.3 %, inclined (11^0-20^0) - 22.5 %, steep (21^0-30^0) - 48.9 % and very steep (above 30^0) - 24.7 %. Forests on shady exposures cover 54,3 %, on sunny exposures 45.7%. The average altitude is about 1170 m. The middle-mountain belt (1001-1600 m..) predominates – 60.2 %, followed by the low-mountain (601 – 1000 m..) – 23.6%, the high-mountain (above 1600 m.) – 10.3 %, the hilly (201-600 m.) – 5.5 % and the lowlands belt (0-200 m.) - 0.4 % (Shikov et al., 1985).

The geological-and-petrographical structure of the Western Rhodope Mountains is characterized by the participation of granites, sienites, riolites, andesites, Karst and sediment rocks.

In climatic aspect the Western Rhodope Mountains is situated in the transient climatic zone with well-expressed mountainous version. The mean annual air temperature varies from 5^0C to 10^0C, the mean January temperatures are below 0^oC and the mean July temperatures are characterized by well-manifested differences depending on the altitude - from 22^0C at Peshtera (440 m.) to 12.7^0C at Beglika (1550 m.).

The annual precipitation rates are generally in the range of 600-800 mm and in the Perelik and Prespa parts – up to 900 mm with summer-autumn minima (August-September) and mainly spring-summer maxima (May-June). There is also a secondary maximum in November-December. In the southern parts, due to the increased Mediterranean influence, the maximum is shifted definitely to the winter months.

The river network is well developed, the bigger rivers being Mesta, Arda, Vucha, Dospatska, Chepinska, Chepelarska, Muglenska, Trigradska etc. The most famous Karst springs are

those in Velingrad, Nastan, Beden, Hubcha and Mugla, which are characterized by an even discharge rate.

The average water-bearing capacity of the Western Rhodope Mountains is about 300 mm, varying from 180 mm in the 300 - 600 m. belt, 280 mm in the 600 - 1600 m. belt (where 75 % of the water resources of this area are formed) to 550 mm above 1600 m. The maximum values of the runoff have been recorded in April-May and the minimum – in August-September (Mandadjiev, 1989, Yordanova et al., 2002). The Western Rhodopes stand out with the biggest steady runoff (47%) of the total water runoff of Bulgarian mountains. The runoff rate of the Eastern Rhodopes is hardly 33% and that of Strandzha Mountain and Sakhar Mountain - 35% (Yordanova, 2002). The available total annual water resource of the region amounts to almost 2 billion m^3, which accounts to 10% of the national total of water resources. Some of the largest dams in the country are situated in the Western Rhodopes: *Dospat, Batak, Golyam Beglik, Shiroka Polyana, Vucha, Krichim.*

The soils in the Western Rhodopes belong to the Mediterranean soil region and the Western Rhodopes mountain province. The distribution of the different types of soils is as follows:

- *Dystric-Eutrcs Cambisols* occupy more than 60 % of the area, mainly in the middle forest vegetation belt. Light *Cambisols* occur at a lower altitude, mainly on sunny exposures up to 1700 m. They are characterized by a small depth and weakly developed humus horizon, while Dark *Cambisols* prefer more shady exposures up to 1900 m., have a greater depth and a better developed humus horizon.

- *Rendzinas* cover 18 % of the territory and their distribution depends on the presence of limestone and marbles, irrespective of the altitude.

- *Chromic Cambisols* occupy 17 % and occur at an altitude up to 800 m.

- *Humic Cambisols* cover about 3 % of the area and are mainly found above 1800 m and, in isolated cases, also between 1600 and 1700 m.

- *Umbrosols* , about 2 % of the territory, are found on the high rounded parts of the mountain and mountain ridges.

From the *Dystric-Eutric Cambisols*, subtype *Eutric Cambisols*, has developed the subtype of *Anthropic-Eutric Cambisols*. They have been formed after forest clearing or forest fires, followed up by ploughing for agricultural purposes (cultivation of potatoes, rye, raspberries) or for use as meadows and pastures (Ninov, 2002).

14.2. Forest vegetation

Biogeographic division

The Western Rhodopes Mountain and its separate parts belong to (Bondev, 2002):

1. European broadleaved forest region

1.1. Illyrian (Balkan) province

1.1.1. Rhodopes district

1.1.1.1. Dabrashki unit

1.1.1.2. Batashki unit

1.1.1.3. Chernatishki unit

The broadleaved forests are spread in the lower eastern and northern parts of the Rhodopes Mountain. The stands comprise *Quercus petraea*, *Fagus sylvatica*, *Carpinus betulus*, *Acer*

pseudoplatanus, *Acer platanoides*, *Ostrya carpinifolia* and other deciduous species. In the higher parts of the mountain are coniferous forests with the dominant participation of *Picea* abies and *Pinus sylvestris*. There are also some stands or individuals of *Pinus nigra*, *Abies alba*, *Juniperus communis*, etc.

The Rhodopes District is a refugium to 90 Balkan endemics, including 58 Illyrian and 32 Macedonian-Thracian ones. One can find there *Astragalus alopecurus, Potentilla fruticosa, Secale montanum* ssp, *rhodopaeum*, *Arenaria rhodopaea, Tulipa rhodopaea, Lilium rhodopaeum, Rosa bulgarica, Carduus rhodopaeus, Satureja rumelica, Galium rhodopaeum, Verbascum humile* ssp. *rhodopaeum*, *Thymus stojanovii.* One interesting paleo-endemic occurs here too - *Haberlea rhodopensis,* (Bondev, 2002).

The Dabrashki unit contains mainly *Pinus sylvestris* forests and on a limited scale *Picea* abies and *Fagus sylvatica* stands, although some remnants of *Pinus nigra* and *Quercus petraea* forests can also be found, as well as *Alnus incana* and *Ostrya carpinifolia*.

The Batashki region is characterized by *Pinus sylvestris* and *Picea* abies forests, however in the lower parts on northern exposures there are forests of *Fagus sylvatica*, *Carpinus betulus* and *Quercus petraea* and on the southern exposures – forests of *Pinus nigra*, *Quercus frainetto* and *Quercus cerris.*

In the Chernatishki Region *Picea* abies plays a dominant role, forming vast massifs. Ranking the second are fragmented forests of *Pinus sylvestris* and *Fagus sylvatica*. There are also stands with participation of *Abies alba*, *Acer pseudoplatanus*, *Acer platanoides*, *Acer monspessulanum*, *Carpinus betulus*, *Ostrya carpinifolia*, *Fraxinus ornus*, *Fraxinus excelsior* and other species.

Altitudinal zonation

The Western Rhodope Mountains are situated in the Thracian forest vegetation region and comprise the following forest belts (Ministry of Forests and Forest Industry, 1976, 1983 and Zakhariev et al. 1979):

I. Low flat-and-hilly and foothill oak forests – from 0 to 700 (600-800) m.

I.1. The floodplain and riverine forests – from 0 to 700 (600-800) m. with mean annual temperature of 9.3 – 12.6^0 C and precipitation rate 500-670 mm/year.

I.2 The flat and hilly Oak forests – from 0 to 500 (400-600) m. with mean annual temperature of 10.5-12.6^0 C and precipitation rate 500-620 mm/year.

I.3. The mixed deciduous forests – from 500 (400-600) m.. to 700 (600-800) m. with mean annual temperature of 9.3-10.5^0 C and precipitation rate 620-670 mm/year.

II. Middle-mountain beech and coniferous forests – from 700 (600-800) to 2000 (1900-2100) m.

II.1 The low-mountain *Quercus petraea*, *Fagus sylvatica* and *Abies alba* forests - from 700 (600-800) m. to 1200 (1100-1300) m. with mean annual temperature of 6.4 - 9.3^0 C and precipitation rate 670-800 mm/year.

II.2 The middle-mountain *Fagus sylvatica*, *Abies alba* and *Picea abies* forests - from 1200 (100-1300) m. to 1700 (1600-1800) m. with mean annual temperature of 4.8 – 6.4^0 C and precipitation rate 800-950 mm/year.

II.3 The mountain *Picea abies* forests from 1700 (1600-1800) m. to 2000 (1900-2100) m..; mean annual temperature of 2.4 - 4.8^0 C; precipitation rate 950-1100 mm/year.

III. High-mountain belt – above 2000 (1900-2100) m.

III.1 High-mountain sub-alpine *Picea abies* forests – from 2000 (1900-2100) m. to 2200 m..; with mean annual temperature below 2.4^0 C; precipitation rate above 1100 mm/year.

14.3. Virgin forests

There are in total 14 reserves in the Western Rhodopes: "Amzovo" (1968) – 0.3 ha; "Beglika" (1960) – 1463.1 ha; "Dupkata" (1961) – 1210.8 ha; "Hvoynata ("Izgoryaloto Gyune")" (1956) – 32 ha; "Kazanite" (1968) – 161 ha; "Kastrakliy" (1968) – 124 ha; Konski Dol" (1962) – 32.0 ha; "Kupena" (1961) – 1761.1 ha; "Mantaritsa" (1968) – 1069.2 ha; Momchilovski Dol (1968) – 31.3 ha; Soskovsheto (1968) – 177.5 ha; "Starata Gora (Shabanitsa)" (1956) - 22.6 ha; "Tamnata Gora" (1962) – 30.2 ha; "Chervenata Stena" (1962) – 3029 ha. In addition, there are several protected localities on whose area there are virgin forests although only partially. They are as follows: 'Arap Chal" (declared 1981) – 220.8 ha; 'Aoluka – Vassil Petleshkov" (1969) – 131.3 ha; Batashki Snezhnik" (1972) – 1063 ha; "Kemera" (1975) – 102.5 ha; "Kleptuza" (1966) – 344 ha; "Martsiganitsa" (1980) – 27.5 ha; "Rogachitsa" (1981) – 129.6 ha; "Rozhen" (1979) – 108.5 ha; "Trigradsko Zhdrelo" (1963) – 269.6 ha; 'Srednite Livadi" (1972) – 70.4 ha; "Chairite" (1973) – 301.4 ha; "Tamra' (1973) – 629.2 ha and "Padala" (1979) – 33.6 ha (Pavlova, Bezlova, 2003).

The main types of forests in the Western Rhodopes Mountain are (Penev et al., 1969):

- fresh *Pinus sylvestris –Fagus sylvatica* forest;
- fresh to dry *Pinus sylvestris* forest with *Vaccinium myrtillus;*
- *Pinus sylvestris* forest on dry rendzines;
- stony *Pinus sylvestris* forest;
- fresh *Pinus sylvestris -Picea abies* forest with mixtoherbosum;
- fresh *Abies alba – Picea abies – Pinus sylvestris* forest;
- *Picea abies* forest with mosses and *Vaccinium myrtillus;*
- valley *Picea abies - Abies alba* forest;
- *Picea abies* forest with *Oxalis acetosellas;*
- *Picea abies - Abies alba – Pinus sylvestris* forest with *Luzula;*
- high-mountain *Picea abies* forest with *Vaccinium myrtillus* and *Luzula*;
- sub-alpine *Picea abies* forest;
- *Picea abies - Abies alba* forest with *Vaccinium myrtillus*;
- wet *Abies alba – Fagus sylvatica - Picea abies* forest;
- Valley *Abies alba* forest with fern species;
- *Pinus nigra - Picea abies* forest with *Abies alba*;
- fresh *Pinus nigra -Picea abies* forest;
- *Pinus nigra* forest on dry *rendzines*;
- *Pinus nigra* forest on rocky places;
- fresh *Picea abies* forest with *Carpinus betulus*;
- *Fagus sylvatica + Quercus petraea + Carpinus betutlus* forest with *Luzula;*
- *Fagus sylvatica* forest with *Galium odoratum*;
- *Fagus sylvatica* forest with *Luzula;*
- *Fagus sylvatica* forest with mixtoherbosum;
- fresh *Fagus sylvatica* forest with fescue species.

The total area of virgin forests in the Western Rhodope Mountains is 8613.6 ha or 0.99% of the area of the mountain, 1.52 % of its forest stock and 1.71 % of the forest-covered area of the mountain. These data indicate that the anthropogenic activity in the Rhodopes Mountain has been quite active in the past as a consequence of stock-rearing and agriculture practices, involving burning, cutting and grazing, followed by rehabilitation activities through aforestation. This has resulted in the present situation that nearly 1/3 of existing forest stock consists of planted forests.

Virgin forests exist mainly in the coniferous forest massifs, whose area in the Western Rhodopes accounts for about 70% of the total area of the mountain. They are composed mainly *Pinus sylvestris*, *Picea abies*, *Pinus nigra*, *Abies alba*, and among the locally represented broadleaved species *Fagus sylvatica* ranks the first. Virgin forests have been preserved mainly in the reserves, the closed basins, protected localities and water supply zones. The road network in the Western Rhodopes is better developed as compared to that in Rila Mountains and the Balkan Mountains Range and for that reason the closed basins account for only about 0.37% of the forest stock. The identification of 25 polygons of virgin forests is an indication for their degree of fragmentation. This circumstance imposes the need of more strenuous efforts for conservation of the available niches on the hard-to-access mountain tops, gorges, ravines and very steep slopes.

The general evaluation of the state of virgin forests in the Western Rhodopes as compared to that in Pirin Mountain, Rila Mountain and the Balkan Mountains Range is far from satisfactory. The programme for economic exploitation of closed basins is a serious threat of liquidation of all remnants from virgin forests. The closed basins in this mountain cover about 2100 ha, which accounts for 24.3 % of the area of virgin forests in the Western Rhodopes. Another threat is the opportunity for economic use when such forests are situated outside reserves These should be incorporated in the so-called buffer zones.

Virgin forests in the Western Rhodopes are found in 25 polygons:

Polygon 1. "Tamnata Gora" Reserve (SFE Garmen), vigin forests area 30.3 ha. Predominant tree species *Picea abies*, *Abies alba* and *Fagus sylvatica.*

Polygon 2. "Konski Dol" Reserve (SGBS Dikchan – Satovcha), virgin forests area 34.4 ha, consisting mainly of *Abies alba*, *Fagus sylvatica* and *Picea abies.*

Polygon 3. Resort forest (DFE Selishte). Virgin forests area 110.3 ha, composed mainly of *Picea abies*, *Pinus sylvestris*, *Fagus sylvatica* and *Abies alba*.

Polygon 4. Resort forest (DFE Selishte), area 70.6 ha, with participation of *Pinus sylvestris* and *Picea abies*.

Polygon 5. Closed basin (SGBS Rakitovo). Virgin forests area 360.5 ha, composed mainly of *Fagus sylvatica*, *Pinus nigra*, *Pinus sylvestris* and *Quercus petraea.*

Polygon 6. "Mantarnitsa" biosphere reserve (SGBS Rakitovo). Virgin forests area 1314.2 ha, composed mainly of *Picea abies*, *Abies alba, Fagus sylvatica* and *Pinus sylvestris*.

Polygon 7. Closed basin (SGBS Alabak), 438 ha virgin forests, composed mainly of *Fagus sylvatica*, *Quercus petraea* and *Pinus sylvestris*.

Polygon 8. Water supply zone (SGBS Chepino). Virgin forests area 138.7 ha, composed of *Picea abies*.

Polygon 9. Closed basin (SFE Peshtera). Area 171 ha with participation of *Fagus sylvatica*, *Pinus sylvestris*, *Abies alba*, *Quercus petraea* and *Carpinus betulus*.

Polygon 10. "Kupena" biosphere reserve + protected locality (SFE Peshtera), 969.3 ha virgin forests composed mainly of *Fagus sylvatica*, *Pinus sylvestris*, *Abies alba*, *Quercus petrea* and *Carpinus betulus*.

Polygon 11. Closed basin (SGBE Borovo – Valcha Polyana), 177.4 ha with participation of *Pinus sylvestris*, *Picea abies* and *Abies alba*.

Polygon 12. "Dupkata" biosphere reserve + neighborhood sections (SGBS Borovo + SGBS Shiroka Polyana + SGBS Rhodopi). Virgin forests area total 1562 ha, predominant tree species *Pinus sylvestris*, *Picea abies*, *Abies alba*, *Fagus sylvatica* and partially *Populus tremula*.

Polygon 13. "Beglika" reserve + neighborhood sections (SGBS Beglika), virgin forests area 1378.4 ha of *Picea abies*.

Polygon 14. "Kastraklii" reserve + neighborhood sections (SFE Borino), virgin forests area 512.9 ha, predominant tree species *Pinus nigra*, *Fagus sylvatica*, *Carpinus betulus* and *Abies alba*.

Polygon 15. Closed basin (SFE Devin), area 347.1 ha with participation of *Picea abies*, *Abies alba*, *Pinus nigra* and *Pinus sylvestris*.

Polygon 16. Closed basin (SFE Devin), area 170.3 ha with participation of *Pinus nigra*, *Pinus sylvestris*, *Fagus sylvatica*, *Abies alba* and *Picea abies*

Polygon 17. Closed basin (SFE Devin), area 145.8 ha, tree species composition: *Pinus sylvestris*, *Pinus nigra* and *Picea abies*.

Polygon 18. Closed basin (SFE Krichim), 172.9 ha with participation of *Pinus nigra*, *Abies alba* and *Pinus sylvestris*.

Polygon 19. Closed basin (SFE Smolyan), area 127 ha with the participation of *Fagus sylvatica* and *Quercus petraea*

Polygon 20. "Kazanite" reserve (SFE Trigrad), covering virgin forests area of 131.1 with predominant participation of *Pinus nigra*, *Abies alba* and *Picea abies*.

Polygon 21. "Chernoka" protected locality (SFE Shiroka Laka), virgin forests area 25.6 ha, composed of *Pinus nigra*.

Polygon 22. 'Usoykata" protected locality (SFE Assenovgrad), 4 ha of *Pinus nigra*.

Polygon 23. "Chudnite Mostove" protected locality (SFE Hvoina), 10.6 ha of *Picea abies* and *Pinus sylvestris*.

Polygon 24. "Dalboki Dol" protected locality (SFE Pamporovo), extending over 6 ha of *Abies alba*, *Picea abies* and *Fagus sylvatica*.

Polygon 25. "Soskovcheto" reserve (SFE Smolyan), virgin forests area 177.5 ha, composed mainly of *Abies alba, Picea abies*, *Pinus sylvestris* and *Fagus sylvatica*.

Summary

The total area of virgin forests in the Rhodope Mountains is 8830.3 ha.

The participation as dominant tree species in the virgin forests is: *Pinus sylvestris* forests – 25.7%, *Picea abies* forests – 22.5%, *Abies alba* forests – 19.3%, *Fagus sylvatica* forests – 13.1%, *Pinus nigra* forests – 9.9%, *Quercus petraea* + *Quercus robur* forests – 5.3%, *Quercus pubescens* forests – 2.4%, *Quercus cerris* forests – 0.5%, miscellaneous species – 0.6% and open areas – 0.7%.

Their altitudinal distribution is: from 200 to 800 m. - 7.6%; from 800 to 2000 m.– 91.0% (composed of 21.5% in the sub-belt 800-1200 m..; 54.3% in the sub-belt 1200-1800 m. and 15.2% in the sub-belt 1800-2000 m.) and in the belt above 2000 m– 1.4%, which means strong domination of virgin forests in the middle-mountain belt.

Split up to their exposure: eastern– 12.2%, western – 12.0%, northern– 10.1%, southern– 12.7%, northeastern – 14.1%, northwestern – 8.8%, southeastern – 12.4%, southwestern – 17.3%, and on flat terrains – 0.4%. The share of the southern component is predominant.

Split up to their inclination: gentle sloping (0 - 10^{o}) – 21.1%, inclined (11 - 20^{o}) – 34.7%, steep (21 - 30^{o}) – 29.5%, very steep (31 - 40^{o}) – 14.0% and ravine (above 40^{o}) – 0.7%. This

distribution shows domination of virgin forests on inclined and steep terrains (64.2%), which are typical for the Rhodopes relief.

Legal status: reserves - 59.5%, closed basins - 25.4%, forest stock (FS) – 11.3%, managed reserves – 2.2% and water supply zones – 1.6%, i.e. the virgin forests are situated predominantly in reserves and closed basins.

Age: virgin forests aged below 120 predominate - 64.5%, followed by those of the age range 120-200 years - 32.6% and above 200 years of age - 2.9%.

Borovets: closed basin virgin forests

Figure 14.1 Investigated regions and identified virgin forests in the Rhodope Mountains

	Investigated region	State forest enterprise	Protection status	Predominant trees	Area of the investigated forests, ha	Area of the identified virgin forest, ha
	Western Rhodope Mountains				**13778.7**	**8475.5**
1		Beslet	R	*Picea abies, Fagus sylvatica, Abies alba*	280.0	30.3
2		Dikchan	R	*Picea abies, Fagus sylvatica, Abies alba*	260.0	34.4
3		Selishte	FS (RF)	*Picea abies, Pinus sylvestris Fagus sylvatica, Abies alba*	320.0	110.3
4		Selishte	FS (RF)	*Pinus sylvestris, Picea abies*	140.0	70.6
5		Rakitovo	CB	*Fagus sylvatica, Pinus nigra, Pinus sylvestris, Quercus sp.*	970.0	360.5
6		Rakitovo	R	*Picea abies, Abies alba, Fagus sylvatica, Pinus sylvestris*	1600.0	1314.2
7		Alabak	CB	*Fagus sylvatica,Quercus sp., Pinus sylvestris*	800.0	438.0
8		Chepino	WSZ	*Picea abies*	530.0	183.7
9		Peshtera	CB	*Fagus sylvatica,Quercus sp., Pinus sylvestris, Abies alba*	510.0	171.0
10		Peshtera	R	*Fagus sylvatica, Pinus sylvestris, Abies alba*	1900.0	969.3
11		Borovo	R	*Pinus sylvestris, Abies alba, Picea abies*	450.0	177.4
12		Borovo Shiroka Polyana Rhodopi (Snezhanka)	R + adjacent R + adjacent R + adjacent	*Pinus sylvestris, Abies alba, Picea abies, Popolus tremula* *Abies alba* *Picea abies, Pinus sylvestris Abies alba*	700.0 800.0 460.0	545.7 626,2 407,5
13		Беглика	R + adjacent	*Picea abies*	1500.0	1279,3
14		Borino	R + adjacent	*Pinus nigra, Fagus sylvatica, Carpinus betulus, Abies alba*	680.0	512.9
15		Devin	CB	*Picea abies, Abies alba, Pinus nigra, Pinus sylvestris*	600.0	322.0
16		Devin	CB	*Pinus nigra, Pinus sylvestris, Fagus sylvatica Abies alba, Picea abies*	250.0	165.0
17		Devin	CB	*Pinus sylvestris, Pinus nigra,*	190.0	146.9

				Fagus sylvatica		
18		Krichim	CB	*Pinus nigra,Abies alba, Pinus sylvestris*	181.7	173.5
19		Mikhalkovo	CB	*Fagus sylvatica, Quercus petraea*	129.0	127.0
20		Trigrad	R	*Abies alba, Pinus nigra, Picea abies*	131.1	131.1
21		Shiroka Laka	PL	*Pinus nigra*	65.8	25.6
22		Assenovgrad	PL	*Pinus nigra*	72.8	4.0
23		Hvoyna	PL	*Picea abies, Pinus sylvestris*	40.3	10.6
24		Pamporovo	PL	*Abies alba, Picea abies, Fagus sylvatica*	40.5	6.0
25		Smolyan	R	*Abies alba, Picea abies, Pinus sylvestris, Fagus sylvatica*	177.5	177.5
	Eastern Rhodope Mountains				**467**	**354.8**
26		Smilyan	CB	*Pinus sylvestris, Fagus sylvatica*	82.2	23.2
27		Zlatograd	CB	*Fagus sylvatica*	143.0	130,3
28		Kirkovo	CB	*Fagus sylvatica*	132.7	113.6
29		Momchilgrad	MR	*Pinus nigra*	36.0	20,1
30		Zhenda	R	*Pinus nigra*	39.9	39.9
31	Upper Thracia	Assenovgrad	PL	*Platanus orientalis*	33.2	27.7
	Rhodope Mountains			**Total**	**14245.7**	**8830.3**

Samokov: training of experts

15. Virgin forests in Strandzha Mountain

15.1. Physical and geographic characteristics

Strandzha Mountain is situated almost parallel to the western Black Sea coastline at a length between 30 and 80 km. Its total area is 1,000,000 ha. The main part of it is on the territory of the Republic of Turkey. It is part of the Asia Minor mountain chain and hence a part of the local plant species originates from Crimea and Caucasus (Stoyanov, 1927; Penev, 1969). The territory of the highest conservation significance in the mountain has been declared nature park. This is the largest protected territory in the country (116,068.5 ha). The data in this paper refer mainly to that part of the mountain, which belongs to the area of the park and where the forests, which have been spared anthropogenic pressure, are situated.

There are five reserves under strict protection regime on the territory of Strandzha Mountain. They are: "Uzunbudzhak" (a biosphere reserve), "Silkosiya" (the first reserve declared in Bulgaria),"Tissovitsa", 'Sredoka" and "Vitanovo".

The geographic location of Strandzha Mountain makes it unique in terms of biodiversity and cultural and historic heritage. It is a typical representative of the broadleaved deciduous forests of the moderate belt with laurel understorey. Thanks to the relatively low degree of urbanization the mountain had been spared anthropogenic pressure that could put at risk its unique nature.

Strandzha Mountain is one of the eight nature sites incorporated in list for targeted monitoring in the framework of the European programme for co-operation in the management of park areas "Parks for Life".

In the framework of the CORINE Biotopes Project the region of Strandzha Mountain has been identified as a priority of the country's ecological network and is one of the most important areas in Europe from the point of view of conservation.

The entire Bulgarian part of Strandzha Mountain is characterized as a middle mountain and low mountain forest vegetation district, whose peaks tower up to 710 m (Gradishteto Peak). The dominant elements of its relief are flat low-mountain ridges, situated at about 200 to 400 m and, in contrast - deeply sunk river valleys. Despite the small altitude the relief of Strandzha mountain is highly indented and attractive.

Strandzha Mountain possesses a relatively young structure and is assumed as an independent tectonic unit. Mesozoic deposits of Triassic, Jurassic and Upper-Cretacean origin account for the largest share (Galabov, 1966). The soil-forming rocks are of relatively young and quite uniform structure. Paleozoic granites and severely affected by metamorphosis Mesozoic sediments – Triassic conglomerates, thick-layer dolomite limestone, Jurassic sandstones and argillite predominate. A characteristic feature of the region is the deep weathering of the rocks and the weathering process itself is quite *advanced.* The end products are characterized by a clay-based mechanical composition.

Hydrology

The rivers on the area of Strandzha Mountain belong to the Black Sea watershed basin. The more important rivers traversing its area are the rivers Veleka and Rezovska.

One of the two major watersheds runs along the Rezovska/frontier ridge, which separates the basin of the river Veleka from that of the river Rezovska. The other one runs along the Bosnenski ridge, which separates the river Veleka from the basins of the rivers Fakiyska, Iizvorska, Ropotamo, Dyavolska and Karaagach.

The water resources are relatively modest as compared to those in other parts of the country. This applies both for surface water resources and ground water resources. A characteristic of the surface water resources is the uneven distribution of their availability throughout the year. In recent years a trend towards diminishing of the river runoff has been observed as a consequence of the drop in the precipitation rates. The latter leads to low surface waters during the warm period of the year, including drying up of certain river sources.

Climate

The climate is formed under continental influence from the west and the north, Black Sea influence from the east and Mediterranean influence from the south. Generally speaking the climate of Strandzha Mountain is transient Mediterranean with winter maximums and summer (August) minimums of precipitation and relatively high mean annual temperatures (Sabev, Stanev, 1959).

Apart from the common for the entire region characteristics the local climate demonstrates also a number of peculiarities, which determine its specifics and differences from other regions with transient-Mediterranean climate. Due to the absence of effective protection against the influx of cold air masses from the north and northwest, abrupt spells of cold weather and fogs are quite typical phenomena for Strandzha Mountain.

Besides the climatic differences between the coastal zone, inland Strandzha and the peripheral northern and southern parts of the mountain, certain climatic differences are characteristic also for the inside area with the change of altitude in western direction towards the major mountaintop. This leads to specific distribution of the Colchic plant species (Stefanoov, 1924).

The mean annual air temperatures demonstrate certain differences between the coastal and the inland zones of the mountain. A specific feature of the local climate is the shift in the daily temperatures higher up towards the high altitude parts of Strandzha Mountain. From the coast to the slopes of the high ridges in the central part of the mountain the temperatures gradually diminish. This situation has definite impact on other climatic elements as well – more frequent and lasting fogs, more ample snowfalls and longer retention of the snow cover, earlier frosts and later development of vegetation. The frequent prolonged fogs at these higher altitude parts of the mountain in winter months create conditions for accumulation of frost and ice on the trees in the wind-struck sections high up in the mountain.

The region under review is characterized by a relatively high for that altitude average annual air humidity. The relative air humidity during spring and summer months is higher along the coast thanks to the breeze circulation.

All in all, the precipitation rates in the central part of the mountain are above the national average. The average annual precipitation total increases in the direction from the coastline to the inland – from 538

mm at the city of Ahtopol, 859 mm at the village of Gramatikovo to 969 mm at the city of Malko Tarnovo. The precipitation maximum is in October-November and is unevenly distributed during the rest of the months. Winters are relatively mild, whereas the Black Sea influence is stronger felt along the valleys of the larger rivers. Well manifested are prolonged dry periods in summer, ranging in length from 35 to 140 days.

Soils and soil processes

Soil formation in Strandzha Mountain is subject to the specific combination interaction of the typical Strandzha climate, the unique forest vegetation, the exclusive variety of soil-forming rocks, the undulating low-mountain relief with multiple ridges, marked by strong indentation, densely branched hydrographic network with short slopes and predomination of sunny exposures.

Chromic Luvisols, LVx, *Planosols, PL, Alisols, Al* and shallow soils (Rendzic Leptosols, LPX, Lithic Leptosols, LPp and Umbric Leptosols, Lpu) predominate. It is in Strandzha Mountain that *Nitisols, NT* also occur, which together with *Alisols, Al* are a rarity for both Bulgaria and Europe.

15.2. Forest vegetation

According to the climatic division of the country Strandzha Mountain falls under the two sub-districts of the Continental-Mediterranean climatic district: the Black Sea climatic sub-district, covering 20-25 km along the Black Sea coast, and the Southern Bulgaria climatic sub-district with the Strandzha climatic region (Zakhariev et al., 1979).

The existence of mesophyllous formations, and above all of *Fagus orientalis*, has provided grounds to Stefanov (1924) to refer the Strandzha region to the sub-Mediterranean floristic district. Bondev (1991) refers the Strandzha Mountain vegetation to the southern-Euxine district.

On the basis of geomorphological and orographic peculiarities Penev et al. (1968) divide the region into Strandzha oak + beech sub-region and a sub-region of xerothermic mixed oak formation in the hilly-and-flat undulating parts of the mountain. The *Quercus petraea - Fagus sylvatica* formation acts as a dividing topographic line between the two sub-regions.

The vegetation of Strandzha Mountain stands out for its phytosociological specifics, which is unique for Europe. It is referred to the biome of broadleaved deciduous forests of the temperate climate, the most common for the entire continent. As different from the forests of this biome, however, Strandzha forests stand out for the existence of edificators and dominants of the Euxine and sub-Euxine flora or for the substantial presence of such floristic elements. The majority of the mesophyllic forests of *Fagus orientalis* feature an evergreen understorey of laurel-like shrubs, most often *Rhododendron ponticum*, characteristic for the Southern-Euxine vegetation, spread in the Western Transcaucasian region, Colchida and the Black Sea coast of Anatolia.

The forests in Strandzha Mountain are relics of Tertiary vegetation, which had been conserved thanks to its being away from the locations of Quaternary ice spells, the mild winters, high precipitation rates and air humidity. Typical for the Strandzha forests is inversion, under which the mesophyllic beech forests with understorey of *Rhododendron* occupy the bottom valley parts of the slopes, while oak forests occupy the areas above them. As compared to the vegetation in Colchida and the Transcaucasian region, the composition of the Tertiary relic species in the vegetation of Strandzha

Mountain is much poorer. This is evident above all from the Strandzha section of the coastline, part of the Black Sea phytogeographic district, as well as in the farthest western parts, belonging to the Fakia region. In terms of distribution *Quercus cerries – Quercus frainetto* forests rank the first, followed by Oak-Hornbeam forests, defined as "sub-Euxine" habitats.

In the local vegetation there is a marked presence of communities of the Mediterranean and sub-Mediterranean types of thermophylous oak forests with an uderstorey of evergreen sclerophyllous shrubs like *Erica arborea*, *Ruscus aculeatus* and cover of *Hypericum calycinum,* as well as shrub communities of *Phillyrea latifolia, Cistus incanus, Cistus salvifolius, Erica* etc. The communities of *Carpinus orientalis* strongly increased due to the anthropogenic pressure. The xerothermic herbaceous communities, spread over vast areas along the coast and in the western part of the park, belong to the secondary vegetation, since they have emerged on the place of forests destroyed by man in the past..

The forests contain 28 forest and 18 shrub habitats. These habitats are of the southern-Euxine type, comprising forests of *Fagus orientalis* with *Rhododendron ponticum*, *Quercus polycarpa* + *Quercus frainetto* forests, *Fagus orientalis* + *Quercus polycarpa* forests, *Quercus polycarpa* + *Rhododendron ponticum* forests, *Fagus orientalis* + *Vaccinium arctostaphylos* forests, *Fagus orientalis* + *Laurocerasus officinalis* + *Ilex colchica* forests, *Quercus polycarpa* + *Rhododendron ponticum* forests, *Quercus polycarpa* + *Primula rosea* forests, *Quercus polycarpa* + *Fagus orientalis* forests, Bulgarian coastal floodplain forests, oak forests + *Quercus hartwissiana*, *Fagus orientalis, Carpinus betulus* and *Tillia argentea* forests and forests with *Calluna vulgaris.* Some habitats are of the sub-Euxine type, comprising forests stands of *Quercus frainetto* and *Quercus cerris* and Oak-Hornbeam forests.

The forest area of the Central part of Strandzha Mountain, which is of interest for the objectives of our studies, covers and area of 89,376.3 ha (95%) and the woodless area is some 227 ha (0.2%). The area not suitable for forests (rocks, forest rides, etc.) is 3476 ha (3.7%).

The principal forest-forming species are oaks, which form 67% of the forests in the region and account for 5.2% of the total area of oak forests in Bulgaria.

The floristic geographic complex of Strandzha Mountain possesses a unique nature on all-European scale. Situated on a bio-geographic crossroads, the mountain has provided habitat for species of the Mediterranean, Central European, Balkan, Euro-Asian, Pontian-Central Asian and Atlantic flora in addition to the relict Euxine flora. *In the course of the study of virgin forests in Strandzha Mountain the expedition has identified a small plot of Cistus laurifolius,, which is a new species for the local flora in Bulgaria, as indicated by Slavcho Dzhimetrov, M.Sc. (Eng.).*

Characteristic virgin forest complexes in Strandzha Mountain

According to the approved methodology a total of 6189 ha of forests have been identified on the territory of Strandzha Mmountain. The predominant tree species there are as follows: *Quercus petraea* – 38.79%, *Fagus orientalis* – 31.68 %, *Q. frainetto* - 22,21%, *Q. cerris* – 1.91% and others – 5.41%. The predominant altitudes are from 100 to 400 m., where approximately 5000 ha of the virgin forests in Strandzha Mountain are situated. The strongly undulated terrain of Strandzha Mountain predetermines the almost equitable participation of all types of exposures. As the only exception some 24.18 ha are situated on flat terrains. Inclined and steep terrains (5 to 20^{o}) predominate - 76%. Very steep terrains are almost exceptional. In terms of age groups virgin forests can be divided as follows: below 80 years of age – 615.96 ha, from 80 to 120 years – 1911.83 ha, from 120 to 150 years – 1871.18 ha and from

150 to 200 years – 1789.88 ha. The share of forests below 80 years-of-age is due to the development of natural regeneration processes.

Polygon 1: The forest is situated in SFE Zvezdets. The area falls within the boundaries of Strandzha Nature Park, "Shuklitsa" locality. Area: 328.3 ha.

The tree stand is mixed and is composed of *Q. frainetto, Q. cerris* and to a lesser extent *Quercus petraea*. *Carpinus betulus* is represented by single trees.

The main formation in the forest is *Q. frainetto* + *Q. Cerris* with the participation of *Carpinus orientalis*. Thirteen different species are represented in the structure of the forest stand.

The regeneration is very good. A significant quantity of young viable understorey has been identified.

Polygon 2: It falls within the boundaries of Strandzha Nature Park – 'Shuklitsa" locality at SGBS Gramatikovo. Area: 232.1 ha. The predominant tree species are: *Q. frainetto*, *Q. cerris.* Type of forest: "*Q. frainetto* + *Q. cerris* forest with participation of *Carpinus betulus*".

Polygon 3: The studied area is within the boundaries of "Vitanovo" reserve, situated on the territory of SFE Malko Tarnovo on the territory of Strandzha Nature Park. In the course of the inventory it has been found that the area on which there had been no economic activity is 1017.5 ha. The predominant type is "*Fagus orientalis* forest with forest plant litter". The stand is made up of *Fagus orientalis.* It demonstrates good growth and productivity. Twelve more tree species, whose participation is limited to several individual specimens, have been described as well.

The regeneration processes evolve well. The ecosystem is in a climax state, which is favorable for the conservation management regime.

Polygon 4: The studied area has the status of "Sredoka" reserve, situated on the territory of SFE Malko Tirnovo. Strandzha Nature Park. The major forest forming species are *Fagus orientalis* (60%) and *Quercus petraea.* (30%). The remaining 10 % are composed of *Populus tremula, Sorbus domestica, Carpinus orientalis, Acer campestre, Pyrus communis, Pyrus amygdaliformus, Prunus cerasifera, Quercus frainetto, Carpinus betulus* etc.

The protected species are *Cyclamen coum Miller, Primula acaulis ssp. rubra L. and Orchis papilionacea L.*

Polygon 5: The "Paroriya" locality bears signs of an ancient Thracian cloister and Mediaeval culture. It has the status of protected locality. It is situated on the territory of SGBS Gramatikovo within the boundaries of Strandzha Nature Park. The identified area is 651.8 ha. The forest-forming tree species are *Quercus petraea, Fagus orientalis, Q. frainetto*. and *Q. cerris*. In the course of the afforestation on the area of "Paroroya" the following rare species have been identified: *Pyracantha coccinea* Roem., *Orchis papilionacea* L., *Cyclamen coum* Miller and *Primula acaulis ssp. rubra* (L.) L.

Polygon 6: The status of the studied area is a reserve named "Tissovitsa". It is situated on the territory of SGBS Gramatikovo. The identified area is 742.9 ha (Table 12)..

Predominant are *Fagus orientalis* and *Quercus* forests with participation of *Rhododendron.* The participation of *Fagus orientalis* is 90%, *Quercus petraea* accounts for 8% and *Carpinus betulus* - for 2%. The tree stand comprises also *Quercus frainetto*, *Quercus cerris*, *Populus tremula*, *Alnus glutinosa*, *Cerasus avium*, *Fraxinus ornus, Sorbus domestica, Sorbus torminalis, Carpinus orientalis*, *Acer campestre* and *Corylus avellana*.

The following protected specimen have been identified: *Rododendron ponticum L., Daphne pontica L., Trachystemon orientale (L.) G. Don. fil., Cyclamen coum* Miller, *Arbutus unedo* L., *Hypericum calycinum* L., *Primula acaulis ssp. rubra* (L.) L., *Anthemis jordanovii* Stoj. et Acht.

Polygon 7: The studied virgin forest is on the area of the "Silkosiya" reserve. The virgin forest is on the territory of SFE Kostu. The identified area is 365.1 ha.

The major forest-forming species is *Fagus orientalis* with participation of *Quercus* species. The main types are "*Fagus orientalis* forest with *Rhododendron ponticum*" and "*Quercus petraea - Fagus orientalis* forest with *Rhododendron ponticum*". The forest stand comprises also single trees of: *Quercus frainetto*, *Carpinus betulus, Populus tremula, Carpinus orientalis, Acer campestre, Tilia tomentosa*, *Fraxinus oxycarpa, Sorbus torminalis* and *Sorbus domestica*.

The protected species are: *Daphne pontica* L., *Rododendron ponticum* L. *Cyclamen coum* Miller., *Trachystemon orientale* (L.) G. Don. fil.

Polygon 8: The identified virgin forest is in the "Lopushna" locality. The status of the area is reserve situated on the territory of SFE Kosti. The area defined in the course of the taxation is 2517.7 ha.

The major formations are oak-beech forests, with participation of: *Quercus petraea* (38%), *Quercus frainetto* (35%), *Fagus orientalis* (22%), *Quercus cerris* (2%).There are single trees of *Sorbus domestica*, *Sorbus torminalis*, *Pyrus amygdaliformus*, *Cerasus avium*, *Populus tremula*, *Carpinus orientalis*, *Fraxinus ornus*, *Carpinus betulus*, *Ulmus minor, Ulmus glabra*, *Populus tremula, Fraxinus oxycarpa*, *Prunus cerasifera*, *Tilia cordata*, *Acer campestre, Acer platanoides, Acer pseudoplatanus*, *Tilia platyphyllos*, *Tilia tomentosa*, *Pyrus communis, Salix alba.*

The protected species in the sample plot are: *Arbutus unedo* L., *Hypericum calycinum* L., *Primula acaulis ssp. rubra* (L.) L. *Alyssoides bulgarica* (Sagor.) Assenov

Rila Monastry Forest: Beech Forest

Figure 15.1 Studied territory and identified virgin forests on its area in Strandzha Mountain

Item No.	Studied territory	State forest enterprise	Protection status	Predominant tree species	Area of the studied territory [ha]	Area of the identified virgin forest [ha]
1	Strandzha	Zvezdets (Shuklitsa)	NP	*Quercus frainetto* *Quercus cerris*	328.3	328.3
2		Gramatikovo (Shuklitsa)	NP	*Quercus frainetto* *Quercus cerris*	256.9	232.1
3		Malko Tirnovo (Vitanovo)	R	*Fagus orientalis*	1017.5	957.5
4		Malko Tirnovo (Sredaka)	R	*Fagus orientalis* *Quercus petraea*	557.4	393.6
5		Gramatikovo (Paroriya)	PL	*Quercus frainetto, Quercus cerris, Quercus petraea, Fagus orientalis*	698.5	651.8
6		Gramatikovo (Tissovitsa)	R	*Fagus orientalis, Quercus petraea, Carpinus betulus*	746.6	742.9
7		Kosti (Silkosiya)	R	*Fagus orientalis, Quercus petraea, Quercus cerris*	388.8	365.1
8		Kosti (Lopushna)	BR	*Quercus petraea, Quercus frainetto, Fagus orientalis*	2581.5	2517.7
				Total:	**6575.5**	**6189.0**

*NP Nature park **R Reserve ***BR Biosphere reserve **** PL Protected locality

Pirin Mountains: Pinus heldreichii

16. Distribution patterns of virgin forests in Bulgaria

The principal factors determining the presence and current state of virgin forests are the peculiarities of the physical geography and in particular the relief, the tree species that compose the structure of the forests and the legal status of the territory. In turn these factors predetermine the impact of the anthropogenic factor – the major threat to the existence of the virgin forests.

The physical geographic regions

As evident from the results of the conducted study, presented in Chapters 4 through 16, and the attached map of virgin forests in Bulgaria, such forests have been identified exclusively in mountain areas.

From the total of 153,146.9 ha of investigated forests in the course of the inventory a total of 103,356.1 ha of forest areas have been identified as virgin forests, which accounts for 2.9% of the afforested area of Bulgaria (Table 16.1)

Table 16.1. Investigated forests and identified virgin forests in Bulgaria

No.	Mountain	Investigated forests, ha	Virgin forests, ha	Percentage of virgin forests, %
1.	The Balkan range	60494.2	34954.3	33.82
1.1.	Western Balkan range	8572.0	3459.4	3.35
1.2.	Central Balkan range	48818.5	29870.5	28.90
1.3.	Eastern Fore-Balkan region	2205.7	1037.4	1.00
1.4.	Balkan range Black Sea coastal region	898.0	587.0	0.57
2.	Pirin Mountain	40110.4	26906.6	26.03
3.	Rila Mountain	22088.6	20394.2	19.73
4.	Rhodope Mountains	14245.7	8830.3	8.54
4.1.	Westerm Rhodope Mountains	13778.7	8475.5	8.20
4.2.	Eastern Rhodope Mountains	467.0	354.8	0.34
5.	Strandzha Mountain	6575.5	6189.0	5.99
6.	Slavyanka Mountain	2324.3	2324.3	2.25
7.	Belasitsa Mountain	4314.1	1588.7	1.54
8.	Sredna Gora Mountain	1606.3	1170.6	1.13
9.	Ograzhden Mountain	583.2	294.8	0.29
10.	Osogovo Mountain	280.4	280.4	0.27
11.	Vitosha Mountain	211.9	211.9	0.21
12.	Malashevska Mountain	312.3	211.0	0.20
	Total:	**153.146.9**	**103.356.1**	**100.00**

Of the nationwide total of virgin forests (VF), 79.58% are situated in the highest Bulgarian mountains: the Balkan range (33.82%), Pirin Mountain (26.03%) and Rila Mountain (19.73%). Smaller shares are found in the Rhodope Mountains (8.54%), Strangzha Mountain (5.99%) and only 5.89% in the rest of the mountains – Slavyanka, Belasitsa, Sredna Gora, Ograzhden, Osogovo (including Vlahina), Vitosha and

Malashevska Mountains. The high percentages on the three locations must be explained by the presence of hard-to-access slopes in the mentioned three mountains, by the protected status and by the occurrence of "closed basins". The survival of virgin forests mainly in the mountains is clearly illustrated in Fig. 1.

Tthe local relief in the mountains

The hard-to-access feature as the leading factor for the survival of the last remnants of primary forests in Bulgaria, depends above all on the altitude of the terrain and on the steepness of the mountain slopes.

The relation of virgin forests with the altitude is shown by fig. 2. Two maxima may be clearly identified. The first one is in the altitude range of 1000-1600 m., where 40.9% of the virgin forests occur, and the second maximum is at 1800-2400 m with 29.8% of the virgin forests. These maxima are also related to the altitudinal distribution of the dominant tree species. In the first case this is *Fagus sylvatica* (beech) and for the upper timber line it is *Pinus mugo* (Mountain Dwarf Pine).

The relation with the inclination of the terrain is illustrated in fig. 3. Only 12.4% of the virgin forests are situated on flat and gently sloping terrains (below 10^0), 30.5% are situated on inclined terrains (from 11 to 20^0), 37.2% on steep terrains (21-30^0), and 19.8%. – on very steep terrains (above 31^0). Therefore, the majority of the virgin forests in Bulgaria have emerged and survived on steep, very steep and ravine terrains. Apparently, this has been and is the primary factor for their conservation, because of the difficult access for commercial exploitation.

The tree species

Virgin forests in Bulgaria are rich in tree species. This richness ensues from the large variety of natural conditions: from sea level to 2500 m.; from the humid and warm climate of floodplain forests to the sub-Alpine climate; presence of diverse geological formations and all the soil types characteristics for the temperate and boreal vegetation belt; all possible exposures of the slopes.

The data in Table 16.2 are a good example of the richness of Bulgarian primary forests.

Table 16.2. The predominant tree species in the virgin forests

No.	Predominant tree species	Virgin forests area	
		ha	%
1.	*Fagus sylvatica*	32338	31.3
2.	*Pinus mugo*	21531	20.8
3.	*Picea abies*	8743	8.5
4.	*Quercus petraea, Quercus robur*	6417	6.2
5.	*Pinus sylvestris*	6072	5.9
6.	*Abies alba*	4203	4.1
7.	*Pinus peuce*	3402	3.3
8.	*Pinus nigra*	2292	2.2
9.	*Fagus orientalis*	2014	1.9
10.	*Pinus heldreichii*	1701	1.6
11.	*Castanea sativa*	1031	1.0
12.	*Quercus pubescens*	708	0.7
13.	*Quercus cerris*	287	0.3
14.	*Aesculus hippocastanum*	7	0.01
15.	Other tree species	5464	5.3
16.	Woodless; phase of the cyclic process	7146	6.9
	Total	**103.356**	**100.0**

The share of beech forests is the highest – a total of 33.2%. A small part of them (1.9%) occurs in Strandzha Mountain, where *Fagus orientalis* predominates. *Fagus sylvatica* is typical for the virgin forests in the Western and Central Balkan range, Sredna Gora Mountain and the smaller mountains. These are typical forests of the middle mountain forest, also called the beech zone. Unfortunately, during the recent fifty years part of the beech forests have been cleared and "reconstructed" by planting of coniferous species.

The *Pinus mugo* formation covers 20.8%, and is mainly found in Rila Mountain and to a lesser extent in Pirin Mountain and Slavyanka Mountain. These are unique forest communities, formed under the extreme conditions of the high mountain and playing an important hydrological and protective function. The ban on their felling during the 1960's has had a decisive role for their conservation.

Fagus sylvatica and *Pinus mugo* together account for 52.1% of the area of virgin forests in Bulgaria. The other 12 species have a much more modest share – a total of 35.7%. Six of them descend in order as follows:

Picea abies> Quercus petraea> Pinus sylvestris> Abies alba> Pinus peuce> Pinus nigra. The total participation of broadleaved species is 41.4% and that of coniferous species - 46.4%.

The legal status of the territories

The legal status of virgin forests in the twelve mountains is documented in table 3. 44251.5 ha or 42.81% of the virgin forests have survived thanks to the fact that in compliance with the Protected Areas Act of 1998 they have been incorporated within the boundaries of the strict, biosphere or managed reserves. Conservation history in Bulgaria goes back to1931, when the first ever reserve in Southeastern Europe was declared – "Silkosiyata" in Strandzha Mountain. In 1933 the first ever National Park on the Balkan

Peninsula – Vitosha National Park – was declared. Some of the more recent developments are those of 1991 and 1992, when some of the biggest national parks in Europe were declared – the Central Balkan National Park and the Rila National Park, and that of 1993, when the biggest nature park – Strandzha Nature Park – was declared (Aladzjem, 2001; Raev, 2004).

From the graphical illustration of the legal status of virgin forests on Fig. 4 it is evident that a substantial part of the virgin forests lies within the boundaries of national parks. These are the Rila, Pirin and the Central Balkan national parks, in which virgin forests of a total area of 32449.5 ha or 31.4% of the total are incorporated. According to the Bulgarian legislation the forests inside reserves and national parks are placed under a strict protection status and no grave violations of their entirety has to be expected. If we add the "protected localities" and "historic localities" (another 777 ha), then the total area of virgin forests, well protected by virtue of the law, extends to 77478 ha or 74.96% of the virgin forests identified by the inventory.

What is the state of the remaining 25.04% of the virgin forests? For the 25878.1 ha shown in Table 3 and Fig 4 there is no guarantee that they will remain virgin forests in the coming years. The anticipation of a certain risk is based on the fact that 21404.5 ha are situated in "closed basins", on "hard-to-access" localities, in the vicinity to the state frontier or on very steep terrains. It is urgent to impose a moratorium on their cutting until they are incorporated in the network of protected nature territories.

The same applies to the situation of virgin forests in water supply zones (1421.9 ha), in the forest stock uncovered by protection status (1994.6 ha) in nature parks (892 ha) and in seed production stands (165.1 ha). It is evident that in the case of 25.04% of the virgin forests targeted action for their protection and rational management is urgent.

The area per polygon

Polygons with 1000-2000 ha of virgin forest, contain 23.8% of the total virgin forests area. The polygons with 2000-5000 ha, contain 21.7%. This means that the polygons with more than 1000 ha of virgin forest contain 71.9% of the total area of virgin forests in Bulgaria.

The average area of virgin forest per polygon is 646 ha. It is evident that the majority of the polygons contain a significant area of virgin forests. This is an optimal condition for rational management and protection of virgin forests.

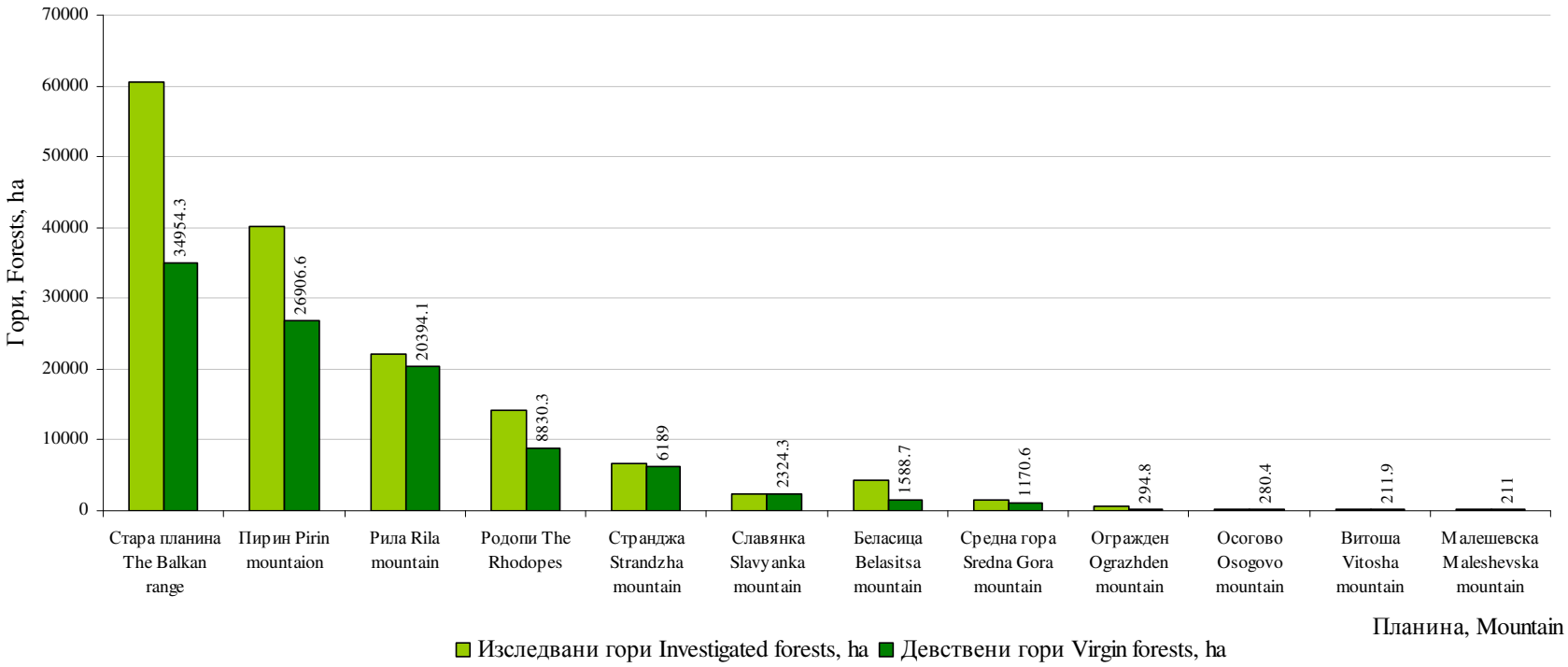
Parangalica Virgin Forest

Table 16.3. The protection status of virgin forests in Bulgaria, ha

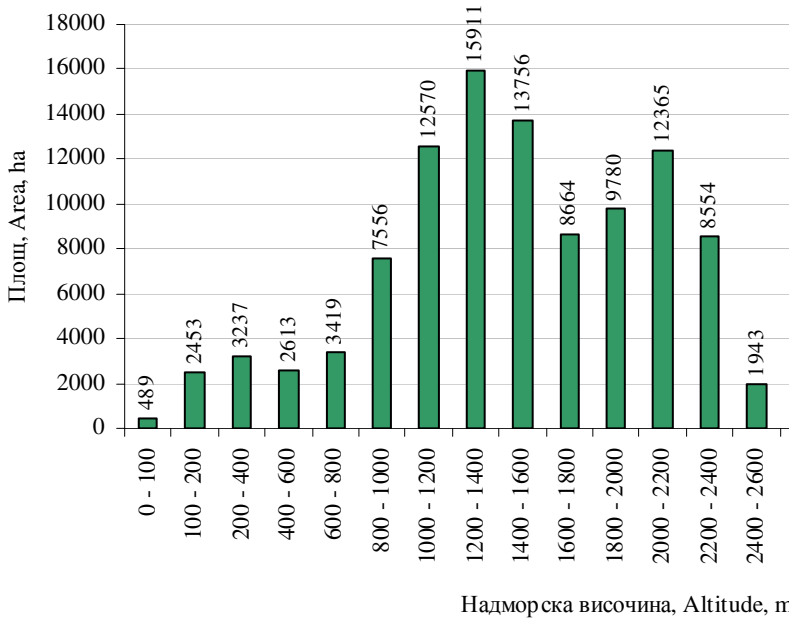
№	Mountain	Reserve	Biosphere reserve	Managed reserve	National park	Closed basin	Forest stock	Water supply zone	Nature park	Protected locality	b
1.	The Balkan range	16795.4	5074.2	679.0	4306.1	7249.2	-	690.4	68.6	-	
2.	Pirin Mountain	2928.2	1850.6	-	11656.9	10470.9	-	-	.	-	
3.	Rila Mountain	2644.7	234.2	-	16486.5	669.5	-	-	263.0	-	
4.	Rhodope Mountains	5252.1	-	191.1	-	2171.0	1003.5	138.7	-	73.9	
5.	Strandzha Mountain	2459.1	2517.7	-	-	-	-	-	560.4	651.8	
6.	Slavyanka Mountain	1628.0	-	-	-	-	696.3	-	-	-	
7.	Belasitsa Mountain	1293.9	-	-	-	-	294.8	-	-	-	
8.	Sredna Gora mountain	-	-	-	-	549.1	-	592.8	-	-	
9.	Ograzhden Mountain	-	-	-	-	294.8	-	-	-	-	
10.	Osogovo Mountain	280.4	-	-	-	-	-	-	-	-	
11.	Vitosha Mountain	-	211.9	-	-	-	-	-	-	-	
12.	Malashevska Mountain	211.0	-	-	-	-	-	-	-	-	
	Total	3.3492.8	9.888.6	870.1	3.2449.5	2.1404.5	1.994.6	1.421.9	892.0	725.7	

Table 16.4. Area of virging forests per polygon

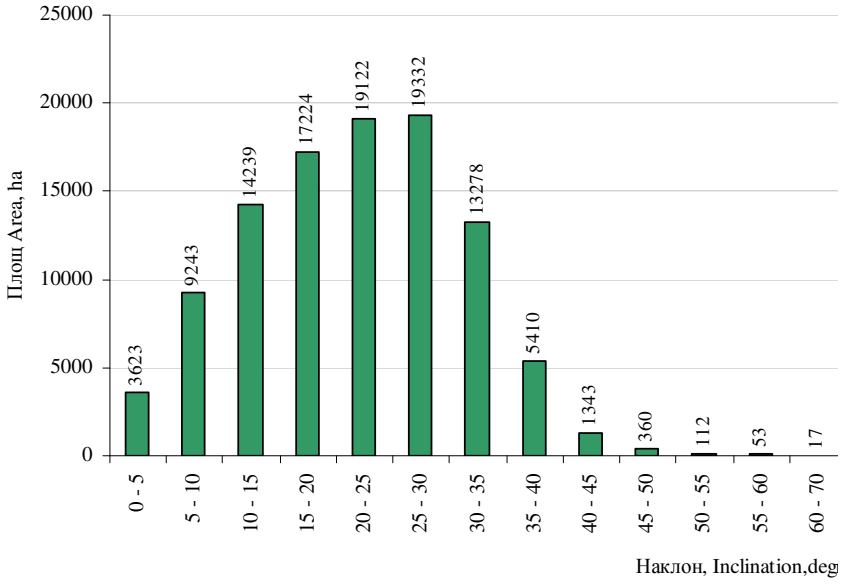
No.	VF area, ha	Number of the polygons	Total VF area, ha	% of total VF area
1.	1 - 100	55	3340.00	3.23
2.	100 - 500	64	14745.35	14.27
3.	500 - 1000	15	10978.03	10.62
4.	1000 - 2000	16	24624.20	23.82
5.	2000 - 5000	7	22436.73	21.71
6.	5000 - 10000	2	13810.35	13.36
7.	> 10000	1	13421.35	12.99
	Total	**160**	**103356.01**	**100.00**



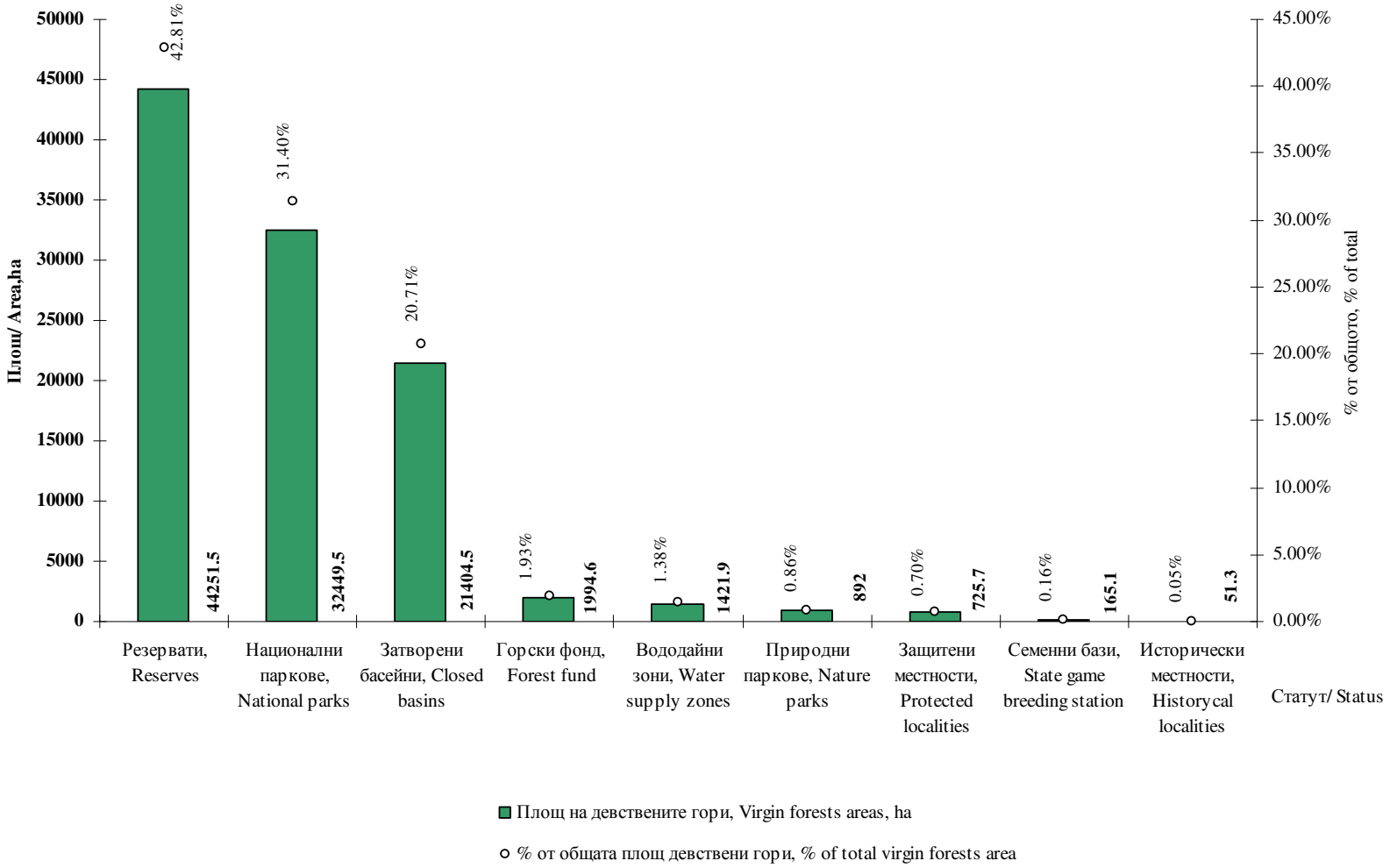
Фиг. 1. Площ на изследваните и девствените гори по планини в България
Fig. 1. Area of investigated and virgin forests in Bulgarian mountains



Фиг. 2. Разположение на девствените гори по надморска височина
Fig. 2. Virgin forests according to the altitude, above sea level



Фиг. 3. Девствени гори според наклона на терена
Fig. 3. Virging forests according to terrain inclination



Фиг. 4. Статус на девствените гори в България

Fig. 4. Status of virgin forests in Bulgaria

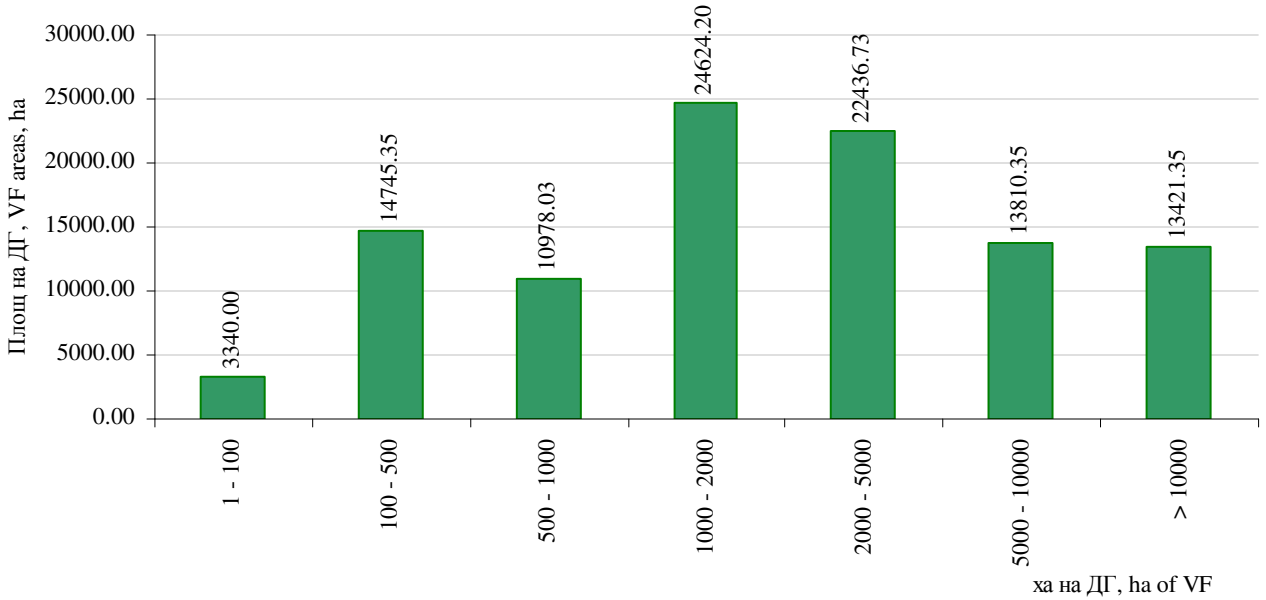


Fig. 5. Areas of virgin forests according to the size of polygons

17. Strategy for conservation of virgin forests in Bulgaria

17.1. Introduction

Since 1978 the Institute of Ecology at the Bulgarian Academy of Sciences began intensive work on the inventory of natural forest territories and grounded suggestions for announcing reserves (category I on IUCN) and extension of existing ones. Until 1992, only for a 15-year-period, new reserve territory has been announced on more than 56,000 ha and the average area of reserves has been increased from 270 to 1360 ha. The strict reserves with area over 1000 ha, recorded in the UN List of protected territories increased from 7 in 1977 to 28. Forests cover about 85% of the territory of the strict reserves (75,000 ha).

The conservation of old natural forests is a priority in the National strategy for biodiversity conservation. As early as during the development of the strategy, the present national parks Central Balkan and Rila have been announced and nature park Strandzha – in the very beginning of 1995. Unfortunately, during the next 10 years the network of protected forest territories has not been developed, with the exception of nature park Bulgarka.

In 1995 the natural old forests in Bulgaria, which have not been destroyed by human being, have covered 7,1% of the forest territory (Rapports de suivi des conferences ministrielles pour la protection des forets en Europe, 1998). According to this index, the country was placed to 3-rd position after Russia and Sweden and according to the absolute area of these forests (about 250,000 ha) – to 5-th position after the above mentioned countries, Finland and Norway. (In 20 European countries the share of natural forests is shown from 0 to 1,0%!).

The investigations, whose aim was to determine the extent of decreasing of natural/virgin forests in the country according to the utilization foreseen in forest management plans and due to the illegal cuttings in the last decade, should continue even after finishing of the project. The data obtained from the inventory of virgin forests until now are disturbing, even after the addition to the area of these forests made by the authors of the report and based on data from the management plans of national and nature parks (Central Balkan, Rila, Pirin, Rila monastery, Strandzha, Vitosha) and from the projects of the inventory of biodiversity in Western Rhodopes and Western Balkan range, from the development of suggestions for establishing of nature park Western Balkan and nature park Prespa-Dobrostan, on the projects CORINE Biotopes, IPA (botanically important places in Bulgaria), etc.

Forests are particularly important for the long-term preservation of biodiversity in Bulgaria. The high-stem autochthonous forests (without plantations) and older forests for transformation, which are important for the biodiversity conservation, cover over 15% state territory, while the rest habitats, which have preserved more or less natural

characteristics (mainly high-mountain woodless and less water habitats), cover only 2%. In the EU-joining process Bulgaria has been engaged for preservation of the threatened forest habitats. The country has these obligations also according to the Bern convention (Resolutions Nr.4/1996 and Nr.6/1998 of the Stearing Committee), as well as on Resolutions H1 and H2 from 1993 of the Ministerial Conference of the European Countries and EU, concerning the principles of sustainable management of forests and biodiversity conservation of the European forests (Rapports de suivi des conferences ministrielles pour la protection des forets en Europe, 1998). The long-term conservation of virgin forests however is of primary importance first of all for Bulgaria itself.

17.2. Conservation importance of virgin forests in Bulgaria

The conservation of virgin forests is activity connected with the long-term biodiversity conservation: forest vegetation communities, habitats of threatened and endemic species of wild animals, plants and mushrooms, genetic fund of tree species (edificators, dominants, other). The levels of conservation significance of species and communities are different: global, regional (European), national; as well as the territories of virgin forests – depending on their status and area, variety of fauna, flora and mycota and species with conservation significance.

Conservation of forests in Balkan range, Sredna gora mountain, Rila-Rhodopes massif and Strandzha mountain is global priority. These forests with codes 77, 78 and 123 (from totally five codes of forest territories in Europe!) are part of 200 priority territories with global significance (WWF), determined for the whole world (Brylski&Abdulin, 2003). The World Bank finances the projects for their conservation with priority. In fact, the virgin forests, inventoried on this project in Bulgaria, are situated with insignificant exceptions on the territories with global priority for conservation of forests. The types of forest habitats on this territory without exceptions are determined as threatened also by the Bern convention (Resolution Nr.4/1996) and to a great extent by Directive 92/43 of the Council of Europe (Directive of habitats). Due to this reason our country has obligations for their long-term conservation.

Numerous remarkable examples of virgin forests have survived or have been preserved in Bulgaria. These are the coniferous forests in reserves Parangalitsa, Bayuvi dupki – Dzhindzhiritsa, Rila monastery forest, Central Rila reserve, Alibotush, Kastrakli, Shabanitsa, Skakavitsa. The primary beech forests cover largest area in the reserves Steneto, Dzhendema, Boatin, Severen Dzhendem, Tsaritchina, Kozyata stena, Peeshti skali, Kongura, Elenova gora. There are magnificent but still unprotected virgin beech forests in Western Balkan range (state forest enterprises Berkovitsa and Petrohan), as well as on the western slopes of Central Pirin mountain. The reserves Uzunbodzhak and Vitanovo, protected territories Paroriya and Veleka in Strandzha mountain keep remarkable examples of broadleaved forests of southern-Euxine type.

The biogeographical and ecological characteristics of forests, types of habitats of virgin forests with codes after the nomenclature of Directive 92/43 of EU and their distribution in the country are shown in chapter “Forest biomes and habitats in Bulgaria”.

The conservation importance of mountain forests in Bulgaria, and particularly of virgin forests, is in a correlation with the variety of fauna, flora and mushrooms, conservation significant species, including endemic ones. The largest number of endemic plant species is in the zone of forests, sub-Alpine belt and mountain pine forests, respectively in virgin forests of Central Balkan range, Pirin mountain, Western Rhodopes, Rila mountain, Western Balkan range and Slavyanka mountain. In fact, these mountains form the most powerful endemic floristic centre in Europe and about 80% of all 555 endemic higher plant species and subspecies in the country occur there. The largest number of Bulgarian endemic species is in Balkan range (90, 20 of them are local endemic species), the Rhodopes (80), Pirin mountain (60, with 30 local endemic species) and Rila mountain (50, with 10 local endemic species) (Petrova, 2001).

The half of the threatened flora of Bulgaria has habitats in forests and mountain pine formations (according to the Red Book of Bulgaria, 1984). The largest number of threatened species is in the forests of Pirin mountain (93), Strandzha mountain (83), Central Balkan range - 75 (only in Central Balkan national park and in nature park Bulgarka), Slavyanka and Rila mountains – 62 each, Central Rhodopes (56), Western Rhodopes (39), Vitosha mountain and nature park Western Balkan (project) - 34 species each (Spiridonov&Stoev, 2003). It is not a coincidence that the largest areas of virgin forests are situated in 7 from these mountains.

The mentioned mountain regions are important not only for the flora but for the invertebrate fauna as well. It is obvious that they form endemic centre as well, which recovers the floristic endemic centre (Spiridonov&Stoev, 2003). The largest number of endemic species is in Pirin mountain, Western Rhodopes (with Central Rhodopes), Rila mountain, Western and Central Balkan mountain. These mountains together with Strandzha have the largest number of rare invertebrate species. The reserves Ropotamo and Kamtchiya, although small in areas, have big concentration of invertebrate and plant species, significant from conservation point of view.

There are 17 mammal species, 16 species of nesting birds and 4 reptile species with conservation significance, which occur in the forest massifs in mountains with huge areas of virgin forests. From them, worldwide threatened (2004 Red List of Threatened Species, 2004) are 11 mammal and 2 reptile species: the bats *Myotis bechsteinii* and *M. myotis*, *Nyctalus lasiopterus*, *N. leisleri* and *Barbastella barbastellus*; the rodents *Sciurus vulgaris*, *Dryomys nitedula*, *Glis glis*, *Muscardinus avellanarius*, *Chionomys nivalis*, *Microtus guentheri*; the reptiles *Testudo graeca*, *T. hermanni*. Threatened on European level are 5 mammal species, 14 species of birds and 2 reptile species (after the Directive of Habitats, appendix II; Directive for Birds, appendix I; Resolution Nr.6/1998 of the Steering Committee of the Bern Convention; European Red Book of Vertebrates, 1997): mammals wolf, bear, *Felis silvestris*, *Lynx lynx*, *Rupicapra rupicapra balcanica*; birds *Aquila pomarina*, *Bonasa bonasia*, *Tetrao urogallus*, *Bubo bubo*, *Strix uralensis*, *Glaucidium passerinum*, *Aegolius funereus*, *Picus canus*, *Dryocopus martius*, *Dendrocopos leucotos*, *Picoides tridactylus*, *Phoenicurus phoenicurus*, *Ficedula parva*, *F. semitorquata*; reptiles *Elaphe longissima* and *Ophisarus apodus*. Besides the above-mentioned species, *Martes martes*, *Pernis apivorus* and *Columba oenas* are also included in the national Red Book, vol. 2 (1985).

There are hundreds of wild animal and plant species, which cannot exist outside habitats of old forests. Some of them are threatened orchids and mosses, predator insects feeding with xylophages, even some vertebrate animals, in spite of the capability (especially of mammals) to adapt themselves to unfavourable environment. Typical species are *Dendrocopos leucotos* and *Picoides tridactylus*. The food of the first species is 90% insects-xylophages and it needs 70-120 ha of old forests with more dead and dying trees. In the western part of Southern Europe the species has survived only in 3 localities. *Picoides tridactylus* inhabits only old coniferous forests, 95% of its food are insects-xylophages. The territory of a *Dryocopus martius* couple in old forests is 300-400 ha, and in regions without such forests - 1600 ha (Red Book of Bulgaria, 1985). In close relationship with old forests are also species like *Martes martes*, *Strix uralensis*, the forest population of *Bubo bubo*, *Aegolius funereus* and *Columba oenas*, and to a great extent the big predators, as well as *Felis silvestris*, *Tetrao urogallus*, *Ficedula parva*, *F. semitorquata*, etc.

Important mechanism for the conservation of vital populations of critical species is providing of ecological corridors between their distant habitats. For the species of old forests the ecological corridors would rather be a system of "stepping stones" of old forests (even if they don't require the criteria for a virgin forest), on which the species could re-colonise or colonise suitable habitats.

The most important regions for the preservation of 37 conservation-significant vertebrate species are Central Balkan range and Rila mountain, followed by Western Rhodopes, Strandzha, Western Balkan range and Pirin mountain – the regions where virgin forests cover biggest territory (Spiridonov&Stoev, 2003; Spiridonov&Spasov, 2005).

17.3. Forest biomes and habitats in Bulgaria

Virgin forests in Bulgaria belong to the biomes broadleaved deciduous forests of the moderate climate and coniferous forests of the moderate climate. Since their distribution in the country is in mountains, they are united in the high belts of the biome Mixed mountain ecosystems with complex zoning (Udvardy, 1975). Among the broadleaved forests, the sub-biome of "...forests with evergreen understorey of laurel-like shrubs" is outlined, which are called in the Bulgarian scientific literature "southern-Euxine" (synonyms: Pontiac, Colchic, Euxine-Hyrcanic, etc.). The sub-biome occurs in Europe only in Strandzha mountain in Bulgaria and Turkey. Most typical societies of southern-Euxine type are forests of *Fagus orientalis* Lipsky and *Quercus polycarpa* Schur with understorey of *Rhododendron ponticum* L., but the shrub understorey in some societies is formed by *Daphne pontica* L., and more rarely by *Ilex colchica*, *Laurocerasus officinalis* Roem, as well as by the Mediterranean evergreen shrub species *Erica arborea* L.

The big part of coniferous forests in Bulgaria are referred to the sub-biome "Quasi-boreal coniferous forests" (Bondev, 1991), spread in the Central-European mountains, which strongly differ ecologically from the boreal forests of the taiga, in spite of the fact that the basic edificator species *Picea abies* (L.) Karst and *Pinus silvestris* L. are common for both regions.

The forests of *Pinus nigra* ssp. *pallasiana*, having azonal distribution mainly in the beech zone, *Pinus leucodermis* Ant. and *Abies borisii-regis* Mattf., however, are referred to the mountainous-Mediterranean (sub-Mediterranean) forests (Horvat, Glavac & Ellenberg, 1974).

The biome "Evergreen sclerophyllic forests and shrubs" scarcely occurs in the southernmost parts of the country. About 250-300 ha of the *Juniperus excelsa* M.B. forests in Tisata reserve and in the natural landmark Moraska in Kresna gorge are over 200-years-old, show good natural regeneration and possess peculiarities of the characteristics of virgin forests. The *Quercus coccifera* L. forests however are transformed into shrubs.

The preservation of forests must cover their entire phytocoenotic variety on levels association and sub-association but in this strategy most of the sintaxonomic units are implicitly included in the higher levels of habitat types, first of all of virgin forests. The following habitat types and codes are basic for these levels, according to the Directive for habitats:

4070 Shrub societies with *Pinus mugo* Turra. (The mountain pine societies in Western and Central Europe are referred to forests).

9170 Oak-beech forests of the type Galio-Carpinetum.

91BA Moesian forests of *Abies alba* Mill.

91CA Rila-Rhodopes and Balkan range Scots pine forests.

91SO Western-Pontiac beech forests.

91WO Moesian beech forests.

9260 *Castanea sativa* Mill. forests.

9410 Acidophyllic forests of *Picea abies* (L.) Karst. in the mountain to the Alpine belt (Vaccinio-Piceetea).

9530 Sub-Mediterranean pine forests with endemic *Pinus nigra* Arn. sub-species.

95AO *Pinus peuce* Grisb. and *P. leucodermis* Ant. forests.

41.76A1 (after the Palaearctic classification, 1996) Euxine-Thracian *Quercus frainetto* Ten. - *Q. cerris* L. forests.

41.76A4 (after the Palaearctic classification, 1996) Strandzha forests of *Quercus polycarpa* Schur.

The above-mentioned 11 habitat types, each of them on area over 1000 ha, cover over 95% of the virgin forests area. The identified habitats with an area under 1000 ha refer to:

9180 Mixed forests of the union Tilio-Acerion on scree and steep slopes.

91FO Riparian mixed forests of *Quercus robur* L., *Ulmus laevis* Pal. and *Fraxinus excelsior* L. or *Fr. angustifolia* along big rivers.

9270 Greek beech forests with *Abies borisii-regis* Mattf.

9560 Endemic forests of *Juniperus* sp.

The beech virgin forests cover the biggest area, most of all in Central Balkan range but also in Western Balkan range and Pirin mountain. The mountain pine forests form basically the sub-Alpine belt in Rila and Pirin mountains and the Norway spruce forests are situated mainly in Western Rhodopes, Rila and Pirin mountains and less in Central and Western Balkan range. Virgin forests in Strandzha mountain and Eastern Balkan range are predominantly of *Quercus polycarpa* Schur., most often mixed with *Q. frainetto* Ten., *Fagus orientalis* Lipsky or *Quercus cerris* L. This is also the area of virgin forests with predominance of *Fagus orientalis* Lipsky, as well as of sub-Euxine *Quercus frainetto* Ten. - *Q. cerris* L. forests, as well as the floodplain forests. The *Pinus peuce* Grisb. forests are situated in Rila and Pirin mountains and the forests of *Pinus leucodermis* Ant. – in Slavyanka and Pirin mountains. *Pinus nigra* Arn. also occurs in virgin forests in Slavyanka and Pirin mountains, as well as in Western Rhodopes and in small spots in Vlahina mountain. The virgin forests of *Pinus silvestris* L. are in Western Rhodopes, Rila and Pirin mountains, and the *Abies alba* Mill. ones – in the same mountains and also in Central Balkan range.

17.4. Threats for virgin forests in Bulgaria

Building activities also disturb the virgin character of forests. Roads cut forest massifs into fragments and allow the massive anthropogenic presence; they are the reason for invasion of ruderal and other aggressive species. Building of roads in closed basins means utilization of forest resources. Building of tourist and recreation centres within or in a close proximity to forests compromises to greatest extent the long-term conservation of biodiversity, especially of rare and threatened species. Winter sports facilities totally destroy the virgin character of forests. Openings are the corridors, which help the winds to destroy vast areas, first of all of spruce forests (High Tatras national park in Slovakia; Pirin and Rila national parks, where this is to happen soon).
Construction of dam lakes and watershed systems disturbs the water regime of forests around and below them. The negative effect of climate drought and atmospheric pollution is increased. There is a real threat of extinction of hydrophyllic species and replacement of societies. Virgin coniferous forests in Rila mountain and Western Rhodopes are under threat.
Climate drought causes drying of forests and dangerous increasing of insect and fungal calamities. Its impact for now is limited under 1000 m a.s.l. but in the silver fir forests it climbs up to 1300 m a.s.l. (Raev, Knight & Staneva – edits., 2003). The climate drought in the country is increased by: the decreasing of the area of mature and pre-mature forests by their utilization; disturbance of water regime of watersheds (by hydrotechnical building activities and over-exploitation of forests); destroying of forests by fires; grazing of domestic animals (first of all in virgin forests in Strandzha mountain and Eastern Balkan range).

The atmospheric pollution (acid rains) - local and from transfer – is in condition to cause big losses of forests, as it is in coniferous forests and plantations in Germany, the Czech

republic, Poland, etc. The negative role of acid rains increases in the conditions of climate drought.
Fires – caused by nature or human being – are dangerous first of all for the coniferous forests. For some of them they could be fatal because of their small area - these are the *Pinus leucodermis* Ant. forests, almost all *Pinus nigra* Arn., *Juniperus excelsa* M.B., *Abies borisii-regis* Mattf. virgin forests, all Balkan range coniferous forests, as well as virgin coniferous forests in some protected territories and closed basins in Rila-Rhodopes massif.

Grazing, tourism, collecting of medicinal and ornamental plants, mushrooms, snails, forest fruits, rare and threatened plants and animals, disturb and scare away wild animals. These activities bring to decreasing of biodiversity and also disturb the virgin character of forest (Spiridonov&Stoev, 2003).

In the final analysis, all mentioned main threats for virgin forests (and not only for them!) bring to a change or destroying of natural habitats of thousands of plant, animal and mushroom species. Some of them extinct even forever. The loss and degradation of habitats are main reason for the threat of extinction of 90% of the globally threatened mammal, amphibian and bird species! (2004 Red List of Threatened Species, 2004).

18. Inquiry among stakeholders on the desired status of virgin forests in closed basins

For the development of a good strategy, as well as of action plan for rational management and conservation of virgin forests with unclear status, Among the basic stakeholder groups an inquiry was organised by Dr. Zdravko Vasilev from the Forest Research Institute – BAS and analysed by Prof. Ivan Raev. The main question was on the status of the so-called closed basins – forests on inaccessible terrains, without roads, where the forest has preserved its primary status. These forest ecosystems have extremely useful hydrological and soil protection functions. They may also contain a precious gene pool with possible high-productive or sustainable genetic forms and varieties, which are of interest for the future of forestry and environmental protection in Bulgaria and Europe. However, their protection status is in most cases unclear.

The inquiry had no question on the status of virgin forests in national parks, reserves, protected territories and historical places because they are protected by the Law of the protected territories since 1998.

The status of virgin forests in closed basins demands attention because most of them lack protection. There is even a realistic threat connected to the National strategy for forests which is being developed. According to this plan, the closed basins are to be opened up for exploitation through the construction of new roads, ropeways, etc.

The total area of these forests is 21404.5 ha or 20.7% from the virgin forests in Bulgaria.

The questions concerning the future of the closed basin virgin forets were:
- What should be their future?
- How to protect them?
- What legislative status should be foreseen?
- Is the “recipe” for solving this problem only one?
- What should and shouldn’t be done in these forests, so they would be able to play the role of virgin forests – natural phenomenon, which is almost totally absent in most European countries?

The inquiry received 510 answers from 372 persons. On some questions 1 to 3 answers could be given. For example, about the future of the virgin forest from a closed basin: 1. to be included in the neighbouring national park, 2. reserve 3. to be included in the NATURA 2000 territory. The number of answers obtained from the stakeholders is shown on figure 18.1.
.

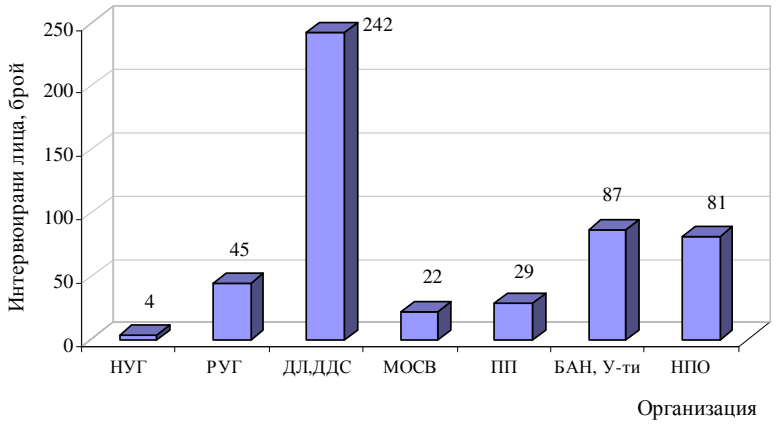


Fig. 18.1 Number of the answers obtained from the organisations

National Forestry Board (NFB); regional forest administrations (RFA); state forest enterprises (SFE) and state game management stations (SGMS); the Ministry of Environment and Water (MOEW) and its units – the Executive Environmental Agency (EEA) and regional inspectorates on environment and water (RIOEW); nature parks (NtrP) at NFB; BAS and universities ; NGOs

Figure 18.2 shows the distribution of the opinion among the inquired persons about their preference for the future form of management and protection.:

.

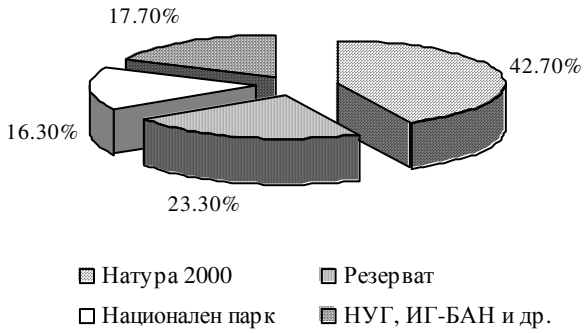


Fig. 18.2 Percentages of prefered legal status of virgin forests

42.7% are for NATURA 2000 status; 23.3% - for reserves; 16.3% - for part of a national park; 17.7% - for management by NFB, FRI-BAS, MOEW, etc

The different stakeholder groups show different preferences (figure 18.3).

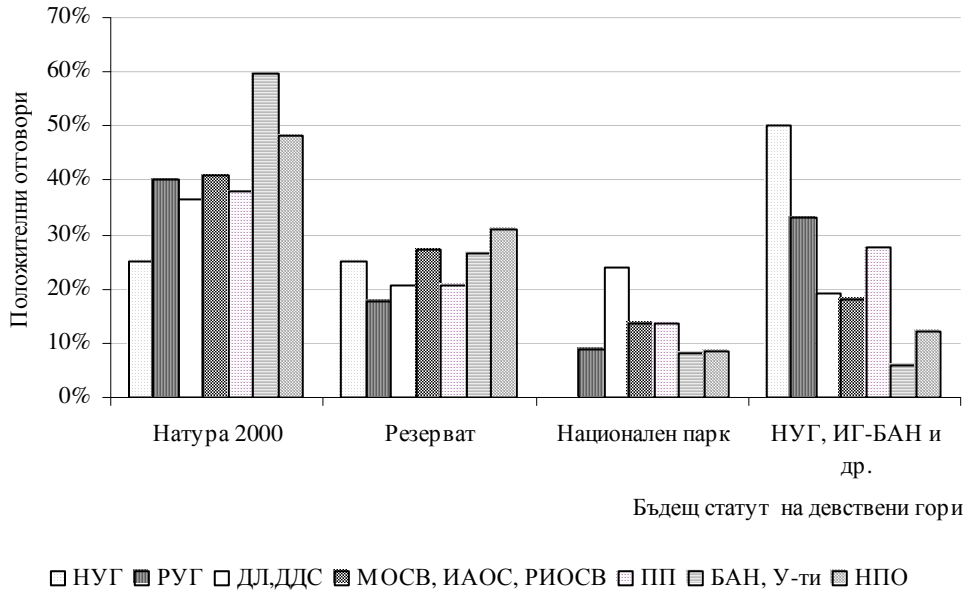


Fig. 18.1 Preferences of the stakeholders concerning the status of virgin forests

Admission to the NATURA 2000 territory is the strongest supported proposal by most groups, in particular by representatives of BAS and the universities (60%). NFB (25%) is the exception.

The reserve status of virgin forests has a stable support (17.8% to 30.9%) by all participating groups and the differences between them are not very significant.

Admission of virgin forests to the territory of neighbouring national parks finds its best support (24%) among the specialists from SFE/SGMS, but scores much lower among the rest of the groups.

To leave the remaining of virgin forests within the state forest fund managed by NFB or under the jurisdiction of FRI-BAS has the preference of specialists from NFB(50%), RFA and nature parks, but get much less support from researchers in BAS and University of Forestry and from the non-governmental sector.

The participants in the inquiry give often reasonable and valuable suggestions, worth to be put in practice. We present some of the highlights. We tried to group them according to stakeholder groups.

Employees of the forestry administration

Stop the financing of building roads for access to virgin forests for timber exploitation.
Forbid absolutely any kind of building activities, grazing, collecting of herbs and mushrooms.
Do not allow building of any objects
No axe should be used in virgin forests.

Establish an independent agency to a new ministry joining NFB and MOEW.
Too many persons and institutions deal with the management and utilisation of forests and lands in the forest fund, this leads to the worsening of the condition of Bulgarian forests.
Provide information to stakeholders about virgin forests and their future management
When the strategy for protection and management of virgin forests is being developed, it must be surely thought about really possible compensating mechanisms.
Owners of these forests must be compensated by European funds.

Do not limit or forbid silvicultural activities like sanitary cuttings, helping the natural regeneration, control of pests and diseases, mineralised stripes against fires, etc.
Only selective cuttings are recommended. The sanitary cuttings to be carried out under very strict control.

Having in mind the growing anthropogenic impact and negative consequences in climate change in global scale, we should try to preserve at least this small part of the naturally conserved ecosystems for future generations.
Conserve the natural character of virgin forests.
Virgin forests should be integral part of a state forest enterprise but with a special status.
Under the current conditions of management of forests by private persons we run the risk to lose this wealth – forests – in the near future.
Virgin forests should be under special survey and their total territory should not be reduced. If they could not be declared as reserves, these forests should be managed only selectively.

Management should be the responsibility of the state and supported by international funds.
If there is nature park in close neighbourhood, these forests could be included in its territory with the aim that the park administration could carry out the infrastructure activities. Foresee in the management of wastes left by tourists and other visitors.
Do not allow access of motor vehicles.
The management of virgin forests by private owners, who only expect benefits, is impossible.

Independent jurisdiction of management of virgin forests within the frame of the concrete managing administration.
In a period of 1 to 3 years, until the full institutional stabilisation, virgin forests could be managed by half-military or military administration with the financial support of the Ministry of Agriculture and Forests and MOEW.
Active research activity, attracting of specialised tourists and active management.

Involve specialists with attitude to environmental protection in the school programmes.

Are there still virgin forests? Who will charge the commission of this project? What will be the benefit for the small owners?

Ministry of Environment and Water

Selective cuttings could be carried out, as well as cuttings to support natural regeneration and biological diversity. In case that only sanitary cuttings are carried out will mean that these forests are not managed but they are left for development of natural succession processes. Depending on origin and occurrence of virgin forests, the aims and regimes should be determined. In this case virgin forests will have the status of maintained reserves without being assigned according to the Law of protected territories.
Each object identified as virgin forest should have its own assessment on the basis of numerous criteria .
Criteria should be developed for determination of virgin forests and to include them in Annex 1 of the Law for biological diversity as type natural habitat for priority preservation.

Bulgarian Academy of Sciences and University of Forestry

Silvicultural exploitation or tourist infrastructure would disturb the balance in these systems. Because of this impact they can not be called virgin anymore. The conservation principle should be the leading one in the management of virgin forests in Bulgaria.
The mentioned areas are very small. The exclusion of forests with smaller size from the category virgin forest could lead to their destruction. As lower limit should 1 ha be accepted, at least when very rare and specific forest communities occur.
Announce a moratorium on cuttings in virgin forests with the average age of more than 100 years, until the acceptance of a strategy and until the announcement of new protected territories in virgin forests.
Do not accept a unificated form for all virgin forests.
Make an attempt to involve owners in virgin forest management.

NGOs

Compensate private virgin forests with forests owned by the state or by municipalities.
Establish public councils for consulting the management of virgin forests.
Active protection of virgin forests like is done in game parks.
The most valuable forest habitats should be closed for access with the exception for researchers and guards.

To develop virgin forests management plan with principles for non-intervention in their natural development, status and balance.
Give priority to the development of the management plan of virgin forests in Western Balkan range (beech forests in Berkovitsa, Norway spruce forests in Tchuprene).
The funds for virgin forests should be included in the budgets of municipalities and the headquarters should be in the town halls.

Literature (selection)

Grozeva, M. 1997, *The soils in the "Central Balkan National Park"*, in Abiotic Factors of the Environment in the Central Balkan National Park, GEF, S., p.p. 22-40

Zakhariev, B., V. Donov, K. Petrunov, S. Masarov, 1979, *Forest Vegetation Regioning in the PRBulgaria*, Zemizdat

Yordanova, M., St. Velev, Iv. Drenovski, 2002. *Characteristics of the Physico-geographic Regions*. In "Geography of Bulgaria', GI-BAS, ForCom

Stoychev, K., P. Petrov. 1981. *Rila Mountain – Nature and Resources*. Nauka i Iskustvo. 204 pp.

Tishkov, H. 1982. *Division by Climatic Characteristics*. In: Geography of Bulgaria, Vol. I, BAS, p. 240-247.

Rubner, K. 1960. *Die pflanzengeographishen Grundlagen des Waldbaumes.*

Radkov, Il. 1970. *Ecological Foundations of Forestry*. Zemizdat. Sofia, 324 pp.

Naumov, Z., G. Antonov. 1965. *Some peculiarities of the structures of the mountain-forest soils in the North-Eastern Rila Mountain*. Gorslostopanska nauka, № 3, p. 189-198 (in Bulgarian)

Antipov-Karataev, I., I. Gerassimov. 1949. *The soils in Bulgaria. – Soviet-Bulgarian expedition*. Sofia, Zemizdat Publ. House, p. 168 (in Bulgarian)

Ghyorghiev, A. 1976. *On the distribution, genesis and certain peculiarities of the mountain*. Gorskostopanska nauka, № 1, p. 64-78 (in Bulgarian)

Raev, Iv. 1989. *Studies on the Hydrological Role of Coniferous Forest Ecosystems in Bulgaria.* Forest Research Institute at the Bulgarian Academy of Sciences. Sofia, 232 pp.

Raev, Iv. 1983. *An Attempt for Differentiation of Mountain Climates in Rila Mountain and the Zone for Optimal Forestry Production*. Collection of reports: International Symposium on Man/Mountain Ecosystems Relationships, Project 6 – MAB, Vratsa, 24-29 October1983, Vol. II, p.p. 227-236.

Raev, I. 1997. Rila National Park: Phytoklimate. In: Abiotic Environmental Factors, GEF - Biodiversity Project, Sofia, 48-63.

Bondev, Iv. 2002. Geobotanic regioning. In: Geography of Bulgaria. ForCom Publ.Nouse, 336-352 (in Bulgarian)

Velchev, V. 2002. Types of vegetation. In: Geography of Bulgaria. ForCom Publ.Nouse, 324-336 (in Bulgarian)

Annexes